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Evaluating the Accuracy of Results for Teacher Implemented Trial-Based Functional Analyses

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Abstract

Trial-based functional analysis (TBFA) allows for the systematic and experimental assessment of challenging behavior in applied settings. The purposes of this study were to evaluate a professional development package focused on training three Head Start teachers to conduct TBFAs with fidelity during ongoing classroom routines. To assess the accuracy of the TBFA results, the effects of a function-based intervention derived from the TBFA were compared with the effects of a non-function-based intervention. Data were collected on child challenging behavior and appropriate communication. An A-B-A-C-D design was utilized in which A represented baseline, and B and C consisted of either function-based or non-function-based interventions counterbalanced across participants, and D represented teacher implementation of the most effective intervention. Results showed that the function-based intervention produced greater decreases in challenging behavior and greater increases in appropriate communication than the non-function-based intervention for all three children.

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Introduction

Young children who engage in frequent or severe challenging behavior are at increased risk for poor educational and life outcomes including teacher and peer rejection (J. J. Wood, Cowan, & Baker, 2002), low academic achievement, school dropout, and criminal behavior (Tremblay et al., 2004). While evidence suggests that universal positive behavior supports in preschool settings can reduce overall challenging behavior at the school and classwide level (e.g., Benedict, Horner, & Squires, 2007), some children will be nonresponsive and require more individualized and intensive behavior supports. These behavior supports are more likely to be effective when matched to the function of challenging behavior (B. K. Wood, Blair, & Ferro, 2009) as identified through a functional behavior assessment (FBA). An FBA is designed to identify environmental stimuli or events that may reinforce, or maintain, the challenging behavior (Shriver, Anderson, & Proctor, 2001). The FBA process typically involves conducting indirect assessments of the target behavior through interviews or rating scales, and directly observing the target behavior during natural settings and routines to form a hypothesis regarding the function of the challenging behavior (Shriver et al., 2001).

In practice, FBAs are often conducted by itinerant support personnel with large student caseloads (Sprague, Flannery, O'Neill, & Baker, 1996). This overreliance on outside personnel may lead to problems in the area of supply and demand, rushed FBAs, and intervention development that lacks contextual fit with the classroom environment (Loman & Horner, 2014). In a review of the literature, B. K. Wood, Drogan, and Janney (2014) synthesized 30 research studies examining FBAs and behavior intervention plans in early childhood settings. Their synthesis revealed that early childhood practitioners were seldom involved in the FBA process, and that when they were involved, their role was often limited, such as only participating as a respondent during an indirect assessment. The lack of teacher involvement in the FBA process has the potential to reduce teacher buy-in, lead to misidentification of the function of behavior, impede intervention implementation, and decrease intervention fidelity (Hassiotis et al., 2009).

The quality and fidelity of FBAs and resulting behavior intervention plans are positively correlated with student educational outcomes including (a) reduction in challenging behavior, (b) increases in appropriate behavior, and (c) improved academic performance (Cook et al., 2012). FBAs comprised of

solely indirect and/or brief descriptive assessment procedures have been shown to produce variable and sometimes conflicting results (Alter, Conroy, Mancil, & Haydon, 2008). Research suggests experimental functional analysis is a more precise method for identifying the function of challenging behavior (e.g., Hanley, Iwata, & McCord, 2003).

Experimental functional analysis of challenging behavior involves the systematic manipulation of environmental stimuli to identify potential antecedents and reinforcing consequences on challenging behavior (Iwata, Dorsey, Slifer, Bauman, & Richman, 1994). Despite being considered by some as the gold standard for identification of function, functional analyses often take considerable time and high levels of technical expertise to complete (Matson & Minshawi, 2007). A newer functional analysis model being explored focuses on conducting the functional analyses in natural settings (e.g., classrooms). The trial-based functional analysis (TBFA) model can be conducted, or even embedded, into a child's natural environment to identify relevant antecedents, establishing operations, and typical sources reinforcement that impact challenging behavior (Rispoli, Ninci, Neely, & Zaini, 2014). TBFA is based on the work of Sigafoos and Saggers (1995) and more recently elaborated on by Bloom, Lambert, Dayton, and Samaha (2013). Similar to traditional experimental functional analysis, TBFA allows specific social conditions to be examined for potential functions of challenging behavior as well as relevant establishing operations. In the literature, TBFA conditions have consisted of access to attention, access to tangibles, escape from demands, and ignore (test for automatically maintained behavior; Rispoli et al., 2014). Trials are brief (2-6 min each), discrete, and distributed throughout the day. Each trial consists of two components: control and test. During the control component, the environment is arranged so that it is unlikely to trigger challenging behavior (i.e., teacher provided attention, toys/objects are accessible, no demands presented). This component is designed to capture relevant "abolishing operations" for challenging behavior. The test component is designed to evaluate whether specific events trigger problem behaviors (i.e., removal of attention, removal of preferred object, presentation of demands). The test component is designed to capture relevant establishing operations for challenging behavior.

As the TBFA model is designed to capture relevant contextual variables which affect challenging behavior in applied settings, it would seem logical that the teacher or service provider within that applied setting would implement this assessment procedure. In fact, in much of the previous research on this model, practitioners have implemented the TBFA (Rispoli et al., 2014). However, research on teaching practitioners to conduct TBFAs has typically involved teaching individuals with backgrounds in behavior analysis or

special education (e.g., Kunnavatana, Bloom, Samaha, & Dayton, 2013; LaRue et al., 2010). Early childhood practitioners, who often serve young children at risk for persistent challenging behavior, are often excluded from the FBA process (B. K. Wood et al., 2014) and have received little attention in previous TBFA research (Rispoli et al., 2015).

TBFA is a potentially promising approach for increasing the contextual fit and implementation of function-based interventions by early childhood practitioners. Six studies have designed function-based interventions based on TBFA results (Bloom et al., 2013; Chezan, Drasgow, & Martin, 2014; Lambert, Bloom, & Irvin, 2012; Lloyd et al., 2015; Schmidt, Drasgow, Halle, Martin, & Bliss, 2013; Sigafoos & Meikle, 1996). In these studies, the function-based intervention resulted in decreases in target challenging behavior. However, in each case, no other intervention was evaluated. It is possible, that an intervention not based on the TBFA results, may also have reduced challenging behavior, thereby calling into question the accuracy of the behavioral function(s) identified in the TBFA. For example, Lambert et al. (2012) taught three young children an alternative response (to request a break or attention) to match the function identified in the TBFA. However, because only one intervention was evaluated for each child, it is unknown whether interventions unrelated to the TBFA would have been more, less, or equally effective. To evaluate the accuracy of TBFA results, research is needed to compare the effects of interventions derived from TBFAs to interventions unrelated to TBFA results on challenging behavior.

Purpose and Research Questions

The purposes of this study were to (a) train Head Start teachers to conduct TBFAs with fidelity during ongoing classroom routines, (b) evaluate the validity of Head Start teacher implemented TBFA results by comparing function-based with non-function-based challenging behavior interventions, and (c) assess teacher perceptions of the social validity of a TBFA in Head Start classroom settings. The following specific research questions were posed:

Research Question 1: What are the effects of a professional development training package on Head Start teacher TBFA implementation?
Research Question 2: What are the effects of a function-based intervention matched to the TBFA results versus a non-function-based intervention on child challenging behavior and appropriate communication?
Research Question 3: Do changes in child behavior maintain when Head Start teachers implement a function-based intervention?

Research Question 4: What are Head Start teachers' attitudes toward TBFA with respect to feasibility and suitability for assessing young children's challenging behavior?

Method

Participants

This study occurred as part of a broader community outreach and research collaboration with a local Head Start program serving children ages 6 weeks to 5 years. The Head Start centers were participating in their first year of program-wide positive behavior interventions and supports (PW-PBIS). PW-PBIS refers to the downward extension of school-wide PBIS to early childhood settings with the goals of promoting social and emotional development and preventing challenging behavior in young children (Frey, Park, Browne-Ferrigno, & Korfhage, 2010; Hemmeter, Fox, Jack, & Broyles, 2007). During the time of the study, PW-PBIS technical assistance was provided to Head Start administrators and teachers on universal supports. This technical assistance emphasized developing clear rules and expectations, teaching expectations to children, and developing systems of acknowledging children for following expectations. The Preschool-Wide Evaluation Tool (Pre-SET; Horner, Benedict, & Todd, 2005) indicated the mean PW-PBIS implementation fidelity for the two settings in which this study was conducted was 61% for the Head Start center and 74% for the Early Head Start center.

The PBIS coach assisted in identifying potential teachers and child participants for the study. To participate in the study, participating teachers had to express an interest in decreasing challenging behavior and have at least one child in their classroom that engaged in challenging behavior that was disruptive to classroom routines.

Teachers. Three Head Start teachers participated in this study. Darlene was a 22-year-old African American female with 1 year of prior experience teaching in Head Start and 6 years of experience in child care settings. She held an associate's degree in early childhood education and reported having had some prior experience with individualized behavior interventions. Kaitlin was a 24-year-old Caucasian female with 1 year of experience in Head Start and 4 years of experience in child care settings. Kaitlin held a high school diploma and also reported having some prior experience with individualized behavior interventions. Katisha was a 35-year-old African American female with 10 years of experience in Head Start and 3 additional months experience

in other child care settings. She had completed some college and had reported receiving prior training on behavior management and function-based interventions. Katisha was also the mother of a child with autism spectrum disorder, and she indicated this background provided her with further knowledge of behavioral intervention.

Children. One child from each Head Start teacher's classrooms was selected for participation in this study. Juan was a 4-year-old Latino boy in Darlene's classroom. He was referred to the study for tantrums defined as screaming, dropping to the floor, and body flailing. Laylana was a 4-year-old African American girl in Kaitlin's classroom. She was referred to the study for aggression toward teachers, such as hitting, and object destruction including throwing toys. Tom was a 3-year-old African American boy in Katisha's class. His challenging behavior included grabbing objects from other children and screaming. Tom received speech therapy once weekly at the Head Start services.

Setting and Materials

All study procedures occurred at each Head Start where the participating teachers were Darlene, Kaitlin, or Early Head Start center where the participating teacher was Katisha. These teachers were trained in the logic and procedural steps of the TBFA process in a one-on-one training with a member of the research team. Only the teacher participant, a researcher, and a data collector were present during the teacher training phase of the study. Training materials included a copy of the Bloom et al. (2013) study, a laptop computer loaded with a PowerPoint presentation with corresponding printed handouts of the slides, and a DVD with a total of three 2-min video clips depicting each TBFA condition (attention, tangible, escape) and the TBFA planning sheet (available from first author).

All TBFA, baseline, and intervention sessions were conducted in the respective teacher's classroom during typical instruction and routines. Each classroom was comprised of approximately 17 children, a lead teacher, and a teaching assistant. Assessment and intervention materials were individually selected for each teacher–student dyad and are described in the procedures section. Time of day, materials, and setting were held constant for each participant during the intervention phase of the study.

Experimental Design, Dependent Variables, and Data Collection

This study used an adapted withdrawal design (A-B-A-C-D/A-C-A-B-D) where A was baseline, B was function-based intervention, C was non-function-based

intervention, and D was teacher implementation of the most effective intervention. The sequence of the B and C intervention phases was counterbalanced across participants to control for potential sequence effects.

Dependent variables included child challenging behavior and appropriate communication. During the TBFA phase of the study, data were collected on the occurrence or non-occurrence of challenging behavior during each component (control and test) of TBFA trials. These data were converted to a percentage of trial components with challenging behavior by condition. During the intervention comparison phase, data were collected on the rate per minute of challenging behavior and appropriate communication defined individually for each child participant.

Data were analyzed using visual analysis supplemented with effect sizes. Visual analysis included examining changes in level, trend, and overlap between adjacent phases. In addition, during the intervention comparison phase of the study, Tau effect sizes were calculated, post hoc, to determine the magnitude of the effects of both function-based and non-function-based intervention on children's challenging behavior and appropriate communication. Tau is a robust effect size for time series data that considers non-overlap between phases (Parker, Vannest, Davis, & Sauber, 2011). Tau values range from −1 to 1 and can be interpreted as the percent of data showing improvement between phases and during treatment (Parker et al., 2011). As a percentage-based effect size, Tau can be interpreted using the guidelines set out by Scruggs and Mastropieri (1998): (a) below 0.50 is ineffective, (b) between 0.50 and 0.70 is questionable, and (c) more than 0.90 is very effective. The statistical significance of Tau is based on the Kendall's S distribution (Parker et al., 2011). Tau tends to show high consistency with visual analysis ratings on both the presence of basic effects and the sufficiency of non-overlap demonstrated between phases (Ninci et al., 2015).

Inter-Observer Agreement (IOA) and Procedural Fidelity

IOA, procedural fidelity, and IOA on procedural fidelity were collected for a minimum of 30% of TBFA trials for each condition and for each teacher–child dyad. Two independent observers (doctoral-level research assistants) collected data per trial component and their IOA was averaged within conditions. During the TBFA phase, an agreement was recorded if both observers independently scored the occurrence or the non-occurrence of challenging behavior during the same trial component. IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. IOA on challenging behavior during the TBFA phase was 100% for all participants and conditions.

Within baseline and each intervention phases, IOA on the rate of child challenging behavior and appropriate communication was collected for a minimum of 20% of session for each phase and each participant. To determine IOA, each minute within the session was divided into 10-s intervals and the observers recorded the frequency of the target behavior during each interval. An agreement was reached if both observers recorded the same frequency of the target behaviors within each 10-s interval. IOA was calculated by dividing the number of intervals with agreements by the total number of intervals with agreements plus disagreements for a session and multiplying by 100%. Mean IOA for both dependent variables ranged from 96% to 100% across all intervention comparison conditions and participants (range = 90%-100% within each condition).

Researcher-developed procedural fidelity checklists were used with each TBFA condition (Rispoli et al., 2015). Each procedural checklist was divided into two parts: control and test component procedures. Each checklist contained five (tangible), six (attention), or seven (escape) total steps. Steps included teacher behaviors such as "Teacher removes the toy from the participant and places it out of reach but visible to the participant." Teacher implementation was observed throughout the entire trial. Observers scored each step as correct if the teacher implemented that step correctly across all opportunities within the trial. Procedural fidelity scores were calculated by obtaining the percentage of checklist items implemented correctly (correct items divided by all possible items and multiplied by 100%). Mean procedural fidelity for each teacher ranged from 94% to 98% across trial conditions (range = 80%-100% within each condition). To collect IOA on procedural fidelity, independent observers rated fidelity to obtain a percentage of agreements on ratings across checklist items. Mean IOA on procedural fidelity for each teacher ranged from 96% to 100% across trial conditions (range = 83%-100% within condition).

During baseline and intervention sessions, IOA on procedural fidelity was collected for a minimum of 25% of sessions for each condition for each participant. Procedural fidelity checklists with a range of six to seven task-analyzed items were used for each intervention condition. Procedural fidelity and IOA on fidelity was calculated in the same manner as was described for the TBFA phase. Mean procedural fidelity ranged from 97% to 100% across conditions for dependent variables and participants (range = 83%-100% within each condition). Mean IOA on procedural fidelity ranged from 94% to 100% across conditions for dependent variables and participants (range = 83%-100% within condition).

Procedures

At the beginning of the study, participating teachers were trained to implement TBFA procedures. A member of the research team then conducted an

initial FBA of each child's challenging behavior (described below). Following the initial assessment, the researcher and teacher met to plan each TBFA condition that would be tested. After the TBFA was completed, the researcher conducted the intervention evaluation portion of the study within the Head Start classroom with the child participants. In the last phase, the researcher trained the teacher to implement the more effective intervention. At the conclusion of the study, the first author met with each teacher individually to debrief, review study results and implications, to answer any questions the teacher had, and to gather teacher input regarding the social validity of the TBFA and the function-based intervention.

TBFA teacher training. Each teacher was individually trained to conduct three TBFA conditions: attention, tangible, and escape. The teacher training procedures consisted of a 60-min session which included a 30-min PowerPoint presentation with video examples and 30 min of role-play and performance feedback. Teacher implementation of the TBFA conditions during role-plays continued until teacher procedural fidelity reached 100% for each condition. Once teacher procedural fidelity reached criterion, the teacher conducted the TBFA with the child participant. Teacher performance criterion for implementation fidelity during TBFAs in the classroom was set as 100% of steps completed correctly for each condition for three consecutive sessions. To help teachers reach these criterion levels, the researcher provided the teacher with verbal and written performance feedback on implementation immediately after session. The minimum possible number of trials for a teacher to reach the fidelity criterion was three. Darlene reached fidelity criteria at five trials for attention condition, and three trials for tangible and escape conditions. Kaitlin's trials to criterion were five for attention condition, three for attention, and four for demand. Katisha required only three sessions per condition to reach criterion.

Initial FBA. Teachers were interviewed to identify and operationally define each child participant's challenging behavior. The initial FBA consisted of two components. First, participating children were observed in their classroom by a member of the research team using the Functional Assessment Observation Form (FAOF; O'Neill et al., 1997). The purpose of this FBA component was to identify typical times or routines in which challenging behavior occurred and potential antecedents and maintaining consequences for challenging behavior. Second, the research team member administered the Motivation Assessment Scale (MAS; Durand & Crimmins, 1992) modified for early childhood to each teacher. This indirect assessment is a checklist with a Likert-type scale designed to identify potential sources of reinforcement for challenging behaviors.

TBFA planning. Following direct observations and indirect assessment procedures, a research team member conferred with each teacher to identify activities and times during the day in which to embed specific TBFA trials. The TBFA Planning Worksheet (available from first author) was used to guide teachers through this process. For each condition, teachers were asked to identify stimuli or events relevant to challenging behavior (preferred toy, difficult or non-preferred activities/demands), times in the day when access to those stimuli/events was provided and removed, to rate the likelihood that the child would engage in challenging behavior during that activity, and to determine whether a TBFA trial would be feasible to conduct at that time.

Teachers reported toys or activities within their classroom that were associated with challenging behavior and could be integrated into the tangible condition. Darlene identified Juan's preferred activity as playing with balls during outside time. Kaitlin identified Laylana's preferred activity as painting during center time, and Katisha identified Tom's preferred activity as playing on the computer during center time. Teachers opted to conduct attention trials during free play periods with low preferred activities for Laylana and Juan and during meal times for Tom. They selected to conduct escape trials during small group activities with pre-academic tasks for Laylana and Juan and during library or clean-up time for Tom.

TBFA implementation. The TBFA consisted of 10 trials in each condition. The results of the initial FBA indicated that each participant's challenging behaviors was socially maintained. As such, attention, escape, and tangible conditions were conducted. Each trial consisted of 60-s control and up to 60-s test components. During the control component, the environment was arranged so that it was unlikely to trigger challenging behavior (i.e., teacher provides attention, objects/activity are accessible, no demands are presented). The test component was designed to assess whether specific events occasion challenging behavior (i.e., removal of object/activity, removal of attention, presentation of demands).

Tangible condition. In the control component of the tangible condition, the teacher sat near the participant and provided access to the preferred activity or item for 60 s regardless of an occurrence of challenging behavior. In the test component, the teacher removed the item, told the participant "You can have this later" and kept it in sight but out of the participant's reach, blocking any child attempts to access the item or activity. The test component continued for 60 s or until the child engaged in target challenging behavior. The item or activity was immediately provided to the participant contingent upon an occurrence of the target challenging behavior.

Attention condition. In the control component of the attention condition, the teacher instructed the participant to engage in play or independent activities and she provided the participant attention at least once every 5 s regardless of the occurrence of challenging behavior. Attention consisted of comments or praise without demands being placed. In the test component, the teacher instructed the participant to continue with the activity, explained that she needed to do some work, and turned her body away from the participant. The teacher did not speak to or look at participant for 60 s unless the child engaged in the target challenging behavior. Contingent upon target challenging behavior, the teacher provided verbal attention such as statements of concern and the trial then ended.

Escape condition. During the control component of the escape condition, the teacher told the child they could play, rest, or take a break. The teacher turned away from the participant and did not provide attention for 60 s. Task materials were not present and demands were not placed. In the test component, the teacher presented task demands associated with the ongoing classroom routine every 10 s with least-to-most prompting (i.e., verbal, verbal plus model, then verbal plus physical). The teacher delivered praise upon successful task completion. The test component lasted 60 s or until the child engaged in target challenging behavior. Contingent upon challenging behavior, the teacher removed task materials and demands immediately and told the child they could have a break.

Baseline. Baseline sessions were identical across participants. At the beginning of each 5-min session, the preferred object or activity was presented to the child participant for 10 s. The item was then placed in sight but out of the child's reach. The researcher did not respond to appropriate or inappropriate child behaviors and all attempts to access the item/activity were blocked. Contingent upon an occurrence of the targeted challenging behavior, the participant was given access to the tangible item for 30 s, after which the item was again placed in sight but out of reach. These procedures continued until 5 min had elapsed.

Function-based intervention. Functional communication training (FCT) was used to teach each child a request response equivalent to the function of their challenging behavior, as identified by the TBFA. FCT is one of the most common function-based interventions in the literature (Rooker, Jessel, Kurtz, & Hagopian, 2013) with more than 20 years of research support since the 1985 seminal study by Carr and Durand. At the beginning of each session, the research stated the following script to the child, "If you want the (name of

toy/activity), say 'My turn' or hand me this card." Using most-to-least prompts, descriptive praise, and 30 s of access to the toy/activity for appropriate requesting, the child was taught to say "My turn" or to hand a 3″ by 5″ photo card of the preferred toy to the researcher. Challenging behavior was placed on extinction and did not receive attention or access to the toy/activity. If challenging behavior did occur during the session, the researcher provided no response until the behavior has ceased for at least 2 s, after which the researcher provided a verbal or physically prompt for the communicative response.

Non-function-based intervention. As a picture card was present in the function-based treatment, a blank red card was present in non-function-based treatment to signal a new condition. Prior to beginning the session, the participant was reminded of program-wide expectations (e.g., be safe, be kind, and be responsible). Such pre-corrective statements are a core feature of universal positive behavior supports (PBS) in early childhood settings (Snell et al., 2014) and were supported by technical assistance provided to the Head Start centers as part of program-wide PBS. As in the function-based intervention, the child was provided with brief access to the preferred toy/activity and then access was removed. However, unlike the function-based intervention, requests for the item/activity were not reinforced. Instead, contingent upon challenging behavior, the participant was reminded to follow the program-wide expectations, the expectations were stated to the child (e.g., "Be safe, be kind, and be respectful"), and the child was reminded that by following expectations, he or she could help the class to earn a reward using the class-wide acknowledgment system. To mirror schedules of reinforcement already in place in the classroom, an fixed ratio two (FR: 2) schedule of reinforcement was implemented in which every second instance of challenging behavior led to 30 s of access to reinforcement. If no challenging behavior occurred during the session, the researcher praised the child for following expectations and delivered a token for the classwide group contingency plan.

Teacher intervention implementation. After each teacher had implemented both function and non-function-based interventions, the first author reviewed the graphed data using visual analysis to determine the most effective intervention. The Head Start teachers were then taught to implement the function-based intervention, which was the most effective intervention for all three child participants. The researcher met with each teacher individually and taught the teacher how to implement FCT using written and verbal instruction, role-play, and a procedural fidelity checklist. Following this initial training, the teachers implemented the function-based intervention in the

classroom. Throughout each session, the researcher coached the teacher by providing verbal prompts following a 5-s time delay if an intervention step was not initiated and by providing specific praise to the teacher at the end of the session. Teachers also had the procedural checklist of intervention steps printed and in view during the sessions.

Social validity assessment. Following the completion of the study, teachers were asked to complete a 16-item social validity rating scale on the use of TBFAs in Head Start classrooms. The scale was modified from the Treatment Acceptability Rating Form–Revised (Reimers, Wacker, Cooper, & de Raad, 1992). The Likert-type scale ranged from 1 to 6 in which 1 indicated *strongly disagree* and 6 indicated *strongly agree*. The total possible score was 96 points. We used reverse-scoring for negatively keyed items to assist in interpreting results so that the higher the overall sum of ratings, the higher the teacher's acceptability of TBFA. Scale items included statements such as "I find this assessment strategy to be acceptable," "I believe this assessment strategy would be disruptive to our center," and "This assessment strategy will fit into our existing classroom routines." In addition, teachers were given the opportunity to respond in writing to open-ended written questions relating to the TBFA process and the function-based intervention. Examples of open-ended questions include "Did you feel like you understood the functional assessment process?" and "Did you observe behaviors improving as a result of the function-based intervention?"

Results

FBA

Data from direct observation (using the FAOF) and indirect assessment (using the MAS) were analyzed to determine potential predictors for challenging behavior and potential functions of challenging behavior for each child. Juan's FAOF data revealed that his challenging behavior occurred during transitions (26% of instances) and during interruptions of play with toys (74% of instances). For each instance of challenging behavior, the perceived function was to access a preferred tangible (100% of instances). Taken together, Juan's FAOF indicated a potential tangible function. The teacher completed MAS identified escape (17 points), and access to tangible (14 points) as the most likely functions of challenging behavior.

FAOF data on Laylana's challenging behavior identified the following predictors: removal of teacher attention (33% of instances of challenging behavior), transitions (28% of instances), demands (22% of instances),

interruptions of activities (11% of instances), and no access to a desired item/activity (6% of instances). Her perceived functions for challenging behaviors according to the FAOF were to access attention (60% of instances), escape from demands/requests (27% of instances), and to access a desired item/activity (13% of instances). Laylana's teacher completed MAS for object destruction indicated high scores on tangible (score of 19), attention (score of 17), sensory (score of 16), and escape (score of 14). Her MAS for aggression had high scores for attention (score of 19), tangible (score of 17), and escape (score of 15), whereas the sensory function had a total score of 7. In summary, Laylana's initial FBA indicated challenging behavior maintained by multiple functions: attention, tangible, and escape. The TBFA served as a means of clarifying these ambiguous results.

The predictors of Tom's challenging behaviors in the FAOF were transitions (20% of instances) and interruption of activities (80% of instances). The perceived functions included access to a desired item/activity (80% of instances) and access to attention (20% of instances). Tom's teacher completed the MAS for screaming and object destruction and provided scores of 21 (tangible), 13 (escape), 8 (attention), and 6 (sensory). In summary, Tom's initial FBA indicated challenging behavior maintained by multiple functions: attention, tangible, and escape. The TBFA served as a means of clarifying these ambiguous results.

TBFA

The results of the TBFA are presented in Figure 1. The TBFA for each child consisted of a total of 30 trials (10 trials per condition for three conditions (attention, escape, tangible) and occurred over the span of 9 days for Juan, 13 days for Laylana, and 5 days for Tom. Challenging behavior did not occur during any control components of the TBFA conditions with the exception of the escape condition for Laylana in which challenging behavior was observed for 10% of trials. The overall absence of challenging behavior during control components and the presence of challenging behavior in at least one test condition suggest that the TBFA trials did capture and manipulate relevant establishing operations associated with challenging behavior for all participating children.

Across all participants, challenging behavior occurred for the highest percentage of trials in the tangible test condition (60% of trials for Juan, 90% of trials for Laylana, and 40% of trials for Tom). Juan engaged in challenging behavior for 20% of the test components of the escape condition. Laylana also displayed challenging behaviors in 30% of escape test conditions and 10% of attention test and escape control conditions. Tom only engaged in

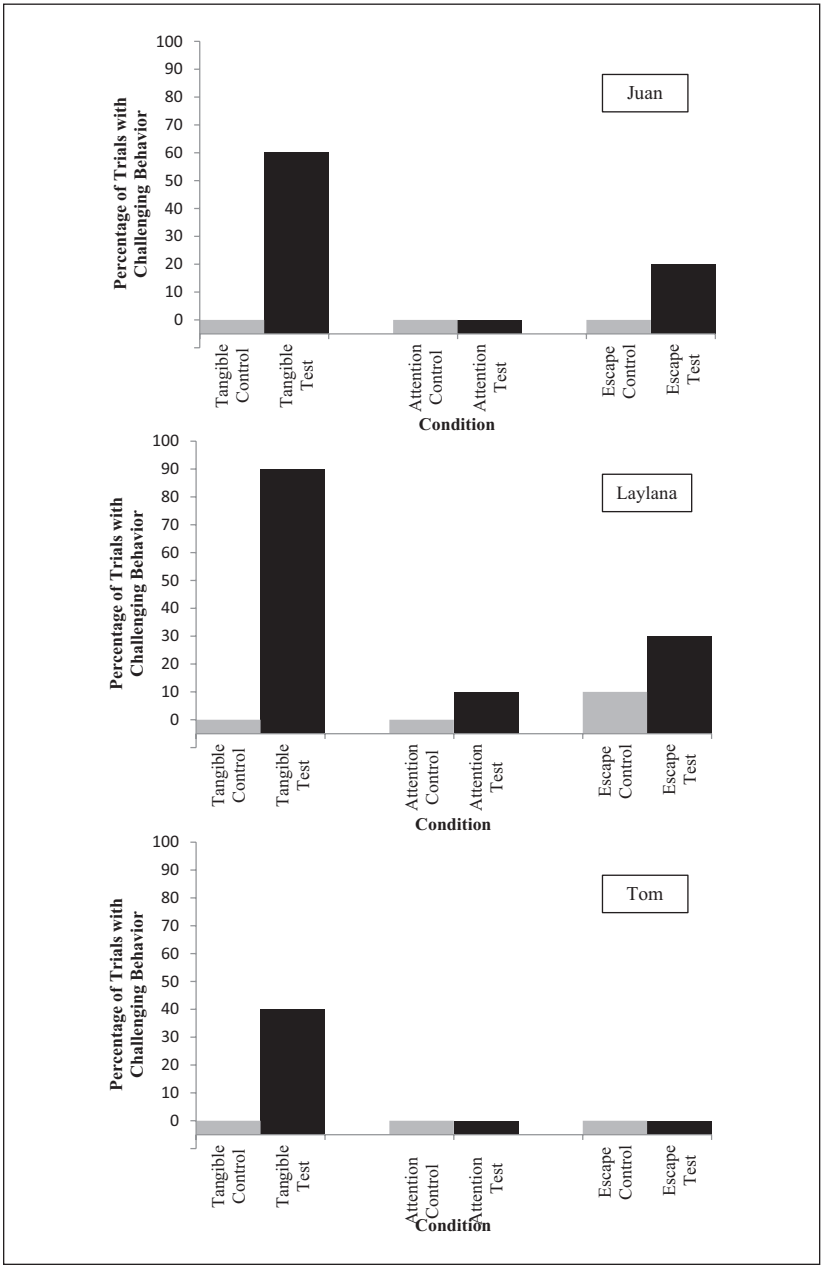

Figure 1. Trial-based functional analysis results.

challenging behavior during the test component of the tangible condition. These TBFA results suggest a primary function of access to tangibles for each child's challenging behavior.

Intervention Comparison

Results of the intervention comparison portion of the study are displayed in Figure 2. The rates of challenging behavior and appropriate functional communication in each condition are presented for Juan, Laylana, and Tom, respectively. All participants engaged in the lowest levels of challenging behavior and highest levels of functional communication during the function-based intervention, FCT. These effects on both child outcome variables generalized to the teacher implemented function-based intervention condition for all three participants. Results for each participant are presented below.

During baseline, Juan engaged in high rates of challenging behavior (M = 2.4 per minute, range = 1.4-2.8 responses per minute). Juan's mean rate of functional communication per minute was 0.1 (range = 0.0-0.4). With the introduction of the non-function-based intervention, Juan's challenging behavior remained high (M = 2.4 challenging behaviors per minute, range = 1.4-3.4) and functional communication remained low (M = 0.04 per minute, range = 0.0-0.2). During the return to baseline condition, Juan's mean instances of challenging behavior per minute were 1.5 (range = 1.0-2.0) and he did not use appropriate functional communication. With the introduction of the function-based intervention (FCT), Juan's challenging behavior dropped to a mean of 0.4 responses per minute (range = 0.0-0.8) and his use of appropriate functional communication increased to a mean of 1.9 responses per minute (range = 1.4-2.8). These changes in both dependent variables persisted during the teacher implemented function-based intervention condition with mean of 0.2 challenging behaviors per minute (range = 0.0-0.4) and a mean of 2.3 functional communication requests per minute (range = 1.4-3.4).

Laylana's data are depicted in the second panel of Figure 2. Laylana's challenging behavior occurred at a mean rate of 1.3 instances per minute (range = 1.0-1.8) in baseline with no instances of functional communication. Following baseline, Laylana was exposed to the FCT intervention. During this intervention, challenging behavior dropped to a mean rate of 0.08 challenging behaviors (range = 0.0-0.4) and her use of functional communication increased to a mean of 1.8 functional communication request per minute (range = 1.2-2.0). In the return to baseline phase, mean rate of challenging behavior was 1.4 per minute (range = 0.6-2.0) with functional communication occurring at a rate of 0.7 per minute (range = 0.4-1.0). Laylana was then

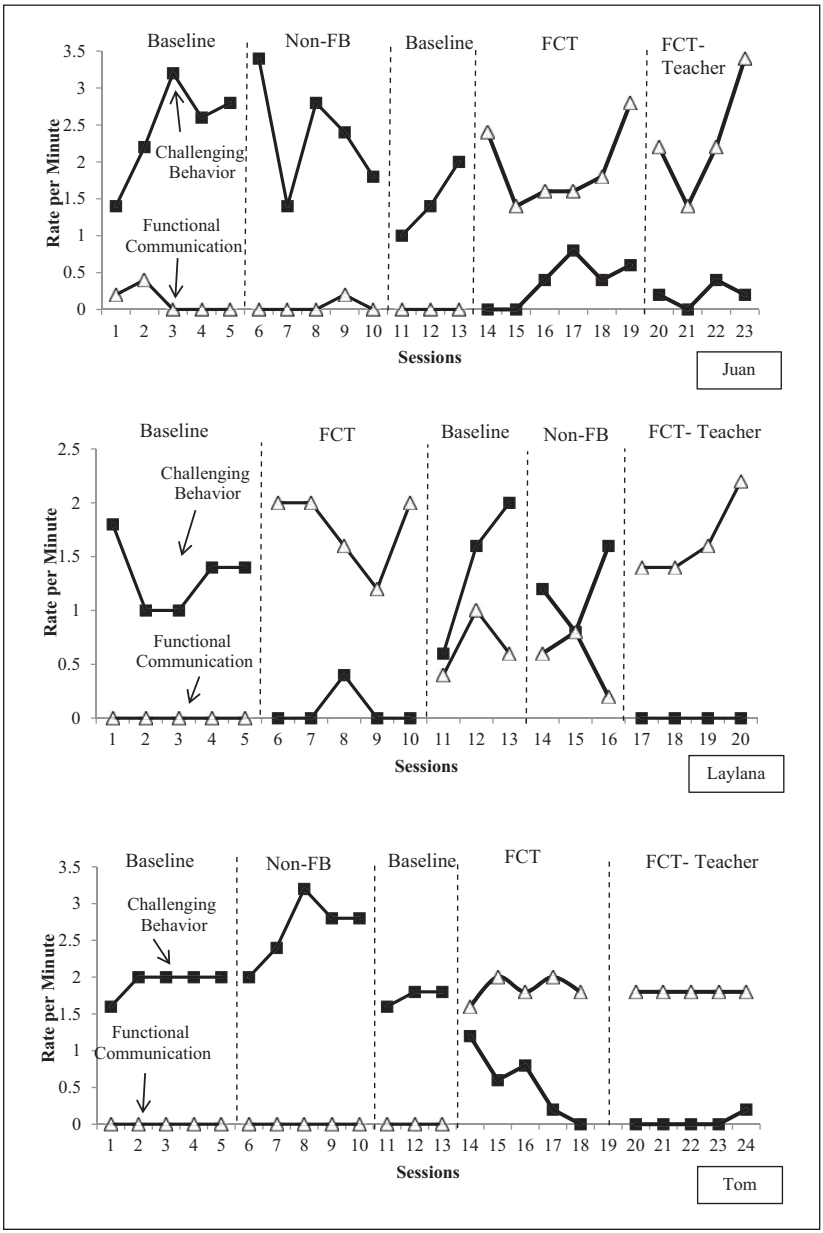

Figure 2. Rate per minute of child challenging behavior and functional communication during non-function (Non-FB)- and function-based interventions.
Note. FCT = functional communication training.

exposed to the non-function-based intervention. During this intervention, Laylana's mean rate of challenging behavior was 1.2 per minute (range = 0.8-1.6) while functional communication occurred at a relatively lower mean rate of 0.5 per minute (range = 0.2-0.8). When Laylana's teacher implemented the FCT intervention, Laylana had no instances of challenging behavior and engaged in functional communication at a mean rate of 1.7 responses per minute (range = 1.4-2.2).

Tom's data are presented in the bottom panel of Figure 2. During baseline, Tom engaged in challenging behavior at a mean rate of 1.9 behaviors per minute (range = 1.6-2.0) with no instances of functional communication. Tom's first intervention phase was non-function-based intervention. During this intervention, Tom's challenging behaviors increased relative to baseline to a mean rate of 2.6 per minute (range = 2.0-3.2) with no occurrences of functional communication. In the return to baseline phase, challenging behaviors occurred for a mean of 1.7 per minute (range = 1.6-1.8) with no functional communication. During the FCT intervention, Tom's challenging behaviors decreased to a mean rate of 0.6 per minute (range = 0.0-1.2) with descending trend while functional communication occurred at a mean rate of 1.8 per minute (range = 1.6-2.0). When Tom's teacher implemented the FCT intervention, Tom's challenging behavior remained low (M = 0.04, range = 0.0-0.2) and his use of functional communication was 1.8 responses per minute for all sessions.

Tau effect sizes across dependent variables are presented in Table 1. Under FCT (i.e., function-based intervention), in comparison with the prior adjacent baseline phase, Tau effect sizes reached statistical significance across participants for both reduced challenging behavior and increased functional communication. Non-function-based intervention did not result in statistically significant reductions in challenging behavior or increases in functional communication for any participants. For Tom, challenging behavior increased with statistical significance in response to non-function-based intervention, relative to the prior baseline.

Social Validity

At the conclusion of the study, teachers were asked to complete a social validity rating scale on the use of TBFAs in Head Start classrooms. The mean score was 68 from a possible 96 points. Total scores were 70 for Darlene, 62 for Kaitlin, and 79 for Katisha. Aspects of the TBFA process that the teachers supported included (a) the importance of determining functions of challenging behavior, (b) their willingness to adjust the classroom as needed to conduct the TBFA, (c) the fit between the TBFA and the existing classroom

Table 1. Tau Effect Sizes Between Baselines and Adjacent Treatment Conditions for Laylana, Juan, and Tom.

	Challenging behavior		Functional communication	
Condition	Tau	90% CI	Tau	90% CI
Laylana				
Function-based	−1.0**	[−1.63, −0.37]	1.0**	[0.37, 1.63]
Non-function-based	0.22	[−1.06, 0.62]	0.22	[−1.06, 0.62]
Juan				
Function-based	−1.0*	[−1.71, −0.29]	1.0*	[0.29, 1.71]
Non-function-based	−0.04	[−0.67, 0.59]	−0.24	[−0.87, 0.39]
Tom				
Function-based	−1.0*	[−1.74, −0.26]	1.0*	[0.26, 1.74]
Non-function-based	0.84*	[0.21, 1.47]	0.00	[−0.63, 0.63]

Note. CI = confidence interval.
*p < .05. **p < .01. ***p < .001.

routines, and (d) the limited amount of time the assessment takes to complete. They also identified aspects of the TBFA process which they had concerns over. These included (a) the likelihood of triggering challenging behavior and (b) disruption to the classroom. During the open-ended questions, two teachers reported they would have liked the TBFA sessions to be conducted more quickly to get to intervention faster. One teacher expressed concern with reinforcing the challenging behavior by providing access to the preferred object during the tangible condition. Teachers stated a major strength of the TBFA was that it allowed them to understand which social functions were related to challenging behavior. Teachers also reported noticing the child's behavior improve with intervention. All three teachers commented they were excited to see that other children in the classroom began imitating the functional communication phrase of "My turn" without direct teaching.

Discussion

There is a critical need to develop individualized behavior supports at the preschool level. TBFA represents an important innovation for developing function-based interventions for children with challenging behavior. Our first research question was to evaluate the effects of training on TBFA implementation with Head Start teachers. To answer this question, three Head Start teachers were trained to implement a TBFA during typical classroom routines and activities for children identified as being non-responsive to program-wide

support. The study successfully demonstrated that teachers could implement the TBFA with 100% fidelity during ongoing classroom routines. The current study replicates and extends previous research on training Head Start teachers to implement TBFA (Rispoli et al., 2015) by demonstrating that results obtained through these TBFAs accurately identified the function of children's challenging behavior.

Our second research question was to evaluate the accuracy of the TBFA results by comparing an intervention based on these results with a non-function-based intervention on challenging behavior and replacement behaviors of young children. We then evaluated whether the more effective intervention remained effective when the Head Start teacher served as the interventionist. For each child participant, challenging behavior decreased the most during the function-based FCT intervention suggesting it was more effective than the non-function-based intervention. The FCT intervention matched the function of challenging behavior (access to preferred tangibles) while the other intervention did not. However, the non-function-based intervention was based on universal supports and FCT based on a model of tertiary supports (intensive and individualized intervention). It is possible that the mechanism of action for the decrease in challenging behavior was not the function matching nature of FCT, but instead the intensity of the intervention. If this were the case, then these results may indicate challenging behaviors were simply non-responsive to universal supports and that more intensive and individualized supports were necessary.

Across all three child participants, challenging behavior decreased and use of the functional communication replacement behavior increased under the FCT condition. For Juan and Laylana, the data show an increasing trend in their use of the replacement response in the teacher implemented FCT condition. High rates of the replacement behavior are common following initial FCT due to dense schedules of reinforcement (Fisher et al., 1993). However, such schedules may not be feasible or acceptable in applied settings. Therefore, FCT often requires systematic intervention to thin the schedule of reinforcement to reduce the child's use of the response (Fisher, Greer, Querim, & DeRosa, 2014). Research should evaluate the effects of a training package to teach Head Start teachers to systemically reduce the overuse of a replacement response for challenging behavior.

Our fourth research question was to explore the social validity of the TBFA process by gathering input from participating teachers. Teachers reported positive views of acceptability, feasibility, and success of the function-based intervention on child challenging behavior and replacement behaviors. This result is encouraging with respect to the future of function-based interventions for challenging behavior in preschool settings. However,

teachers also expressed concerns with aspects of the TBFA process related to evoking challenging behavior, which may disrupt classroom routines, and reinforcing challenging behavior in front of other children. Research is needed to modify the TBFA model so that it is more acceptable to early childhood teachers with minimal prior exposure to principles of behavior analysis. Researchers should continue to develop and refine professional development packages to better illustrate how the FBA process contributes to effective, function-based interventions.

The results of this study highlight the value of including preschool teachers in the FBA process. Teachers with very little prior training in challenging behavior prevention learned to implement the TBFA procedures with 100% fidelity within fewer than five trials. The TBFA itself took less than 60 min overall to complete, and was split into trials which were each no more than 2 min. In all three cases, the TBFA led to the identification of a function of behavior within 1 to 2 weeks. This result is in contrast to the typical duration of current FBA practices within the participating Head Start programs, which can last about 4 weeks from referral for assessment to FBA completion. Head Start mental health professionals in the participating programs reported that the current practice for FBA involves a single, brief observation of the child and does not include teacher input and that traditional functional analysis are rarely conducted. A reduced time frame for the TBFA may allow for children to access intervention more quickly and efficiently than under less systematic FBA formats, which often lead to trial-and-error intervention development (Alter et al., 2008). Furthermore, the active involvement of the teacher in the TBFA process may lead to interventions that are a better contextual fit with the classroom environment.

A main objective of this study was to explore involving teachers in meaningful ways in the FBA process. The results of this study are promising in this regard and in terms of building capacity within preschool settings to assess and prevent challenging behavior. By involving teachers in conducting aspects of an FBA, such as a TBFA, the FBA process may be expedited. In current practice, teachers often have to rely on the busy schedules of itinerant professionals to conduct the FBA. When outside professionals directly observe child behavior, there is also the risk of reactivity on the part of the child (Kazdin, 1979) which can lead to misidentification of the function of behavior. By teaching classroom teachers to conduct TBFAs, contextual variables within the natural environment may be more accurately identified, leading to more accurate FBA results and reduced latency to effective intervention.

In the current study, teachers were trained to implement FCT, which not only decreases challenging behavior but also teaches and reinforces a replacement behavior. This allowed the teachers to focus on and respond to

appropriate behavior, rather than relying on punishment or coercion to decrease inappropriate behavior. Anecdotal observations revealed positive social interactions during the teacher implemented FCT condition. Both teacher and children tended to have positive affect, and teachers were likely to provide positive touch to children (fist bumps, pats on back, hugs). Future research should explore the impact of professional development on the characteristics of teacher–child interactions.

Limitations

One limitation of the study is that all three children engaged in tangibly maintained challenging behavior. Future research should replicate these procedures with children who engage in behavior maintained by other social functions. Second, while teachers were taught to collect data during TBFAs, we did not systematically assess their acquisition of these skills. Future research is needed to determine whether Head Start teachers can simultaneously conduct a TBFA with fidelity and collect reliable data on child behavior. These skills would assist in improving the capacity of preschool teachers to implement TBFAs.

Future Research

The teachers self-reported several aspects of the TBFA process which they liked and were willing to implement; however, they also identified several concerns which warrant future research. In particular, teachers expressed concerns with triggering and reinforcing challenging behavior in the classroom during the TBFA trials. Their concerns were not only for reinforcing the child's challenging behavior but also in allowing this to serve as a potential model for other children to imitate. Future research is needed to determine how professional development packages can better facilitate teacher understanding of current schedules of reinforcement in the classroom for challenging behavior as well as the rationale for altering specific antecedents and consequences for challenging behavior as part of the TBFA process.

The role of Head Start teachers within the TBFA model of functional analysis requires additional attention and discussion. To date, it is unknown whether Head Start teachers can design TBFAs and accurately analyze results independently. Without the skills to design and analyze TBFA, teachers must still rely on other professionals, which could impede the efficiency of the assessment model. However, professionals with technical expertise in behavior analysis may be necessary given the complexity of identifying and manipulating establishing operations for challenging behavior. This issue highlights

a current tension within the field between the view that behavior analysis should be "given away" versus the view that behavior analytic interventions should be implemented by only those with specific and extensive training and skills.

We propose that there may be a middle ground between these two positions which aligns with the "bidirectional approach" of implementation science as described by Fixsen, Naoom, Blasé, Friedman, and Wallace (2005) and Odom, Cox, and Brock (2013). In the current study, the research staff and the teachers formed a collaborative partnership in which they worked together to design the TBFA. The research staff brought the expertise in behavior analysis (top-down approach), and the teachers brought the expertise in the structure of the classroom, the child's challenging behavior, and the feasibility of the proposed TBFA design (bottom-up approach). The teacher conducted the TBFA trials, but the research staff analyzed the results. Such a collaborative teaming model would allow for teachers to be meaningful contributors to the FBA process without going beyond their knowledge and skills relating to challenging behavior. Future research should evaluate the feasibility of collaborative teaming on the implementation of TBFAs in classroom settings.

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