J Behav Educ (2010) 19:185–204
DOI 10.1007/s10864-010-9109-2

ORIGINAL PAPER

A Comparison of Function-Based Differential Reinforcement Interventions for Children Engaging in Disruptive Classroom Behavior

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Published online: 28 July 2010

Abstract This study provides a direct comparison of differential reinforcement of other behavior (DRO) and differential reinforcement of alternative behavior (DRA). Participants included three children in center-based classrooms referred for functional assessments due to disruptive classroom behavior. Functional assessments included interviews and brief functional analyses. An alternating treatments design was used to evaluate the relative effectiveness of function-based DRO and DRA interventions. Results indicated that both intervention procedures effectively reduced disruptive behavior, but the DRA procedure consistently resulted in greater reductions in disruptive behavior across all participants. Results are discussed in terms of directions for future functional assessment and intervention research as well as implications for applied practice.

Keywords Functional behavior assessment · Differential reinforcement · DRA · DRO · Brief functional analysis

Disruptive behavior disorders are common in young children, especially those from disadvantaged backgrounds (Anderson 1983; Carr and Durand 1985; Webster-Stratton and Hammond 1998, 2001). Additionally, disruptive behaviors evidenced during early childhood may be stable and predictive of myriad negative developmental outcomes (e.g., academic failure, restrictive educational placements dropout; Barkley 1998; Campbell and Ewing 1990; Pierce et al. 1999). Disruptive

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classroom behaviors negatively impact the student who is exhibiting these behaviors as well as other students in the classroom. However, early intervention may disrupt this negative behavioral trajectory and support a productive learning environment. Functional assessment and function-based interventions have been demonstrated effective across a wide range of individuals, presenting problems, and settings (see Ervin et al. 2001 for review). However, there is less research evaluating functional assessment in center-based classrooms (e.g., Head Start, kindergarten) with typically developing children relative to other populations and settings (Gresham et al. 2004).

Functional assessment data provide a description of the antecedents that occasion behavior and consequences that maintain the behavior. Function-based interventions have an *a priori* likelihood of success because knowledge of a behavior's environmental conditions allows for manipulation of contingencies in a way that produces a desired behavioral outcome. Function-based interventions typically include extinction and differential reinforcement. Specifically, reinforcers are withheld following occurrence of the behavior targeted for reduction and are provided contingent upon the absence of that behavior or for some alternative response. Common approaches to differential reinforcement include differential reinforcement of other behavior (DRO) and differential reinforcement of alternative behavior (DRA).

DRO includes delivering a reinforcing stimulus when a particular response is not emitted for a specified interval of time (Reynolds 1961). A number of studies have demonstrated the effectiveness of DRO procedures for reducing the occurrence of problem behavior (Konczak and Johnson 1983; Mazaleski et al. 1993; Repp et al. 1974). DRA includes withholding the reinforcer that is maintaining a problem behavior following its occurrence and providing that reinforcer contingent upon the occurrence of a desired alternative behavior (Volmer and Iwata 1992). DRA-based interventions are designed to reduce a problem behavior while simultaneously increasing the occurrence of an appropriate replacement behavior. DRA has been shown to be effective across numerous studies (Beare et al. 2004; Lucas 2000; Volmer et al. 1999).

Although there is an extensive literature base supporting the effectiveness of DRO and DRA, there are gaps in the literature worthy of discussion and additional research. Limitations include restricted range of participants in terms of intellectual functioning and limited response topographies. First, the overwhelming majority of studies including DRO and DRA have included individuals with developmental disabilities (Petscher et al. 2009; Whitaker 1996). As a result, much less is known regarding the effectiveness of DRO and DRA procedures with typically developing individuals. Second, the majority of studies using DRO and DRA have evaluated intervention impact on destructive, stereotypic, and self-injurious behaviors. Consequently, little evidence is available to support the use of DRO and DRA with high-incidence problem behaviors (e.g., disruptive classroom behavior). Taken together, these limitations call into question the external validity of DRO and DRA.

Whereas few studies have evaluated functional assessment and differential reinforcement procedures in center-based classroom settings with typically developing children exhibiting high-incidence behavior problems, some recent studies are

worth detailing. Wilder et al. (2007) conducted functional analyses of noncompliance for two typically developing 3-year-old boys in preschool. Functional analyses indicated that both boys' noncompliance was maintained by continued access to a preferred activity. Function-based DRA interventions were implemented for both boys and resulted in substantial increases in compliance relative to a baseline condition. Dufrene et al. (2007) conducted abbreviated functional analyses of disruptive classroom behaviors (i.e., aggression, noncompliance) for three children in Head Start and daycare settings. Results from the abbreviated functional analyses were used to develop DRO interventions that successfully reduced occurrence of disruptive behaviors relative to a baseline condition. Taken together, these studies suggest that functional analysis and differential reinforcement procedures in preschool settings with typically developing children engaging in high-incidence behavior problems are emerging as beneficial approaches to assessment and intervention.

To date, the function-based intervention literature including DRO and DRA procedures is limited with regard to demonstrations with typically developing children engaging in high-incidence behavior problems in center-based classroom settings. The limited studies in this area (e.g., Dufrene et al. 2007; Wilder et al. 2007) have found that function-based DRA and DRO procedures may be beneficial for improving children's behavior in preschool settings. However, function-based differential reinforcement studies have not directly compared DRA and DRO. Therefore, this study was designed to expand the literature by conducting a systematic replication of the Dufrene et al. and Wilder et al. studies while providing a direct comparison of DRA and DRO. In doing so, this study will provide further evidence of the utility of functional analysis procedures in center-based classroom settings and examine the differential effects of DRA and DRO on decreasing problem behavior.

Method

Participants and Setting

Participants included three children referred by their teacher for behavioral consultation services due to repeated occurrences of disruptive classroom behavior. Participants were selected based on the following criteria: (a) the child was enrolled in either a preschool or kindergarten program, (b) consent from the child's legal guardian(s) was provided, (c) consent from the child's classroom teacher was provided, (d) the child's disruptive behavior was frequent and observable, and (e) the child did not have an individualized function-based intervention plan in place.

All sessions were conducted during direct instruction for early literacy and vocabulary in each child's classroom located in a rural, southeastern state. There were approximately 15–20 children in each classroom. Children received teacher-led direct instruction for early literacy and vocabulary in small groups of 8–10 children. Children sat in individual chairs facing the teacher who delivered direct instruction sessions according to a script that included rapid delivery of academic

prompts (e.g., Which one begins with A?). A paraprofessional was present in each classroom; however, paraprofessionals did not participate in direct instruction or any experimental activities. Direct instruction sessions were delivered each school day and lasted approximately 10–15 min. A university-based Institutional Review Board approved all procedures in this study in order to safeguard participants' welfare.

Henrik and Nicklas were 4-year-old African American males enrolled in Head Start; neither had been previously diagnosed with any learning, health, or mental health condition. Johan was a 6 year-old African American male enrolled in kindergarten and had no previous diagnoses or special education ruling. None of the students in this study had previously experienced a functional assessment or individualized behavior intervention plan.

Teacher participants included two women, each of whom was the primary instructor in their respective classroom. Paraprofessionals were present in each classroom, but did not participate in assessment or intervention sessions. Henrik and Nicklas' teacher, Ms. Babcock, was a 10-year veteran of the Head Start program. Henrik's participation in the study began first, and Nicklas' participation in the study began approximately 2 weeks following completion of Henrik's participation. Additionally, Henrik and Nicklas were assigned to separate early literacy groups. Therefore, Nicklas was never present during Henrik's brief functional analysis or treatment sessions. Johan's teacher, Ms. Holland, was a second-year kindergarten teacher. Both teacher participants had no prior experience with functional assessment or any of the intervention techniques used in the study.

Materials

Functional Assessment Informant Record for Teachers Pre-School Version (FAIR-T P)

The interview component of each FBA was conducted using the FAIR-T P (Dufrene et al. 2007). The FAIR-T P is a modified version of the FAIR-T, which has been included in a number of previous studies, and has demonstrated convergence with other functional assessment procedures (e.g., functional analysis) and proven useful for intervention development (e.g., Doggett et al. 2001, 2002; Moore et al. 1999). The FAIR-T P is divided into four sections. The first section is dedicated to gathering information regarding child demographic data as well as information addressing children's compliance, work completion, and accuracy of their work. The second section asks the teacher to identify and rank order one to three problem behaviors based on severity of the behavior. Section three consists of questions that gather information that can be used to generate hypotheses regarding the antecedent events that occasion targeted problem behavior(s). Section four consists of questions that aim to gather information about consequences that typically follow the targeted problem behavior(s). Once the information in section four is gathered, hypotheses can then be developed regarding the consequences that could potentially be maintaining the specified problem behavior(s). Preliminary research has indicated that data from the FAIR-T P matches results from direct-descriptive assessments

and abbreviated functional analyses (Dufrene et al. 2007), and may be useful for intervention development.

Assessment Rating Profile-Revised (ARP-R)

A modified version of the Assessment Rating Profile-Revised (ARP-R; Eckert et al. 1999) was used to evaluate each teacher's acceptability of the functional assessment procedures. The ARP-R is a one-factor 12-item Likert scale that assesses the general acceptability of assessment procedures. The ARP-R includes a six-point Likert scale with a response continuum that ranges from *Strongly Disagree* (1) to *Strongly Agree* (6). Scores on the ARP-R range from 12 to 72 with higher scores indicating greater acceptability. The ARP-R has demonstrated strong psychometric qualities (Eckert et al. 1999). For this study, the ARP-R was modified such that present tense items were converted to past tense and the term "school psychologist" was substituted with "teacher".

Intervention Rating Profile-15 (IRP-15)

The Intervention Rating Profile-15 (IRP-15; Martens et al. 1985) was used to evaluate each teacher's acceptability of the intervention procedures. The IRP-15 consists of a 15-question Likert scale that ranges from *Strongly Disagree* (1) to *Strongly Agree* (6). Ratings on the IRP-15 range from a total score of 15–90. A total score above 52.5 or above represents an "acceptable" rating (Von Brock and Elliott 1987). The IRP-15 has demonstrated strong internal consistency (Cronbach alpha = .98) (Martens et al. 1985).

Dependent Measures and Data Collection Procedures

This study included data for occurrence of inappropriate behaviors. Each child was referred for behavioral consultation services due to inappropriate vocalizations during classroom instruction. Inappropriate vocalizations were defined as any task-irrelevant vocalization made by the child that was audible to an observer. Inappropriate vocalizations exhibited by study participants included humming, making unusual vocal noises, speaking to other children, making noises with one's teeth, and swearing. Each child was reported to engage in multiple forms of inappropriate vocalizations. These behaviors were deemed disruptive and worthy of assessment and intervention for at least three reasons. First, teachers reported that they perceived the children's inappropriate vocalizations as substantially disruptive to direct instruction. Second, teachers reported that inappropriate vocalizations resulted in diverting their attention from delivering direct instruction to attending to disruptive behavior. As a result, inappropriate vocalizations resulted in reduced academic prompts to the group by the teacher, which resulted in fewer learning trials for children. Finally, it was sometimes the case that one child's inappropriate vocalization served as a trigger for inappropriate vocalizations by other children in the group.

Inappropriate behaviors were coded using a 10-s partial interval recording procedure during 10-min observation sessions. An Mp3 player and headphones were used to cue the observers to record the occurrence of the dependent measures every 10 s. Observers included advanced graduate students in a school psychology training program who had been previously trained in behavioral observation. Observers recorded behavior from an unobtrusive location in the classroom to minimize the likelihood of participants' reactivity to observations. All brief functional analysis and intervention observations were conducted during direct instruction for early literacy and vocabulary.

Design and Data Analysis

Brief functional analyses in this study were based on the work of Northup et al. (1991) and included a brief multi-element design with four conditions: (a) control (i.e., free play), (b) access to attention, (c) access to preferred tangible, and (d) escape from task demands. The tangible condition was included in the analyses for two reasons. First, toys were located in multiple locations throughout the classrooms and children could easily gain access to toys during instruction. Second, McKerchar and Thompson (2004) found that material presentation and access was a common consequence in preschool classrooms. Brief functional analyses concluded with a contingency reversal phase (i.e., B–A–B) that provided an added demonstration of the potency of the proposed maintaining variable that had been identified during the brief functional analysis. Order of brief functional analysis conditions was randomized for each participant in an effort to reduce the likelihood of sequencing effects. Data from the brief functional analyses were visually analyzed to determine which condition was associated with the highest level of the target behavior.

An alternating treatments design (ATD) with a verification phase was used to evaluate relative effectiveness of intervention conditions. The ATD included three conditions: (a) DRA, (b) DRO, and (C) control. The three conditions were implemented in a semi-random fashion where no condition could be implemented on more than two consecutive sessions in an effort to reduce the likelihood of sequencing effects. Moreover, only one session was conducted per day and the ATD concluded with a verification phase (i.e., most effective condition implemented in isolation) in order to reduce the threat of multiple treatment interference. ATD data were analyzed visually for level, trend, and variability. The primary demonstration of intervention effectiveness across series was determined by inspecting divergence across conditions.

Procedure

Teacher Interview

The study began with functional assessments for each participant. Functional assessments included teacher interviews and brief functional analyses. Teacher interviews were conducted using the FAIR-T P as a semi-structured interview

instrument in which the interviewer answered any teacher questions and asked teachers to elucidate any ambiguous responses. The interviewer also prompted teachers to provide expanded descriptions and examples of target behaviors to facilitate development of operational definitions of target behaviors. Interviews lasted approximately 35 min and were conducted by the first author. The information gathered during the FAIR-T P interview was evaluated by the first author and an independent rater for identification of the consequent events that might maintain the problem behavior. Evaluation included identifying the consequent event that was identified as occurring most often following the problem behavior.

Brief Functional Analysis

The experimental conditions used in the brief functional analysis were similar to those used by Boyajian et al. (2001). Brief functional analysis conditions included the following: (a) access to tangible, (b) control (i.e., free play), (c) access to attention, (d) escape from task demands, and (e) contingency reversal. The order of experimental conditions was selected in a random fashion for each participant by writing the name of each condition on a sheet of paper, placing all of the sheets into a hat, and drawing each sheet until no sheets remained. Each condition lasted 10 min, and conditions were conducted on separate days due to the short duration of direct instruction sessions. Contingencies provided during the brief functional analysis were delivered by experimenters while the teacher delivered direct instruction for early literacy to the group.

In order to ensure the potency of tangible items that were used during the tangible condition of the brief functional analysis, brief multiple-stimulus preference assessments were conducted prior to each child's brief functional analysis. The protocol for the preference assessment was developed from the work of Carr et al. (2000). Preference assessments began by exposing each child to an array of eight stimuli arranged on a table. Stimuli included toys and objects already present in the children's classroom (e.g., toy cars, dinosaurs, action figures). When the eight stimuli were presented, the child was instructed to select one object from the table. If the child failed to respond, the instruction was repeated. After an item was selected, the child was given 10 s of access to that item before it was removed and placed away from the table. The remaining stimuli were then repositioned in a random order. The selection process continued until all stimuli had been selected. Based on the selection process, percentages were calculated by dividing the number of times a stimulus was chosen by the number of trials in which it was available. Percentages were then ranked from 1 (highest) to 8 (lowest). This process was conducted before any functional analyses were initiated. Only the highest preferred stimulus was used during the tangible condition for each student (i.e., ranked first).

Immediately prior to the tangible condition, an experimenter gave the child free access to their preferred item for a period of 2 min. Following 2-min access, an experimenter removed the preferred item from the child and the classroom teacher

began small group early literacy instruction. For the duration of the tangible condition, the tangible item was presented to the child contingent on the occurrence of any inappropriate vocalization. The child was allowed access to the tangible item for 30 consecutive seconds and no other consequence was provided. After 30 s, the experimenter removed the tangible item from the child's possession without any explanation or additional attention. Direct instruction for early literacy by the teacher was provided continuously throughout the session.

During the control condition, the child had free access to toys and activities typically provided to young children in center-based classrooms. No demands were placed on the child during this time; an experimenter positioned himself near the child and provided intermittent non-contingent attention every 30 s. Intermittent non-contingent attention included experimenter-delivered statements such as "that block is grey" or "hockey is a sport." No other attention was provided, and inappropriate vocalizations were ignored.

In the attention condition, an experimenter provided attention to the child contingent upon occurrence of an inappropriate vocalization. Attention included directing a verbal reprimand to the child immediately following an inappropriate vocalization. Verbal reprimands included statements such as "Stop that," and "You know you're not supposed to talk out." All other behaviors were ignored during the attention condition. Reprimands were used because, during teacher interviews, teachers reported sometimes reprimanding children following disruptive behavior. Additionally, anecdotal classrooms observations indicated that children were routinely reprimanded for disruptive classroom behavior.

During the escape condition, the classroom teacher provided small group instruction as it was delivered during the other conditions. The task was terminated (i.e., teacher stopped delivering instruction) for 30 s following occurrence of any inappropriate vocalization by the target child. Following the 30-s escape interval, the task was then re-presented. If the child did not comply with the task demand, but did not exhibit any inappropriate vocalizations, a three prompt hierarchy was used. The three prompt hierarchies consisted of (a) verbal command, (b) verbal command and gesture, and (c) physical guidance. When each task was verbally presented, the child had 5 s to initiate engagement in behaviors that were associated with the completion of the task. If the child did not comply, and did not engage in the target behavior, the task was represented verbally accompanied by a gesture toward something relevant to task completion. If the child still did not comply, an experimenter physically guided the participant through the completion of the task. Once the task was completed, direct instruction resumed.

The contingency reversal (Northup et al. 1991) included a brief reversal design (i.e., B–A–B) in which B was the contingency reversal and A included replicating the condition that produced the highest level of behavior during the initial brief functional analysis. During the contingency reversal (i.e., B), the reinforcer identified during the brief functional analysis was withheld following occurrence of an inappropriate vocalization and then provided contingent upon a 30-s absence of inappropriate vocalizations. For example, if the brief functional analysis indicated that the child's inappropriate vocalizations were maintained by access to attention, then the contingency reversal (i.e., B phase) included providing attention for a 30-s

absence of inappropriate vocalizations (i.e., DRO) while withholding attention following an inappropriate vocalization (i.e., extinction). During the A session, inappropriate vocalizations were followed by a reprimand as had occurred during the attention condition of the brief functional analysis. No training was provided to children prior to contingency reversal sessions. Additionally, the children were not provided with any instructions regarding the contingencies that would be available during contingency reversal sessions.

Intervention Analysis

Three conditions were evaluated in an ATD format: (a) DRA, (b) DRO, and (c) control. Prior to intervention analysis, each teacher was trained in one session to implement DRA and DRO strategies using direction instruction techniques (i.e., modeling, practice, performance feedback). DRA in this study was an intervention package that included a pre-teaching script that was used immediately prior to each DRA session. Pre-teaching included direct instruction for the targeted replacement behavior (i.e., appropriate vocalizations). Pre-teaching was included in the DRA condition for three reasons. First, as participants were between the ages of 4 and 6, it was not assumed that the children possessed the skills necessary to access reinforcement. So, it was believed that pre-teaching was an important practical component of the DRA intervention. Second, it was believed that the pre-teaching session could serve as a discriminative stimulus for the availability of reinforcement for appropriate vocalizations during the subsequent early literacy lesson. As such, we believed that pre-teaching would increase discriminability between conditions. Finally, the current zeitgeist of positive behavior interventions and supports suggests that frequent reminders and teaching of behavioral expectations may promote exhibition of desired behaviors (Sugai and Horner 2002).

Teachers implemented pre-teaching sessions using a step-by-step lesson plan developed by the first author. Each lesson plan operationally defined inappropriate and appropriate vocalizations and clearly communicated expected behaviors (i.e., appropriate vocalizations) to the children. Additionally, teachers were provided with a DRA protocol that provided instructions for how to withhold reinforcement from the student contingent upon the occurrence of inappropriate vocalizations and how to provide reinforcement contingent upon the occurrence of appropriate vocalizations (lesson plans and scripts are available from the first author upon request).

Immediately prior to the start of a DRA session, the teacher took the child to a quiet corner of the room and read through the pre-teaching lesson plan. The lesson plan provided the behavioral expectations and encouraged the use of appropriate vocalizations during the upcoming session. Once the teacher completed the lesson, the child was asked two questions regarding expected behaviors based on the content of the lesson. If the child answered a question incorrectly, the teacher then provided the answer, waited 10 s, and then repeated the question. Once the child answered both questions correctly, the teacher and the child returned to the group and the DRA session began. During the DRA session, the teachers were prompted by an experimenter to engage in the correct response for inappropriate and

appropriate child behaviors. Specifically, a green card was used to signal reinforcer delivery for an appropriate vocalization, and a red card was used to signal withholding of the reinforcer following an inappropriate vocalization. In the DRA condition, the reinforcer was delivered following the first appropriate vocalization after 30 s in which an inappropriate vocalization did not occur. If the child engaged in an inappropriate vocalization, the reinforcer was withheld and the interval was reset.

During DRO intervention sessions, teachers ignored any instance of inappropriate vocalizations and provided the identified form of reinforcement contingent upon a 30-s absence of inappropriate vocalizations. Identical to the DRA condition, teachers were prompted by an experimenter to engage in the correct intervention component. A green card was used to signal delivery of the identified form of reinforcement for the absence of inappropriate vocalizations, and a red card was used to signal withholding of reinforcement following an inappropriate vocalization.

During control condition sessions, teachers were instructed to provide academic instruction in the manner that they routinely used. Additionally, teachers were instructed to manage behavior in the manner that they used prior to the beginning of the study. Experimenters were present in the classroom during control conditions to record behavior, but did not provide teachers with any prompts for addressing children's behavior.

Interobserver Agreement, Procedural Integrity, and Treatment Integrity

Interobserver Agreement (IOA) was conducted for 42.8% of the functional analysis sessions (45.4, 33.3 and 47% for Henrik, Nicklas, and Johan, respectively). Occurrence IOA was calculated as the total number of agreements for occurrences of the target behavior divided by the total number of agreements plus disagreements and multiplied by 100%. Occurrence IOA was used because of the relatively low levels of the target behavior across participants. Advanced school psychology graduate students were trained to conduct observations; 90% agreement with the primary investigator was used as criterion for observers. Average IOA for brief functional analysis sessions by participant were 98.3% for Henrik (range 96.6–100%) and 100% for Nicklas and Johan.

IOA data for intervention sessions were collected for 47.6% of the sessions for Henrik and averaged 96% (range 92.8–100%). IOA data for intervention sessions were collected across 35.2% of the sessions for Nicklas and averaged 98% (range 96.6–100%). IOA data for intervention sessions were collected across 47% of the sessions for Johan and averaged 94% (range 91.6–100%).

Procedural and treatment integrity data were collected by independent observers who were graduate students with advanced training in behavioral observations and integrity evaluation. Procedural integrity observations were conducted for 100% of the functional analysis sessions for Henrik, Nicklas, and Johan. To determine procedural integrity, experimenters completed checklists that corresponded to the procedural guidelines followed during the respective

functional analysis condition. The number of steps included in the integrity checklists for the control, attention, escape, and tangible conditions included five steps, eight steps, six steps, and five steps, respectively. Procedural integrity was calculated as the percentage of steps competed accurately by the experimenter and was 100% for all functional analysis sessions. Treatment integrity data for intervention sessions were collected by experimenters for 100% of treatment sessions using checklists that included relevant treatment components. Treatment integrity checklists included for DRA and DRO interventions included eleven steps and three steps, respectively. Treatment integrity was calculated as the percentage of treatment steps accurately completed by teachers and was 100% for all sessions.

Results

Brief functional analysis results for all participants are presented in Fig. 1. Intervention data for all participants are presented in Fig. 2. Description of visual analysis for brief functional analyses and intervention data are provided by student below.

Henrik

Functional Assessment

Henrik's teacher, Ms. Babcock, identified inappropriate vocalizations as the most severe problem behavior and identified appropriate vocalizations as an appropriate replacement behavior. Additionally, during FAIR-T P interview, Ms. Babcock indicated that Henrik's inappropriate vocalizations were most often followed by access to tangible items. Brief functional analysis data for Henrik are provided in the first panel of Fig. 1. The highest level of inappropriate vocalizations was observed during the tangible condition (i.e., 36.6% of the observed intervals). To further demonstrate a functional relationship between the tangible condition and the increase in occurrence of inappropriate vocalizations, a contingency reversal was implemented. Inappropriate vocalizations occurred during approximately 20% of the observed intervals when the contingency was reversed while occurring at 38.3% of the observed intervals when the tangible condition was replicated. As a result of information obtained from the FAIR-T P interview and data from the brief functional analysis, it was determined that Henrik's inappropriate vocalizations were maintained by access to tangible items. Therefore, the DRA intervention included withholding the preferred tangible contingent upon inappropriate vocalizations and providing 30 s of access to that tangible contingent upon the first appropriate vocalization following a 30-s absence of inappropriate vocalizations. During the DRO sessions, 30 s of access to the tangible was provided following a 30-s absence of inappropriate vocalizations.

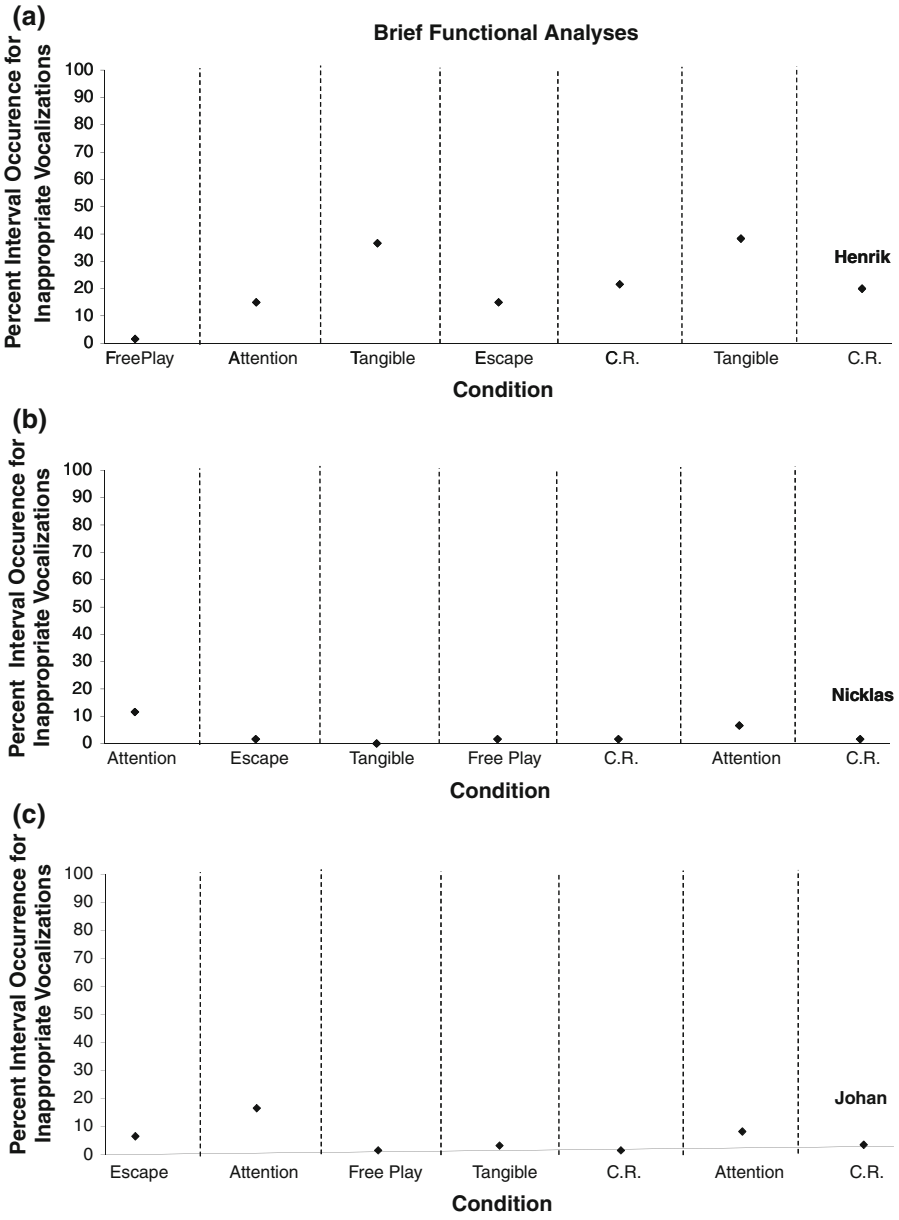

Fig. 1 Brief functional analyses. C.R. is contingency reversal

Intervention

Henrik's intervention data are presented in the first panel of Fig. 2. Level of inappropriate behavior was lowest during DRA sessions (mean = 10.8%) relative to DRO and control condition sessions (means = 13.7% and 21%, respectively).

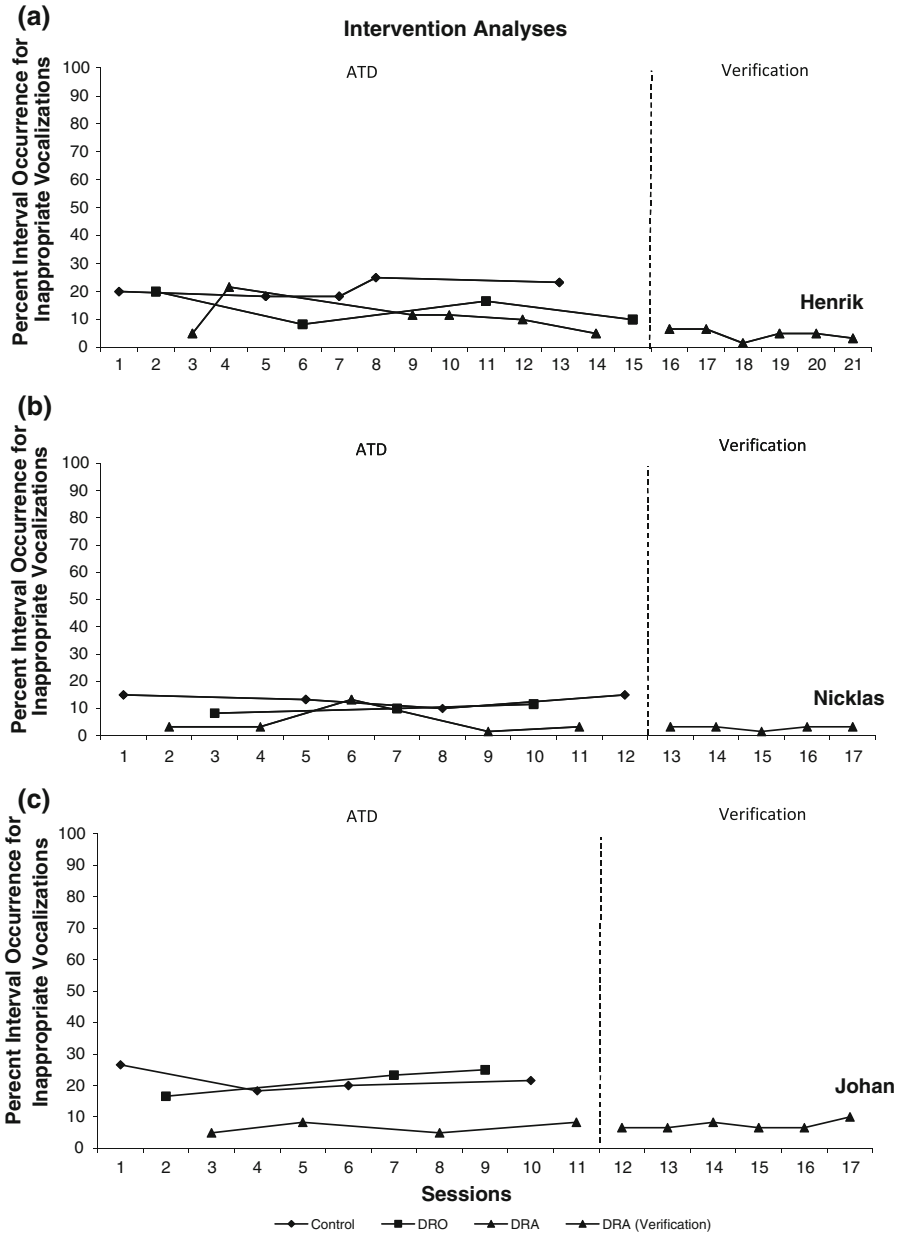

Fig. 2 Intervention analyses. ATD is alternating treatments design; *DRO* is differential reinforcement of other behavior; *DRA* is differential reinforcement of alternative behavior

Level of inappropriate behavior trended downward during the final five DRA sessions and ended at 5% of the observed intervals. During the verification phase, Henrik's inappropriate vocalizations were stable and occurred at a low level (mean = 4.6%).

Nicklas

Functional Assessment

Nicklas' teacher, Ms. Babcock, identified inappropriate vocalizations as his most severe problem behavior and identified appropriate vocalizations as an appropriate replacement behavior. Additionally, during the FAIR-T P interview she indicated that inappropriate vocalizations were most often followed by access to attention in the form of reprimands. Results from the brief functional analysis appear in the second panel of Fig. 1. Level of inappropriate vocalizations was low across all analysis conditions; however, the highest level was observed during the attention condition (i.e., 11.6%). During both contingency reversal conditions, Nicklas engaged in inappropriate vocalizations during 1.6% of the observed intervals. When the attention condition was replicated, Nicklas' inappropriate vocalizations occurred during 6.6% of the observed intervals. As a result of information from the teacher interview and data from the brief functional analysis, it was determined that Nicklas' inappropriate vocalizations were maintained by access to attention. Therefore, the DRA intervention included providing access to attention (e.g., specific labeled praise) following the first appropriate vocalization following a 30-s absence of inappropriate vocalizations. During DRO sessions, inappropriate vocalizations were ignored and attention was provided contingent upon 30 s of the non-occurrence of inappropriate vocalizations.

Intervention

The second panel in Fig. 2 includes intervention analysis data for Nicklas. Inappropriate vocalizations occurred at a low level for all three conditions during intervention analysis (i.e., less than 20% of the observed intervals). However, inappropriate vocalizations consistently occurred at the lowest levels during DRA sessions (mean = 4.9%) relative to DRO and control condition sessions (means = 9.9% and 13.3%, respectively). During the verification phase, inappropriate vocalizations remained low and stable through the duration of the phase (mean = 2.9%).

Johan

Functional Assessment

Johan's teacher, Ms. Holland, identified inappropriate vocalizations as the most severe problem behavior. Additionally, during the FAIR-T P interview, she indicated that inappropriate vocalizations were most often followed by access to attention in the form of reprimands. Johan's brief functional analysis data are displayed in the third panel of Fig. 1. Inappropriate vocalizations occurred at low levels across all analysis conditions. However, the highest level was observed during the attention condition (i.e., 16.6%). To further demonstrate a functional relationship between the attention condition and the increase in occurrence of inappropriate vocalizations,

a contingency reversal was implemented. During the contingency reversal sessions, Johan engaged in inappropriate vocalizations during 1.6 and 3.6% of the observed intervals. When the attention condition was replicated, Johan's inappropriate vocalizations were observed during 8.3% of the observed intervals. As a result of information obtained from the interview and data from the brief functional analysis, it was determined that Johan's inappropriate vocalizations were maintained by access to attention. Therefore, the DRA intervention included providing attention (e.g., specific labeled praise) following the first appropriate vocalization following a 30-s absence of inappropriate vocalizations. During DRO sessions, Johan received attention contingent on the 30-s absence of inappropriate vocalizations and attention was withheld contingent on the occurrence of an inappropriate vocalization.

Intervention

Johan's intervention analysis data are displayed in the third panel of Fig. 2. During intervention analysis, the lowest level of inappropriate vocalizations was observed during DRA sessions (mean = 6.6%) relative to DRO and control condition sessions (means = 21.6% for both conditions). During DRA sessions, inappropriate vocalizations occurred at a low and stable level, and there was no overlap between any DRA sessions and DRO or control condition sessions. During the verification phase, inappropriate vocalizations maintained at a low and stable level with a mean of 7.4% of the observed intervals.

Assessment and Treatment Acceptability

Each teacher completed the ARP-R at the completion of the FBA process. Overall, both teachers indicated high acceptability with the assessment process. Mrs. Babcock's total score was 70 for both Henrik and Nicklas, and Mrs. Holland's total score was 72 for Johan. At the conclusion of intervention, each teacher completed the IRP-15. Overall, the teachers found the intervention process to be acceptable, beneficial, and appropriate. However, one teacher anecdotally reported that the procedures used resulted in negative side effects for the child. Specifically, Ms. Holland indicated that Johan began to play with objects following intervention implementation. As a result, additional consultation was provided at the conclusion of the study and Johan's assigned seat was reassigned to one near Mrs. Holland. The new seating location allowed the teacher to remove any objects that were being manipulated during instruction. Mrs. Babcock's total scores were 86 and 85 for Henrik and Nicklas, respectively. Mrs. Holland's total score was 83 for Johan. A total score of 52.5 or greater represents an "acceptable" rating (Von Brock and Elliott 1987), which suggests that all three teachers were very accepting of the intervention process.

Discussion

School-based professionals spend considerable time providing consultation to teachers regarding disruptive classroom behaviors. Functional assessment and

intervention procedures have emerged as an effective approach to ameliorating problem behaviors in the classroom. Function-based interventions typically include differential reinforcement procedures as a means of reducing problem behaviors while potentially increasing other behaviors. Unfortunately, the differential reinforcement literature primarily includes individuals with developmental disabilities engaging in destructive, stereotypic, and self-injurious behaviors. In fact, reviews of the DRO and DRA literature indicate that less than 8% and 10% of studies using DRO and DRA, respectively, have included individuals without developmental disabilities (Petscher et al. 2009; Whitaker 1996). As a result, the scope of external validity of DRO and DRA research is limited. This study provides an important contribution to the literature in that DRO and DRA procedures were implemented with typically developing young children in traditional center-based classroom settings. Additionally, results indicated that both procedures were effective for decreasing disruptive behaviors, and teachers rated the procedures as acceptable.

Research with individuals with developmental disabilities is often conducted in restrictive settings that allow researchers to more easily control the stimulus conditions present in the research environment. For example, threats to intervention integrity like adventitious reinforcement from a peer cannot occur in analog intervention sessions that include only a researcher and the participant. In this study, intervention procedures were implemented in traditional center-based classrooms with the typical array of stimulus conditions included in those settings (e.g., other children, classroom decorations, multiple play and work stations). Despite this, results indicated that intervention procedures were implemented with integrity, rated as acceptable by teachers, and implementation resulted in decreases in inappropriate behavior. Consequently, these results extend the differential reinforcement literature by demonstrating the usability and effectiveness of the procedures in naturalistic classroom settings with the full array of stimulus conditions those settings include.

Another unique contribution of this study is the within child direct comparison of DRO and DRA. Functional assessment data informed development of DRO and DRA interventions, and intervention impact was evaluated for problem behaviors. Previous research has demonstrated the effectiveness of function-based differential reinforcement procedures in preschool classrooms (Dufrene et al. 2007; Wilder et al. 2007); however, studies have failed to directly compare DRA and DRO procedures. Results from this study indicate that DRO and DRA procedures were effective for reducing preschool children's disruptive classroom behaviors relative to a control condition. However, DRA was consistently more effective at reducing inappropriate vocalizations when compared to DRO. Although the differences in inappropriate behavior were modest, those differences were consistent across all participants. DRA may have been more effective due to explicitly programming for an alternative replacement behavior. In other words, children likely engaged in more appropriate vocalizations during DRA sessions thus limiting their ability to engage in inappropriate vocalizations.

This study also extends the functional assessment literature in some important ways. First, this study provides and added demonstration of the usefulness of

functional assessment in preschool and center-based classroom settings with children who do not have developmental disabilities. Functional assessment research in these settings with typically developing children is relatively limited (Ervin et al. 2001; Gresham et al. 2004). However, more recently investigations have demonstrated the usefulness of functional assessment for intervention planning in preschool and center-based classrooms (Carter and Horner 2007; Dufrene et al. 2007; VanDerHeyden et al. 2001; Wilder et al. 2007). As the preschool functional assessment research grows, researchers will gain more insight into the generalized utility of functional assessment. Again, the current study expands the functional assessment literature by demonstrating the feasibility and acceptability of functional assessment in preschool and center-based classrooms. Functional assessments were conducted during routine classroom activities (i.e., early literacy instruction), were rated as acceptable by teachers, and data were used to develop interventions that effectively reduced children's disruptive classroom behaviors.

Results from this study also extend the small literature base for the FAIR-T P. The FAIR-T P was developed to provide an indirect functional assessment instrument specifically designed for children in center-based classroom settings (Dufrene et al. 2007). This study provides further demonstration of the usefulness of the FAIR-T P. Specifically, for all three participants, information from the FAIR-T P interview converged with brief functional analysis results. Convergence between the FAIR-T P and brief functional analyses provides an additional demonstration of the instrument's criterion-related validity. Finally, this study extends use of the FAIR-T-P in terms of settings. Dufrene and colleagues' study was conducted in Head Start and daycare classrooms only, whereas this study included use of the FAIR-T P in a kindergarten classroom in a public school.

Although the current study contributes to the literature base on the applied use of functional assessment and differential reinforcement procedures in preschool settings, there are some limitations that should be taken into account. First, all three participants were African American males and attended Head Start or kindergarten. Future research should evaluate function-based DRO and DRA interventions across multiple age groups and educational levels. Moreover, future research may include children from various racial and ethnic backgrounds as well as those who attend center-based classrooms other than in Head Start and kindergarten. Such research might expand the external validity of the current findings. A second limitation to this study was that the targeted inappropriate behavior for all three participants was inappropriate vocalizations. As a result, it is unknown whether similar results would be obtained for different target response classes. Future research should evaluate these assessment and intervention procedures across a range of disruptive behaviors so that external validity may be expanded.

A third limitation was that data were not collected for the rate of reinforcement across DRA and DRO conditions. Therefore, it is unknown whether a greater rate of reinforcement emerged for one condition versus the other. Consequently, differences in rate of reinforcement across conditions may have been an extraneous variable. Fourth, the DRO schedule was arbitrarily set at 30 s across all participants. Previous research (Rozenblat et al. 2009) has indicated that briefer DRO intervals based on baseline inter-response times (IRT) may be more effective at suppressing

problem behavior. Future research may include establishing initial DRO intervals based on participants' baseline IRT.

The current investigation did not include a follow-up phase to assess whether teacher intervention implementation and student behavioral gains were maintained at a desirable level following the end of data collection. In this study, teachers were prompted to engage in correct intervention implementation by experimenters because the purpose of this study was to determine whether or not there were relatively immediate differential effects for DRO and DRA. As a result, long-term feasibility and effectiveness, in the absence of experimenters' prompts, were not evaluated. The current study suggests that there may be immediate differences between DRO and DRA procedures, so future research may evaluate the extent to which the DRA procedure is implemented accurately, in the absence of experimenter supports, and children continue to respond positively to intervention.

Finally, the DRA procedure in this study was a package that included a pre-teaching component. Therefore, it is not known whether the DRA procedure would have been as effective without the pre-teaching procedure. The pre-teaching component was included in this study due to the age of the child participants. Specifically, all child participants were between the ages of 4 and 6, and therefore, possessed a relatively limited skill repertoire. So, it was believed that pre-teaching behavioral expectations was practically important because reinforcement procedures cannot be effective unless individuals are able to engage in the behavior that allows for contact with reinforcement. Additionally, pre-teaching behavioral expectations is consistent with the current movement toward routinely providing direct instruction for expected behaviors (Sugai and Horner 2002). However, it is still important that future research evaluate DRA procedures with and without pre-teaching. Information regarding the need for pre-teaching coupled with DRA may inform applied practice in terms of identifying the most time and resource efficient intervention approach.

Despite limitations, the current study provides some important contributions to the functional assessment and differential reinforcement literatures as they pertain to center-based classroom settings. The current study provides an added example of the utility of functional assessment data in the development of effective function-based interventions for children in center-based classrooms. Additionally, the current study provides preliminary evidence that DRA may more preferred than DRO for typically developing children as DRA may more consistently reduce disruptive behaviors.

References

Anderson, D. R. (1983). Prevalence of behavioral and emotional disturbance and specific problem types in a sample of disadvantaged preschool-aged children. *Journal of Clinical Child Psychology, 12*, 130–136.

Barkley, R. A. (1998). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (2nd ed.). New York: Guilford Press.

Beare, P. L., Severson, S., & Brandt, P. (2004). The use of a positive procedure to increase engagement on-task and decrease challenging behavior. *Behavior Modification, 28*(1), 28–44.

Boyajian, A. E., DuPaul, G. J., Handler, M. W., Eckert, T. L., & McGoey, K. E. (2001). The use of classroom based brief functional analyses with preschoolers at risk for attention deficit hyperactivity disorder. *School Psychology Review, 30*, 278–293.

Campbell, S. B., & Ewing, L. J. (1990). Follow-up of hard-to-manage preschoolers: Adjustment at age 9 and predictors of continuing symptoms. *Journal of Child Psychology and Psychiatry, 31*, 871–889.

Carr, E. G., & Durand, V. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*, 111–126.

Carr, J. E., Nicolson, A. C., & Higbee, T. S. (2000). Evaluation of a brief multiple-stimulus preference assessment in a naturalistic context. *Journal of Applied Behavior Analysis, 33*, 353–357.

Carter, D. L., & Horner, R. H. (2007). Adding functional behavioral assessment to first step to success: A case study. *Journal of Positive Behavior Interventions, 9*, 229–238.

Doggett, R. A., Edwards, R. P., Moore, J. W., Tingstrom, D. H., & Wilczynski, S. M. (2001). An approach to functional assessment in general education classroom settings. *School Psychology Review, 30*, 313–328.

Doggett, R. A., Mueller, M. A., & Moore, J. W. (2002). Functional assessment informant record for teachers: Creation, evaluation and future research. *Proven Practice, 4*, 25–30.

Dufrene, B. A., Doggett, R. A., & Henington, C. (2007). Functional assessment and intervention for disruptive classroom behaviors in preschool and head start classrooms. *Journal of Behavioral Education, 16*(4), 368–388.

Eckert, T. L., Hintze, J. M., & Shapiro, E. S. (1999). Development and refinement of a measure for assessing the acceptability of assessment methods: The assessment rating profile- revised. *Canadian Journal of School Psychology, 15*(1), 21–42.

Ervin, R. A., Ehrhardt, K. E., & Poling, A. (2001). Functional assessment: Old wine in new bottles. *School Psychology Review, 30*, 173–179.

Gresham, F. M., McIntyre, L. L., Olson-Tinker, H., Dolstra, L., McLaughlin, V., & Van, M. (2004). Relevance of functional behavioral assessment research for school-based interventions and positive behavioral support. *Research in Developmental Disabilities, 25*, 19–37.

Konczak, L. J., & Johnson, C. M. (1983). Reducing inappropriate verbalizations in a sheltered workshop through differential reinforcement of other behavior. *Education and Training of the Mentally Retarded, 18*(2), 120–124.

Lucas, R. L. (2000). The effects of time-out and DRA on the aggressive behavior of a spirited two-year-old. *Child and Family Therapy, 22*, 2.

Martens, B. K., Witt, J. C., Elliott, S. N., & Darveaux, D. (1985). Teacher judgments concerning the acceptability of school-based interventions. *Professional Psychology: Research and Practice, 16*, 191–198.

Mazaleski, J. L., Iwata, B. A., Vollmer, T. R., Zarcone, J. R., & Smith, R. G. (1993). Analysis of the reinforcement and extinction components in DRO contingencies with self-injury. *Journal of Applied Behavior Analysis, 26*(2), 143–156.

McKerchar, P. M., & Thompson, R. H. (2004). A descriptive analysis of potential reinforcement contingencies in the preschool classroom. *Journal of Applied Behavior Analysis, 37*, 441–444.

Moore, J. W., Doggett, R. A., Edwards, R. P., & Olmi, D. J. (1999). Using functional assessment and teacher-implemented functional analysis outcomes to guide intervention for two students with Attention-Deficit/Hyperactivity Disorder. *Proven Practice: Prevention and Remediation Solutions for Schools, 2*, 3–9.

Northup, J., Wacker, D., Sasso, G., Steege, M., et al. (1991). A brief functional analysis of aggressive and alternative behavior in an outclinic setting. *Journal of Applied Behavior Analysis, 24*(3), 509–522.

Petscher, E. S., Rey, C., & Bailey, J. S. (2009). A review of empirical support for differential reinforcement of alternative behavior. *Research in Developmental Disabilities, 30*, 409–425.

Pierce, E. W., Ewing, L. J., & Campbell, S. B. (1999). Diagnostic status and symptomatic behavior of hard-to-manage preschool children in middle childhood and early adolescence. *Journal of Clinical Child Psychology, 28*, 44–57.

Repp, A. C., Deitz, S. M., & Speir, N. C. (1974). Reducing stereotypic responding of retarded persons by the differential reinforcement of other behavior. *American Journal of Mental Deficiency, 79*, 279–284.

Reynolds, G. S. (1961). Behavioral contrast. *Journal of the Experimental Analysis of Behavior, 4*, 57–71.

Rozenblat, E., Brown, J., Brown, A., Reeve, S., & Reeve, K. (2009). Effects of adjusting DRO schedules on the reduction of stereotypic vocalizations in children with autism. *Behavioral Interventions, 24*(1), 1–15.

Sugai, G., & Horner, R. (2002). The evolution of discipline practices: School wide positive behavior supports. *Child and Family Behavior Therapy, 24*, 23–50.

VanDerHeyden, A. M., Witt, J. C., & Gatti, S. (2001). Descriptive assessment method to reduce overall disruptive behavior in a preschool classroom. *School Psychology Review, 30*, 548–567.

Volmer, T. R., & Iwata, B. A. (1992). Differential reinforcement as treatment for behavior disorders: Procedural and functional variations. *Research in Developmental Disabilities, 13*, 393–417.

Volmer, T. R., Roane, H. S., Ringdahl, J. E., & Marcus, B. A. (1999). Evaluating treatment challenges with differential reinforcement of alternative behavior. *Journal of Applied Behavior Analysis, 32*, 9–23.

Von Brock, M. D., & Elliott, S. N. (1987). Influence of treatment effectiveness information on the acceptability of classroom interventions. *Journal of School Psychology, 25*, 131–144.

Webster-Stratton, C., & Hammond, M. (1998). Conduct problems and level of social competence in head start children: Prevalence, pervasiveness, and associated risk factors. *Clinical Child and Family Psychology Review, 1*, 101–124.

Webster-Stratton, C., Reid, J., & Hammond, M. (2001). Social skills and problem-solving training for children with early-onset conduct problems: Who benefits? *Journal of Child Psychology and Psychiatry, 47*, 943–952.

Whitaker, S. (1996). A review of DRO: The influence of the degree of intellectual disability and the frequency of the target behaviour. *Journal of Applied Research in Intellectual Disabilities, 9*, 61–79.

Wilder, D. A., Harris, C., Reagan, R., & Rasey, A. (2007). Functional analysis and treatment of noncompliance by preschool children. *Journal of Applied Behavior Analysis, 41*, 173–177.