TEACHER IMPLEMENTATION OF TRIAL-BASED FUNCTIONAL ANALYSIS AND FUNCTION-BASED INTERVENTIONS FOR STUDENTS WITH CHALLENGING BEHAVIOR

by

Susan Dagenhart Flynn

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Approved by:

_____
Dr. Ya-yu Lo

_____
Dr. David W. Test

_____
Dr. Charles L. Wood

_____
Dr. Pamela Lassiter

ABSTRACT

SUSAN DAGENHART FLYNN. Teacher implementation of trial-based functional analysis and function-based interventions for students with challenging behavior. (Under the direction of DR. YA-YU LO)

Children and youth with autism spectrum disorders (ASD) or emotional and behavioral disabilities (E/BD) often exhibit challenging behavior including aggression, self-injury, non-compliance, or property destruction (Kamps, Kravits, Rauch, Kamps, & Chung, 2000; National Autism Center, 2009). As a result, students with ASD or E/BD often miss out on critical opportunities for learning due to their challenging behavior.

Fortunately, the literature provides information on the effectiveness of functional behavioral assessment (FBA) to assess or reduce challenging behavior and increase appropriate behavior of children and youth with ASD or E/BD (e.g., Hanley, Iwata, & McCord, 2003; Horner, Carr, Strain, Todd, & Reed, 2002; Lane, Kalberg, & Shepcaro, 2009; Simpson, 2005). Functional analysis (FA), conducted as a component of FBA or alone, is specifically used to identify the function of targeted challenging behavior via a systematic experiment. The literature suggests the importance of FA as a more valid method than indirect methods or descriptive analyses in identifying behavioral functions (Asmus, Vollmer, & Borrero, 2002). FA is the only method that can demonstrate a causal relationship between an antecedent stimulus or reinforcer and a behavior (Asmus et al., 2002); however, FA is rarely used in school settings. A possible reason is associated with the complexity of FA procedures (e.g., manipulating stimuli accurately) and time constraints. To address these issues, many variations to the standard FA have been made, including trial-based FA (i.e., TBFA).

In addition to the need for accurately identifying the function of students' challenging behavior, there is also a critical need for the design and implementation of function-based interventions (FBI) for students in school settings (Scott & Kamps, 2007). Interventions based on behavioral functions are essential in educational settings, especially for students with ASD or E/BD due to their susceptibility to receive disciplinary actions because of their challenging behavior. In order for FBI to be effective in addressing challenging behavior, research on FA and professional development for special education teachers is crucial.

The current study used a multielement research design (Kazdin, 1982) to determine the function of six student participants' challenging behavior using TBFA in the classroom setting. Data on teacher participants' acquisition of skills learned after TBFA and FBI training and performance feedback, and their effect on students' challenging and replacement behaviors were evaluated using a multiple-probe-across-participants research design (Horner & Baer, 1978) in the classroom setting. Findings indicated that all three teacher participants were able to implement TBFA during TBFA with feedback conditions and FBI during FBI with feedback conditions with high procedural integrity. In addition, two of three teachers maintained high procedural integrity during generalization measures. Findings also indicated a reduction in students' challenging behavior and an increase in replacement behavior after training. Finally, social validity data suggested teachers felt that TBFA and FBI had an overall positive impact on student behavior. Limitations of the study, suggestions for future research, and implications for practice are also discussed.

DEDICATION

I would like to dedicate this dissertation to three people I love more than life itself and who have sacrificed the most the past three years. To my husband and best friend, Kris, I thank you for supporting my dream and believing in me. Without your love and friendship this would not have been possible. I would also like to dedicate this dissertation to my sons, Liam and Evan. You mean the world to me, and I hope that you know how proud I am of you.

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CHAPTER 1: INTRODUCTION

Statement of the Problem

Behavioral challenges of students with autism spectrum disorders or emotional and behavioral disabilities. Children and youth with autism spectrum disorders (ASD) or emotional and behavioral disabilities (E/BD) often exhibit challenging behavior including aggression, self-injury, non-compliance, or property destruction (Kamps, Kravits, Rauch, Kamps, & Chung, 2000; National Autism Center, 2009). Without appropriate interventions, these challenging behaviors will persist and likely worsen. In addition, these behaviors hinder opportunities for inclusion in the general education setting for students with ASD or E/BD (Emam & Farrell, 2009; Niesyn, 2009). Students' challenging behavior is a major teacher stressor (Dorman, 2003); and teachers who are stressed are likely to handle challenging behavior less effectively (Kokkinos, Panyiotou, & Davazoglou, 2005). As a result, students with ASD or E/BD often miss out on critical opportunities for learning due to their challenging behavior.

Fortunately, previous research provides information on the effectiveness of several behavioral assessments and interventions to assess or reduce challenging behavior and increase appropriate behavior of children and youth with ASD or E/BD, including functional behavioral assessment, differential reinforcement, extinction, and functional communication training (Hanley, Iwata, & McCord, 2003; Horner, Carr, Strain, Todd, & Reed, 2002; Lane, Kalberg, & Shepcaro, 2009; The National Professional Development

Center on Autism Spectrum Disorders, n.d.; Reid & Nelson, 2002; Simpson, 2005). Functional behavioral assessment (FBA) helps researchers and practitioners identify consequences triggering and maintaining challenging behavior leading to an intervention designed to specifically address the function of behavior (O'Neill et al., 1997). Components of the FBA include indirect methods (e.g., interviews), descriptive analyses (e.g., direct observations), and functional analysis.

Use of functional analysis to address challenging behavior. Functional analysis (FA), conducted as a component of FBA or alone, is specifically used to identify the function of targeted challenging behavior via a systemic experiment. The literature suggests the importance of FA as a more valid method than indirect methods or descriptive analyses in identifying behavioral functions (Asmus, Vollmer, & Borrero, 2002). FA is the only method that can demonstrate a causal relationship between an antecedent stimulus or reinforcer and a behavior (Asmus et al., 2002). The basic process of an FA involves presenting and withdrawing different environmental stimuli during brief (i.e., 10-15 min) test conditions to observe how the stimuli affect an individual's behavior (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). The experiment also involves evoking and reinforcing that challenging behavior by creating an establishing operation (EO), with the presentation of a possible reinforcer. Consistent increases of a target behavior during an FA are typically thought of as sufficient evidence to determine what is evoking and maintaining the challenging behavior.

Despite the accuracy of an FA in identifying the function(s) of a student's challenging behavior, the procedure is rarely used in school settings. A possible reason is associated with the complexity of FA procedures (e.g., manipulating stimuli accurately).

In a literature review of FA methodology, Hanley et al. (2003) found that only 31.4% of studies reviewed were implemented in schools. Also, studies that did involve conducting FA in schools did not collect data on teachers' perceptions of procedures. Social validity is a critical feature in the field of applied behavior analysis; to be an applied study, the behavior being analyzed and changed must be important to the individual and those around him or her (Baer, Wolf, & Risley, 1968; Wolf, 1978). For example, teachers need to feel that behavioral assessment and behavior change procedures are easy to implement and are effective in addressing students' challenging behavior in school settings in order to use them on a consistent basis.

In order to address the issue of complexity associated with FA implementation, researchers have made many variations to FA procedures that have resulted in reduced assessment time (e.g., brief functional analysis; Northup et al., 1991). For example, Northup et al. (1991) modified the standard FA by developing the brief functional analysis (BFA), where one or two 5-min sessions were conducted under test conditions to determine the function of challenging behavior for 3 participants with severe disabilities in a classroom setting. Although successful at determining the function of behavior, teachers were not trained to implement the procedures.

Since Northup et al.'s (1991) study, additional variations to the standard FA have been designed (e.g., Broussard & Northup, 1997; Mueller, Sterling-Turner, & Moore, 2005). For example, Sigafoos and Saggers (1995) conducted the first trial-based FA (TBFA) in a classroom setting with 2 students with challenging behavior. Each trial began with a 1-min test segment (setting up the EO to see if the student exhibited the target behavior, then reinforcing that behavior), and concluded with a 1-min control

segment (providing the student access to leisure items and attention with no academic demands). Although successful at determining the function of behavior for both participants, a noted limitation was that challenging behavior evoked during the test condition carried over into the control condition. Bloom, Iwata, Fritz, Roscoe, and Carreau (2011) extended this study by conducting TBFA with 10 students with developmental disabilities, hearing impairments, and speech delays exhibiting different challenging behavior. Unlike the study by Sigafoos and Saggers, the control condition for each trial was conducted first to avoid carryover of challenging behavior from test to control condition (i.e., from EO present to EO absent). Bloom et al. noted the main benefit of the TBFA is that each trial is brief in duration and is not as disruptive to the classroom routine as the standard FA. However, Bloom et al. indicated longer test conditions than control conditions might improve precision of determining the function of behavior (e.g., 1-min control, then 3-min test). A recommendation for future studies also includes teacher implementation of TBFA in school settings.

To properly assess and address challenging behavior, teachers must be able to operationally define challenging behavior, understand the functional relation between challenging behavior and consequences, and provide antecedents and consequences with high integrity. Without this knowledge, teachers may respond inconsistently to these behaviors, which could hinder the effectiveness of an intervention. Consequently, teachers need training to implement accurate FA and design function-based interventions (FBI) based on FA results.

Current research on effective training of professionals on FA. Training preservice and in-service educators and other professionals who are not behavior analysts to conduct

FA has been a focus of recent research. There have been a small number of studies that illustrated the effectiveness of training individuals (e.g., undergraduate students, teachers) to conduct an FA with high levels of procedural integrity in very little time (e.g., Barretto et al., 2006; Iwata et al., 2000; Moore et al., 2002; Wallace et al., 2004). In these studies, workshops, video demonstrations, role-playing in simulated environments, and performance feedback were demonstrated to be effective components of a training package. However, the majority of these studies did not include generalization measures and data interpretation training (e.g., Iwata et al., 2000; Wallace et al., 2004), or procedural integrity (e.g., Kamps et al., 2006; Moore et al., 2002). Therefore, it remains unknown if teachers can practically use FA procedures in the classroom with multiple students and with high procedural integrity.

Use of function-based interventions to address challenging behavior. Function-based interventions are interventions designed based on the function (e.g., access to preferred tangible, escape from a task) of an individual's behavior rather than on the topography of the behavior (e.g., screaming, self-injurious behavior). The effectiveness of function-based behavioral interventions have been well documented with multiple student populations, including those identified as having developmental disabilities and ASD (e.g., Blair, Umbreit, Dunlap, & Jung, 2007; Brooks, Todd, Tofflemoyer, & Horner, 2003), and students with E/BD (e.g., Heckaman, Conroy, Fox, & Chait, 2000; Lane, Umbreit, & Beebe-Frankenberger, 1999; Reid & Nelson, 2002).

The importance of function-based interventions is well documented. When interventions are selected without considering behavioral function, many issues can arise. Vollmer and Northup (1996) indicated challenging behavior can be inadvertently

strengthened through positive or negative reinforcement, and the intervention might not include alternative replacement behavior that is functionally equivalent to the challenging behavior. Furthermore, interventions based solely on topography of the behavior do not address the function of behavior, and therefore may not be effective in reducing the challenging behavior. For example, a student may bite his hand to escape a task demand, but may also bite his hand to mand inappropriately for a snack. Different interventions would need to be designed and implemented to provide socially mediated negative reinforcement (e.g., escape from task demands) for the former function, or to provide socially mediated positive reinforcement (e.g., access to tangible) for the latter function.

Despite previous research, Scott et al. (2005) indicate that professionals (e.g., teachers) continue to select punitive and exclusionary measures regardless of the function of a student's behavior. The reason for this may be that these measures often serve as negative reinforcers on the part of professionals who want to avoid implementing more time-intensive behavior support plans. As a result, training on function-based intervention design and implementation in schools is critical.

Current research on effective training of professionals on function-based interventions. In addition to the need for accurately identifying the function of students' challenging behavior, there is also a critical need to design and implement function-based interventions for students in school settings (Scott & Kamps, 2007). The maintaining reinforcer identified in an FA can be manipulated to form a function-based intervention to reduce challenging behavior. Further, interventions based on behavioral functions are essential in educational settings, especially for students with ASD or E/BD due to their susceptibility to receive disciplinary actions because of their challenging behavior. IDEA

(2004) stipulates that students who engage in challenging behavior have behavioral supports in place to ensure they make adequate academic progress. This provision of IDEA is intended to provide behavioral support to students with disabilities so they are not at risk for a host of possible negative developmental outcomes, including school failure, peer rejection, delinquency, and antisocial behavior (Van Acker, Boreson, Gable, & Potterton, 2005). Although most teacher education programs in special education train teachers to utilize evidence-based approaches (e.g., applied behavior analysis; ABA) to teach behavioral skills to students with disabilities, the outcome of this training is not so bright. For example, Van Acker et al. (2005) found many teachers' submissions of FBAs and behavior intervention plans (BIPs) displayed serious flaws; the most common being failure to verify the hypothesized function of the behavior before implementing intervention. To successfully assess the function of challenging behavior and design function-based interventions, educators need a strong understanding of human behavior.

Summary

School personnel are in need of training on conducting FA and then designing function-based interventions that are easy to implement, accurate, and effective to address the behavioral needs of their students with ASD or E/BD. Although previous studies show individuals other than behavior analysts are capable of implementing FA procedures, the majority of studies were conducted in simulated settings (e.g., Iwata et al., 2000; Kamps et al., 2006) and not in applied settings. In addition, many studies did not include generalization measures and data interpretation training (e.g., Iwata et al.; Wallace et al., 2004), or procedural integrity (e.g., Kamps et al.; Moore et al., 2002). Finally, only a few studies have focused on including function-based intervention training

along with FA training (e.g., Shumate & Wills, 2010). Clearly, more studies are needed to address these limitations.

Significance of Study

This study provides theoretical and practical training to special education teachers that go beyond their preservice coursework or professional development. Specifically, this study provides teachers with behavioral assessment and data analysis procedures, function-based intervention procedures, and teacher training protocols with students with ASD or E/BD to effectively assess and address their challenging behavior. Students who are being educated by these teachers benefit by receiving best practice recommendations in the field of behavior analysis. In addition, teachers having the skills to conduct behavioral assessments themselves will reduce the time and cost of having behavior analysts or other consultants conduct these assessments for them.

There are several differences between the current study and other similar studies. First, this study includes teachers in implementing TBFA, analyzing results of the TBFA, and designing and implementing the resulting function-based interventions. The results of the TBFA lead to a function-based intervention incorporating strategies to reduce challenging behavior, as well as to teach appropriate replacement behavior. Second, although there is an abundance of research on reducing challenging behavior through functional analysis, most FA research has not included subsequent function-based interventions. The majority of current research on TBFA and resulting interventions has been conducted in analogue settings with limited application in public school settings by teachers without outside support (e.g., behavior analyst consultants). Third, the level of teacher involvement offered in the current study allows teachers to initiate the assessment

process in the absence of a consultant. Too often, effective intervention is delayed due to lack of available resources (specifically teachers who are specially trained to conduct behavioral assessments). Fourth, where teacher involvement has traditionally been limited to participating in the assessment process, this training additionally guided teachers through analysis of data collected to help develop a hypothesis about the behavior being assessed. Finally, the majority of studies conducted on FA and function-based interventions training have not included generalization measures. Generalization data are needed to ensure that teachers' learned skills can be transferred to different students, settings, and behavior to demonstrate mastery of newly acquired knowledge.

Research Questions

The purpose of this study was to determine the effects of training and performance feedback on teachers' reliable implementation of TBFA procedures, accurate analysis of TBFA results, and correct design and implementation of effective FBI for students with ASD or E/BD. The secondary purpose was to measure and evaluate the occurrences of students' challenging behavior and alternative replacement behavior before and during the FBI. This study addressed current research limitations related to teacher implementation of FA procedures, analysis of FA data, design of interventions based on FA results, and teachers' perceptions of FA procedures (Ervin et al., 2001). The following seven research questions were addressed.

1. What was the effect of training and performance feedback on teachers' reliable implementation of TBFA procedures with students with ASD or E/BD in a school setting?

2. What was the effect of training and performance feedback on teachers' reliable implementation of FBI procedures?
3. What was the effect of training and performance feedback on teachers' generalization of learned skills related to TBFA and FBI implementation to new students?
4. What was the effect of teacher-designed and delivered FBI based on the results of a TBFA conducted by teachers on the reduction of students' challenging behavior?
5. What was the effect of teacher-designed and delivered FBI based on the results of a TBFA conducted by teachers on students' use of replacement behavior?
6. What was the effect of training on teachers' reliable identification of behavioral functions and accuracy of data collection during TBFA and FBI?
7. What were the classroom teachers' perspectives on the importance, acceptance, and effectiveness of the TBFA procedures and the subsequently designed FBI plans?

Limitations/Delimitations

This study sought to examine the effects of training and performance feedback on teachers' ability to implement TBFA procedures, to analyze the TBFA results, and to consequently design effective function-based interventions for their students with ASD or E/BD. It is important to define the limits of the current study so readers may interpret results from this study accurately. First, this study was only conducted with special education teachers, which affects the ability to generalize results to general education

teachers or other school personnel. A second limitation is that this study only addressed the behavioral needs of students with ASD or E/BD, which affects the ability to generalize findings to students with other disabilities or students without disabilities.

Definition of Terms

Terms that were used in the study and their definitions are presented in the following section. The terms chosen are critical for understanding the implementation procedures and observed results.

Applied behavior analysis (ABA): the scientific application of operant behavior principles to improve an individual's life (Baer, Wolf, & Risley, 1968).

Automatic reinforcement: reinforcement related to a response that is usually produced automatically by the response, or that is not mediated by the deliberate action of another (Catania, 2007; Vaughan & Michael, 1982). This can take the form of automatic positive reinforcement (the response is reinforced by the individual, usually when there is inadequate reinforcement from others available in the environment), or automatic negative reinforcement (a response by the individual to remove pain or internal discomfort, such as an earache or headache).

Behavioral function: event that motivates, occasions, and reinforces a response class (Catania, 2007).

Brief functional analysis (BFA): a modified version of the standard functional analysis (Iwata et al., 1982/1994) that includes fewer test conditions, single data points for each condition, repeated conditions containing the highest and lowest rates of challenging behavior to verify information provided by the single data points for each condition, and a contingency reversal (Northup et al., 1991).

Discriminative stimulus (S^D): a stimulus that influences the occurrence of a response because of the contingencies of schedules of reinforcement or paradigms of reinforcement/punishment that are or have been associated with that response. The S^D signals the availability of reinforcement (Cooper, Heron, & Heward, 2007).

Establishing operation (EO): an environmental variable that increases the current reinforcing effectiveness (value-altering) of a stimulus and increases the current frequency of (evocative effect) of behavior that has obtained that stimulus in the past (Michael, 1982).

Extinction: the operation of discontinuation of the contingency between the response and the reinforcer (Catania, 2007; Iwata et al., 1993).

Functional analysis (FA): a behavioral assessment that involves presenting and withdrawing different environmental events during brief (i.e., 10-15 min) test conditions to observe how they affect an individual's behavior (Iwata et al., 1982/1994). The standard FA is usually conducted in an analogue (i.e., contrived) setting to maintain experimental control.

Functional behavioral assessment (FBA): a process that identifies consequences triggering and maintaining challenging behavior with a resulting intervention designed to address the function of behavior (O'Neill et al., 1997). Components include indirect methods (e.g., interviews, rating scales), descriptive analyses (e.g., direct observations), and functional analyses.

Function-based intervention (FBI): an intervention designed to specifically address the function of a behavior determined in a functional behavioral assessment.

Generalization: the spread of the effects of reinforcement, extinction, or punishment during one stimulus to other stimuli differing from the original along one or more dimensions (Catania, 2007). It is the occurrence of a behavior in a non-training condition (e.g., across settings, people, behavior; Stokes & Baer, 1977).

Mand: a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of an establishing operation (Skinner, 1957).

Procedural integrity: the extent to which a procedure (e.g., behavioral assessment, intervention) is applied exactly as planned and described and no other unplanned variables are administered inadvertently along with the planned procedure (Cooper et al., 2007).

Reinforcer: a consequent stimulus that increases or maintains the future likelihood and/or rate of occurrence of a behavior (Catania, 2007).

Response class: a class of responses that includes two or more topographically different behavior, which have the same effect on the environment (Carr, 1988).

Socially mediated positive reinforcement: when a response is reinforced by the delivery of positive reinforcement by another person (e.g., attention, tangible; Smith, Iwata, Vollmer, & Zarcone, 1993).

Socially mediated negative reinforcement: when a response is reinforced by the removal of aversive stimuli by another person (e.g., escape; Smith et al., 1993).

Tact: verbal behavior that is under the control of the nonverbal environment and includes nouns, actions, adjectives, pronouns, relations, and others (Skinner, 1957). A tact is a label of something in the environment or vocabulary.

Trial-based functional analysis (TBFA): a variation of the standard FA where each condition is presented in a trial format (i.e., stimulus, response, and reinforcement) with a control segment. Each condition (trial) lasts in duration between 2 and 4 min, with the trial terminated once the response is exhibited and reinforcement is delivered (Bloom et al., 2011; Sigafoos & Saggers, 1995).

CHAPTER 2: REVIEW OF THE LITERATURE

Assessing problem behavior and designing function-based interventions for students with ASD or E/BD has been a challenge for educators for some time. Children and youth with ASD or E/BD commonly engage in challenging behavior including self-injury, aggression, stereotypy, or property destruction (e.g., Conroy, Dunlap, Clarke, & Alter, 2005; Horner, Carr, Strain, Todd, & Reed, 2002; McClintock, Hall, & Oliver, 2003). Without appropriate interventions, challenging behavior has a propensity to persist over time and can restrict educational and social opportunities (e.g., Murphy, Beadle-Brown, Wing, Gould, Shah, & Holmes, 2005). Further, challenging behavior can hinder teachers' instruction (Carr, Taylor, & Robinson, 1991), and teachers report increased levels of "emotional burnout" when challenging behavior is addressed ineffectively (Hastings & Brown, 2002).

The importance of appropriate intervention design and implementation is highlighted in IDEA (1997, 2004) by requiring implementation of a functional behavioral assessment (FBA) and subsequent design of a behavior intervention plan (BIP) or modification of an existing BIP for students with disabilities who engage in challenging behavior that interfere with their learning or the learning of other students. However, IDEA does not provide guidance on what the FBA process should involve and each state has interpreted this requirement differently (Weber, Killu, Derby, & Barretto, 2005). As a

result, states have implemented FBAs that include one or more of the following procedures: direct observation and description of the challenging behavior and ecological context; review of records; use of checklists regarding environmental circumstances; interview of student and others; team meetings; scatterplot recording; antecedent-behavior-consequence (ABC) analysis; experimental functional analysis; reinforcer assessments; and development of a hypothesis regarding causes of challenging behavior. Luckily, a considerable literature base provides information regarding the implementation and effectiveness of FBA procedures and interventions to decrease challenging behavior of children and youth with ASD or E/BD (Conroy et al., 2005; Didden, Duker, & Korzilius, 1997; Hanley, Iwata, & McCord, 2003; Horner et al., 2002; Kates- McElrath, Agnew, Axelrod, & Bloh, 2007; Scotti, Evans, Meyer, & Walker, 1991). The implementation of an accurate FBA might be considered the most important step in addressing challenging behavior, because interventions are more effective when created based on the results of an FBA (Didden et al., 1997). Not surprisingly, IDEA 2004 requires schools to have trained staff available to conduct FBAs and design and modify BIPs.

The need to conduct an FBA in school settings is increasing as the number of behaviorally diverse students increases in schools. One of the reasons for this increase is due to the mainstreaming and full inclusion of children with developmental disabilities and severe behavior problems (Scott et al., 2004). Another reason pertains to accountability. Anytime that educators have concerns about the behavior of a student with a disability, they are mandated by IDEA to implement the FBA process to determine why the student is demonstrating this behavior. By determining the purpose of the

behavior, educators can then design interventions to help the student exhibit more appropriate behavior that will meet his or her needs or desires (the "function" of the behavior).

One important component of the FBA is the functional analysis (FA), in which antecedents and consequences are manipulated to indicate their separate effects on the behavior of interest. Bijou, Peterson, and Ault (1968) noted that only an FA can actually provide information on the functional relations among the variables being studied (e.g., social contingencies). However, most often teachers utilize indirect methods due to their ease of use, and tend to have limited competence in conducting FA (Ellingson, Miltenberger, & Long, 1999). Therefore, teachers learning to implement FA and function-based interventions may require intensive training and support (Addison & Lerman, 2009; Applegate, Matson, & Cherry, 1999; Campbell & Halbert, 2002; Johnston & O'Neill, 2001; Kehle & Bray, 2004). This review of the literature will focus on five major themes, including: (a) students with ASD or E/BD and challenging behavior, (b) functional analysis, (c) teacher training in functional analysis, (d) function-based interventions, and (e) teacher training in function-based interventions.

Students with ASD or E/BD and Challenging Behavior

Although individuals with any disabilities may exhibit challenging behavior to some degree, students with ASD or E/BD are in greater jeopardy of exhibiting high levels of challenging behavior due to the nature of their disabilities. Students with ASD have been found to have fewer social and communication skills (e.g., O'Neill & Happé, 2000; Sigman & Ruskin, 1999), more behavior problems (Eisenhower, Baker & Blacher, 2005), and less behavioral flexibility (Didden et al., 2008). In addition, many students with

E/BD are found to be behaviorally disruptive, noncompliant, verbally abusive, and physically aggressive (Reid, Gonzalez, Nordness, Trout, & Epstein, 2004). These behaviors can significantly impair the ability of students with ASD or E/BD to benefit from educational opportunities and to succeed both in school and in society.

Students with Autism Spectrum Disorders

ASD is a group of developmental disabilities under the umbrella term "pervasive developmental disorders" (PDD; DSM-IV-TR; American Psychiatric Association, 2000). ASD is a growing group of disabilities among children. In fact, the Centers for Disease Control and Prevention's (CDC) most recent Autism and Developmental Disabilities Monitoring (ADDM) network data indicate that between 1 in 110 children have an ASD, with an estimated prevalence of about 1%. These results reflect data collected in multiple communities throughout the U.S. in 2006 (CDC, n.d.). ASDs include autism, Asperger's syndrome (AS), Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), Childhood Disintegrative Disorder, and Rett syndrome. Characteristics of the disorders vary, and can range from mild to severe. Regardless of the severity level, there are common characteristics, usually seen before the age of three, including communication delays, social skills delays, and repetitive and ritualistic behavior (i.e., stereotypy; DSM-IV-TR; American Psychiatric Association, 2000).

Students with an ASD have communication deficits that include both vocal-verbal behavior (e.g., spoken) and nonvocal-verbal behavior (e.g., gestures, facial expressions). Delays in language are common, and may include receptive (e.g., ability to follow instructions) and/or expressive (using communication repertoire to tact and/or mand) language deficits. In addition, many students with an ASD exhibit echolalia (e.g., repeat

entire phrases or parts of phrases). Social skills deficits may include the inability to start or finish a conversation appropriately. Joint attention deficits (i.e., inability to share the experience of observing an event) are also noted. Finally, many students with an ASD engage in ritualistic and repetitive behavior. This may include lining up cars by color repetitively, obsessively focusing on one topic of interest (e.g., only talking about planes with others), and exhibiting self-stimulatory behavior (e.g., hand flapping, finger flicking, unintelligible vocalizations).

These deficits may impact the ability of students with ASD to form friendships and learn new concepts in school, and may also encourage bullying by their peers (Van Roekel, Scholte, & Didden, 2010). Further, due to lack of communication skills, these deficits may likely result in challenging behavior. Examples of challenging behavior commonly seen in individuals with an ASD include elopement (i.e., running away), aggression toward others, and self-injury, which often interfere with day-to-day functioning (Taylor & Seltzer, 2011). As a result of these skill deficits and challenging behavior, students with ASD often experience poor post-school outcomes such as unemployment or underemployment (Howlin et al., 2004). Consequently, BIPs are commonly designed to address these challenging behaviors.

Students with Emotional/Behavioral Disabilities

While states differ on how they prefer to label students with E/BD, IDEA uses the term "serious emotional disturbance" and defines it as:

> ... a condition exhibiting one or more of the following characteristics over a long period of time and to a marked degree that adversely affects educational performance –

(a) An inability to learn that cannot be explained by intellectual, sensory, or health factors; (b) an inability to build or maintain satisfactory interpersonal relationships with peers and teachers; (c) inappropriate types of behavior or feelings under normal circumstances; (d) a general pervasive mood of unhappiness or depression; or (e) a tendency to develop physical symptoms or fears associated with personal or school problems. (Individuals with Disabilities Education Act § 300.7[b][9]).

In North Carolina, its legislation uses the term "(serious) emotional disability." The state defines this disability as:

i) a condition exhibiting one or more of the following characteristics over a long period of time and to a marked degree that adversely affects a child's educational performance:

a) An inability to make educational progress that cannot be explained by intellectual, sensory, or health factors.

b) An inability to build or maintain satisfactory interpersonal relationships with peers and teachers.

c) Inappropriate types of behavior or feelings under normal circumstances

d) A general pervasive mood of unhappiness or depression.

e) A tendency to develop physical symptoms or fears associated with personal or school problems.

ii) Serious emotional disability includes schizophrenia. The term does not apply to children who are socially maladjusted, unless it is determined that they have an emotional disturbance under paragraph (b)(5)(i) of this section.

The U.S. Department of Education (2005) indicated about 1% of public school students have an E/BD; however, this number may actually be closer to 5-20% due to the number of students who are never identified (Harry, Hart, Klingner, & Cramer, 2009). Students with E/BD are often categorized as exhibiting two types of behavior: externalizing and internalizing behavior. Students with E/BD exhibiting externalizing behavior (i.e., behavior that the verbal community may see) may display noncompliance to teacher directives, physically or verbally aggressive behavior toward staff and classmates, physical destructiveness toward materials, and self-injurious behavior (e.g., cutting oneself). These students are usually identified as having a Conduct Disorder or Oppositional Defiant Disorder. Students who have internalizing behavior (i.e., private events of which may be hard for the verbal community to shape tacts) can be characterized by "traits," such as withdrawal/isolation from others, sadness, and shyness. These students are usually diagnosed with depression or an anxiety disorder (e.g., Generalized Anxiety Disorder, Obsessive Compulsive Disorder). With either type of behavior, these students often fail to tact their "emotions" or mand reinforcement appropriately. Consequently, they may act in inappropriate ways to communicate (e.g., hit a peer to mand peer attention). By nature of the disability specification, students with E/BD frequently display behavior incompatible with routines and requirements of their classrooms. In fact, students with E/BD are at the highest risk of all disability populations to be suspended or expelled from school (Jolivette, Stichter, Nelson, Scott, & Liauspin, 2000). When the challenging behavior of these students is not addressed in an appropriate way, the likelihood increases for poor academic outcomes, peer rejection, adult mental health issues, and undesirable effects on their families, their service providers, and their

communities (Harry et al., 2009). Due to these challenging behavior, the educational outcomes of students with E/BD is likely poor. For example, 44% of these students drop out of school before graduating (Gage & Lewis, 2010). In addition, poor post-school outcomes for students with E/BD include high rates of unemployment and low participation in postsecondary education (Gage & Lewis). Therefore, BIPs are usually a salient feature of these students' educational programs.

Challenging Behavior as Communicative Acts

Operant Conditioning

Operant conditioning provides an important view in defining challenging behavior. In 1949, Fuller conducted one of the first studies on the application of principles of operant conditioning with humans. The participant was an 18-year-old boy with a profound intellectual disability who was described as being in a "vegetative state." He was unable to roll over and would only lie on his back. Fuller filled a syringe with warm sugar-milk solution and injected it into the participant's mouth every time the boy would move his arm, which he was capable of moving, albeit infrequently. Within only four sessions, the participant was moving his arm at a rate of three times per min (Fuller, 1949). Thorndike's experiments with cats continued the conceptualization of the process (Kimble, 1961). With these experiments, Thorndike learned that in situations where behavior is followed by consequent stimuli that provide satisfaction, those behaviors become correlated with the stimuli and are more likely to happen again in those situations. Skinner (1953) elaborated on the concept by discovering operant behavior consisted of behavior that could be learned during the individual's life (e.g., talking, driving a car, eating with a fork).

Operant learning is based on several ideas. First, behaviors are observable events (e.g., what people say and do). Second, these events can be analyzed in a deterministic fashion, making them lawful (Skinner, 1953). Third, behavior follows a stimulus-response-stimulus (S-R-S) contingency paradigm that has also been referred to as antecedent-behavior-consequence (ABC) or three-term contingency (Skinner, 1953). In other words, stimuli (antecedents) evoke a response, the response is exhibited (behavior), and then a stimulus (consequence) follows. Then, the consequence that follows the behavior either increases (positive or negative reinforcement) or decreases (extinction or punishment) the likelihood of that behavior occurring again in the future under similar antecedent stimuli conditions.

Challenging Behavior Serving Functional and Communicative Features

From the perspective of operant conditioning, all challenging behavior are members of two general functional response classes: positive and negative reinforcement (Iwata et al., 1993). Positive reinforcement indicates that a stimulus is presented, while negative reinforcement indicates that a stimulus is removed. For example, if a challenging behavior results in attention, which in turns reinforces the behavior, the attention is given in a form of positive reinforcement (Mace, Page, Ivancic, & O'Brien, 1986). If an exhibition of challenging behavior results in the removal of an aversive stimulus, it is a negative reinforcer (Iwata et al., 1993). There are also two means for this reinforcement to occur in that reinforcement can be socially mediated or automatic. Socially mediated reinforcement (whether positive or negative) is delivered by another individual, whereas automatic reinforcement occurs when behavior is reinforced by the stimulation it produces, making it independent of the action of others (Vaughan &

Michael, 1982). Automatic reinforcement can be either positive (e.g., self-stimulation to address low stimulation in the environment) or negative (e.g., plugging the ears with one's fingers to remove the aversive sound of the fire alarm). Other types of automatic reinforcers such as primary reinforcers (e.g., food) also exist.

Previous research has demonstrated a relationship between the individual's level of communicative skill and occurrence of challenging behavior (e.g., Carr & Durand, 1985). An exception to this is in the case of automatic reinforcement, which does not rely on communication between individuals. However, with other functions, this relationship suggests that challenging behavior may function as communicative acts to mand specific reinforcers that are socially mediated (Carr & Durand, 1985; Sigafoos & Meikle, 1996). This has implications for designing interventions that are based on function. The key tenet of operant conditioning is that individuals learn from the consequences of their behavior, with behavior being defined as everything the person does, including overt behavior as well as private events such as thoughts and feelings. Consequences are classified in terms of the behavior changes that follow them. Specifically, the primary mode of assessment is analysis of contingencies that appear to control the behavior of interest. An effort is made to systematically determine relationships among antecedents of a behavior, the behavior itself, and its consequences. Through such systemic analysis of behavior and its antecedents and consequences, referred to as functional analysis, an educator can form a hypothesis about contingencies maintaining problem behavior and seek to alter these contingencies effectively. Based on this relationship, the focus of a function-based intervention might be the differential reinforcement of alternative behavior (DRA) that uses the original consequence as reinforcement (Iwata et al., 1993).

An example of this might be teaching a student who is manding attention to say, “Look at me, please.” Importantly, before any effective intervention is designed, the function of the challenging behavior (and reinforcers) must be correctly determined.

Treatment of Challenging Behavior

Operant conditioning is especially important in assessing and treating challenging behavior because it is one of the few theories used in education that is firmly based on empirical research. Applications of operant conditioning in education have generated many approaches to producing behavior change. The most commonly used methods in education are positive reinforcement and contingency management (Hall & Hall, 1998). Operant conditioning also plays an important part in methods that use other learning principles (Baer & Rosales-Ruiz, 2003). For instance, during social skills training, modeling is combined with reinforcement of appropriate behavior by the teacher and others in the student’s environment. At a more specific level, operant conditioning has offered several important principles to the core knowledge of the field of special education. The idea that positive reinforcement can be a powerful means of change may be the most obvious. Educators have become aware that reinforcers can take on various forms and that they not only can promote appropriate behavior but also can inadvertently maintain inappropriate behavior.

The contribution of operant conditioning to work with selected behavior problems and populations can be demonstrated by the following methods that have been used, which show the breadth and variety of the contribution. Conduct disorders in students with E/BD have been treated with a point reinforcement system and contingency contracting (Kamps et al., 2011); behavior problems of students with ASD have been

addressed successfully by using contingencies with reinforcement of alternative behavior and extinction of inappropriate behavior (Casey & Merical, 2006); and classroom challenging behavior have been reduced with identification of antecedents, self-monitoring of performance, self-administered reinforcement, communication training, and teacher use of contingency management (e.g., token economies, response cost; Tiano, Fortson, McNeil, & Humphreys, 2005).

Summary

Students with ASD or E/BD often exhibit challenging behavior that put them at risk for academic failure, peer rejection, and poor post-school outcomes. Interventions that successfully address these behaviors are needed. Consequently, conducting rigorous behavioral assessments are critical to the process of designing appropriate interventions.

Research involving the use operant conditioning principles is of great utility to educators. Avoiding theories and methods that do not have empirical support and that depend on hypothetical mental constructs to account for human behavior encourages more precise and systematic scientific inquiry, which in turn leads to a steady collection of well-grounded information on human behavior, as well as a list of effective interventions to address challenging behavior. Interventions based on this empirical foundation are more effective and have more sustainable outcomes.

Functional Analysis

The term “functional analysis” refers to any empirical demonstration of a causal relation (FA; Baer, Wolf, & Risley, 1968). Although FA procedures can differ, all variations share the common characteristic of observing behavior under specific test versus control conditions. The test condition contains the variable of interest whose

influence is being evaluated whereas a control condition is used to rule out the possibility that challenging behavior observed under the test condition would have occurred regardless of what the condition contained (Iwata & Dozier, 2008). Another key component of FA is antecedent events. Antecedent events are those in effect prior to the occurrence of challenging behavior and serve as potential establishing operations or EOs (Laraway, Snycerski, Michael, & Poling, 2003). For example, in the test condition for attention, attention is withheld or is delivered to someone other than the targeted individual, either of which may increase the "value" of attention as a reinforcer.

Establishing Operations as Important Roles in Functional Analysis

Motivation has been defined as a "drive," or a change in response level as a result of satiation or deprivation (Skinner, 1957). Michael (1993) described the establishing operation (EO) as an "environmental event, operation, or stimulus condition that affects an organism by momentarily altering (a) the reinforcing effectiveness of other events and (b) the frequency of occurrence of the part of the individual's repertoire relevant to those events as consequences" (p. 192). Instead of motivation, Michael (2000) argued that the term "establishing operation" should be used only when referring to a change in the environment that meets the above requirements and increases the behavior. For example, attention can function as a consequent stimulus to increase behavior, but the effectiveness of attention as a consequence is dependent on other factors such as attention deprivation. In this example, attention would more likely increase behavior if the individual has not obtained attention for a long period of time, therefore making attention more rewarding. On the other hand, an abolishing operation (AO) refers to any event that decreases the effectiveness of a consequence (Laraway et al., 2003). Using the previous example, if the

individual has obtained attention for a long period of time and has become satiated, attention may no longer serve as an effective reinforcer (at that moment).

Both EOs and AOs play important roles in assessing and designing function-based interventions. Significant advances in the field of ABA have led to improved intervention strategies for students with disabilities. The use of FA has also taken advantage of the concept of EOs. In FA research, the role of a particular consequence that maintains the challenging behavior is assessed during test conditions that either (a) withhold the potential reinforcer and deliver it contingent upon occurrence of the targeted challenging behavior, or (b) present an aversive stimulus and remove it contingent upon occurrence of the targeted challenging behavior. Restriction of a potential positive reinforcer or presentation of a potential negative reinforcer during FA test has been conceptualized as an EO (Iwata et al., 1994). In addition to providing information on the cause of the target behavior, an FA may also suggest: (a) antecedent stimuli that are serving as EO, (b) sources of reinforcement, and (c) intervention strategies that should be used or avoided (Iwata, Vollmer, & Zarcone, 1990). Understanding the role of EO to determine possible stimuli that maintain the targeted behavior can strengthen practitioners' ability to both assess and address challenging behavior.

Before the early 1980s, challenging behavior were usually measured using indirect assessment (e.g., rating scales; Iwata & DeLeon, 1996) and descriptive analyses (e.g., scatterplot; Touchette, MacDonald, & Langer, 1985). The introduction of FA was a major advancement in empirically understanding what variables maintained challenging behavior. First introduced in 1982 by Iwata and colleagues, FA offered a systematic method of evaluating factors maintaining an individual's challenging behavior (Iwata,

Dorsey, Slifer, Bauman, & Richman, 1982/1994). FA has been shown to be extremely accurate in identifying the function of challenging behavior demonstrated by students with disabilities (Iwata et al., 1982/1994). The process of FA includes presenting and withdrawing different stimuli (e.g., discriminative stimulus [S^D], reinforcer) during brief (i.e., 5-15 min) test conditions to observe how they affect an individual's behavior (O'Neill et al., 1997). The experiment also involves evoking and reinforcing the challenging behavior by creating an EO (e.g., attention deprivation), with the presentation of a possible reinforcer (e.g., teacher attention). Consistent increases of a target behavior during an FA (compared to a control condition) are typically thought of as sufficient evidence to determine what is triggering and maintaining the challenging behavior. For example, if presenting a difficult task to the student and then removing it when the challenging behavior is exhibited consistently evokes the challenging behavior, then it can be determined that presenting the task (S^D) triggers the behavior and removing the task reinforces the behavior.

FA has been successfully used to assess a variety of challenging behavior, including self-injury (e.g., Iwata, Pace, Dorsey et al., 1994), aggression (e.g., Marcus, Vollmer, Swanson, Roane, & Ringdahl, 2001), tantrums (e.g., Vollmer, Northup, Ringdahl, LeBlanc, & Chauvin, 1996), stereotypy (e.g., Kennedy, Meyer, Knowles, & Shukla, 2000), vocalizations (e.g., Wilder, Masuda, O'Connor, & Baham, 2001), noncompliance (e.g., Wilder, Harris, Reagan, & Rasey, 2007), pica (e.g., Piazza, Patel, Gulotta, Sevin, & Layer, 1998), and food refusal (e.g., Piazza et al., 2003). In addition, FA has been used successfully to asses a variety of behavioral functions including: attention from others (e.g., teacher or peer attention); access to tangible items (e.g., food)

or a preferred activity (e.g., computer); escape from instructional demands (e.g., independent seatwork), social interaction (e.g., recess), or aversive noise (e.g., fire alarm); and automatic/sensory stimulation (e.g., finger-flicking). For example, Iwata, Pace, Dorsey, et al. (1994) indicated out of 152 cases of FA implementation, 91% resulted in data clearly indicating a behavioral function. A review conducted by Asmus et al. (2004) indicated successful identification of behavioral function in 96% of 138 FA of the challenging behavior of individuals with and without developmental disabilities.

Carr (1977) operationalized FA by providing a framework for an experimental methodology for determining functions of self-injurious behavior. Specifically, Carr proposed five hypotheses for challenging behavior in individuals with developmental disabilities; three of which were maintained by contingencies of reinforcement (i.e., attention, escape, and sensory consequences). A resulting implication of this was that a reinforcer could be modified as a form of intervention. Iwata et al. (1982/1994) extended this by defining a more comprehensive methodology for examining the functions of self-injurious behavior. In this particular study, Iwata et al. manipulated antecedent and consequent stimuli within 15-min sessions conducted in an analogue setting to assess the function of self-injurious behavior (i.e., biting, head banging, face slapping, self-choking, and hair pulling) of 9 participants with developmental disabilities. In order to assess the socially mediated positive reinforcement (e.g., attention) hypothesis, Iwata et al. set conditions of low attention and provision of mild reprimands and physical contact as forms of attention contingent only on demonstrations of self-injurious behavior by the participants. When assessing the socially mediated negative reinforcement hypothesis (e.g., escape), the authors presented tasks to participants, and only withdrew tasks

contingent on occurrence of self-injurious behavior. To assess the automatic reinforcement hypothesis, the participants were placed in a room without other people, toys, or materials. A control condition, which consisted of unrestricted access to materials and attention, was used for comparison to the test conditions. All conditions were conducted within a single-case, multielement research design. Results indicated multiple functions of behavior within and between participants, which suggested self-injurious behavior could be maintained by different sources of reinforcement for different students. Findings from this study also indicated intervention selection could be both individualized and targeted for maximum efficacy by identifying the function(s) of behavior for each individual. The study conducted by Iwata et al. led to many studies using FA to determine the function of behavior with varying populations and settings. Hanley, Iwata, and McCord (2003) noted in their review of studies using FA that 70% included children, 37.2 % included adults, 91.3% included individuals with a developmental disability, 20.9% included individuals with autism, and 9% included individuals with no diagnosis of a disability. In addition, Hanley et al. indicated that 32.5% of these studies were conducted in a hospital inpatient setting, 31.4% in a school setting, 25.3% in an institution, 7.6% in the home, 7.6% in a clinic (outpatient setting), and 2.2% in a vocational program.

Since the review by Hanley et al. (2003) was conducted, more studies have been conducted using FA with children and youth with ASD or E/BD (e.g., Love et al., 2009; Reese et al., 2003, 2005). For example, O'Reilly et al. (2010) used a single-case, multielement research design to conduct FA to determine the function of the challenging behavior of 10 children with ASD. Each child exhibited a variety of challenging behavior

including aggressive behavior (e.g., hitting others), inappropriate vocalizations (e.g., crying, screaming), stereotypy (e.g., hand flapping, jumping up and down), and self-injurious behavior (e.g., body hitting). FA conditions were conducted in a room at each child's school. Results indicated for 8 of the 10 children, challenging behavior was maintained by automatic reinforcement, but was maintained by multiple sources of reinforcement for the other two children.

In addition, a few studies have focused on using FA procedures exclusively with individuals with a diagnosis of E/BD (e.g., Kamps, Wendland, & Culpepper, 2006). For example, Wright-Gallo, Higbee, Reagon, and Davey (2006) conducted FA of challenging behavior for two students with E/BD. All FA sessions were conducted at a table in the back of a self-contained classroom. Challenging behavior included talking-out to peers and teacher without permission, using profanity or sexually-explicit language, and elopement. Results from the FA indicated both students' challenging behavior were maintained by escape from task demands and recruitment of attention.

Functional Analysis in School Settings

The settings in which FA has been conducted vary from highly contrived (i.e., analogue) settings, such as hospitals, outpatient clinics, and unoccupied rooms in schools (e.g., resource rooms or cafeterias) to somewhat uncontrolled settings such as bedrooms in children's homes and classrooms with other children present (Hanley et al., 2003). Although FA has been conducted successfully in each of these settings, there remain questions regarding the best settings in which these behavioral assessments can be completed accurately. Analogue settings are usually preferred because they provide strong experimental control over variables that may affect the integrity of the analysis.

Baer et al. (1968) noted that an FA of a behavior consists of a demonstration of the events that can be responsible for the occurrence (or non-occurrence) of that behavior. This requires control over (a) measurement (dependent variable), (b) application of intervention (independent variable), and (c) potential sources of confounding variables. Although analogue settings provide experimental control over these variables, there are some limitations in conducting FA in these settings. Sterling-Turner, Robinson, and Wilcynski (2001) found that the ability of the analysis to accurately depict behavior in analogue settings is compromised by the artificial conditions of the setting. For example, it may be difficult to evoke the challenging behavior if the setting is different from the classroom where the challenging behavior typically occurs. If the classroom setting is itself a discriminative stimulus (S^D) that signals the availability of reinforcement (e.g., peer attention), an analysis conducted in an analogue setting may not produce accurate results (Lang, Sigafoos, Lancioni, Didden, & Rispoli, 2010; Sterling-Turner et al., 2001; Tiger, Hanley, & Bessette, 2006).

On the other hand, the natural situation refers to settings where the challenging behavior actually occurs (e.g., the student's classroom rather than an unoccupied classroom). Lang et al. (2008) compared implementing FA in an analogue setting (i.e., empty assessment room) to a more natural setting (i.e., the students' actual classroom) with two students with ASD who exhibited challenging behavior including dropping to the floor, hitting the therapist, elopement, and head hitting. Attention, escape, and control conditions were conducted with both students. FA conditions were alternated in a single-case, multielement research design, and the influence of the setting (assessment room compared to the classroom) was examined using an ABAB design (A represented the

assessment room and B represented the classroom; Lang et al., 2008). Areas of results were noted. The first area pertained to whether both FA identified the same behavioral function(s). For one student, escape was the identified function in both settings. The second area pertained to whether behavioral functions differed across settings. For the second student, this was the case. Levels of challenging behavior were elevated during both attention and escape conditions compared to control conditions in the assessment room; however, unclear results were obtained in the classroom. Lang et al. noted that one possible reason for this could have been alternative sources of reinforcement (e.g., peer attention). This has important implications for considering potential discrepancies in the function of challenging behavior across settings in the design of function-based interventions.

FA conducted in classroom settings raise concerns about threats to experimental control due to various potential variables that can influence the setup of test and control conditions. For example, control over all possible providers of reinforcement may be compromised by the presence of other students or stimuli in the classroom setting. In this case, although criteria may be created to limit unintentional delivery of reinforcement, the presence of other students and stimuli makes such experimental control questionable. Another potential limitation of FA conducted in the classroom is that teachers are understandably reluctant to allow FA in their classrooms due to the increased risk to staff and peers in cases where students' challenging behavior are evoked (Solnick & Ardoin, 2010). As a result, variations to the standard FA have been designed in order to strengthen the design of FA conducted in school settings.

Variations of Functional Analysis

Iwata and Dozier (2008) found most common criticisms of FA in the classroom focus on time and training issues (i.e., too specialized), and setting constraints (i.e., inability to exert tight control over environmental conditions). Specifically, Iwata and Dozier noted that many researchers have described FA as too time-consuming or too complex to train teachers to perform. To address these limitations, variations to FA procedures were designed.

Variations addressing time constraints. To address the issue of time, researchers have made many variations to FA procedures that have resulted in reduced assessment time (e.g., brief functional analysis; Derby et al., 1992; Northup et al., 1991). For example, Northup et al. (1991) modified the traditional functional analysis methodology by developing the brief functional analysis (BFA). The BFA consisted of a single exposure to 5-min test and control conditions, conducted with replication of a key test condition followed by a treatment probe to determine the function of challenging behavior for three participants with severe disabilities. Results indicated conducting a BFA during a 90-min assessment that can lead to the identification of a behavioral function is feasible. The BFA was found to be a practical substitute when a more comprehensive analysis could not be done, as it effectively addressed the issue of time constraints. However, Northup et al. noted that a limitation of the BFA is the design may not be appropriate for low rates of challenging behavior.

Derby et al. (1992) conducted BFA with 79 participants with varying challenging behavior. Participants included individuals with mild intellectual disability (ID), moderate ID, severe to profound ID, or autism. Challenging behavior included self-injury

and aggression towards others. The authors were able to determine the function of behavior for 46% of the participants (i.e., 37 out of 79) through BFA. Iwata and Dozier (2008) indicated that this was remarkable, given that the BFA was completed in such a short period of time. Derby et al. also noted BFA is preferred over indirect measures (e.g., surveys) because they lower the degree of conjecture needed to identify maintaining contingencies. Although somewhat effective, Derby et al. were careful to note that the BFA should not be considered as a replacement for the more researched standard FA method.

Another variation of the standard FA that addresses time constraints is the single function test (Iwata & Dozier, 2008). This variation tests for a single hypothesized function. When informal observations strongly suggest a specific source of maintenance, the single-function test could be used. The single-function test consists of a single test condition versus a control condition. If the challenging behavior occurs at a high rate, the participant immediately goes in to intervention phase. This variation may be helpful when the target behavior is potentially dangerous (e.g., SIB, aggression). Importantly, Iwata and Dozier indicated that it is unknown as to whether there is loss in accuracy in determining the function of behavior using the single-function test, when compared to a standard FA. The authors cautioned to only use this procedure if a single function is highly likely. Vollmer, Marcus, Ringdahl, and Roane (1995) used a second variation of the single-function test as part of an assessment package to specifically assess the challenging behavior of 20 individuals with developmental disabilities. This variation consisted of observing the individual during repeated “alone” or “ignore” conditions to test for an automatic reinforcement function. Challenging behavior in Vollmer et al.’s

(1995) study included self-injury, aggression, stereotypy, and tantrums. Results indicated that six (approximately 30%) participants demonstrated challenging behavior as a result of automatic reinforcement.

Variations addressing setting constraints. To address the issue of setting constraints, the trial-based functional analysis (TBFA) was designed. Specifically, the TBFA was designed to address the issue of limited environmental control via embedded assessment in ongoing activities. Sigafoos and Saggers (1995) conducted the first TBFA in a classroom setting with two students with ASD who exhibited challenging behavior. Challenging behavior included frequent aggressive acts toward staff. Probes trials during ongoing instruction were conducted across the school day, and continued for the entire school week. The TBFA is similar to the standard FA by using the same conditions, but standard FA conditions are conducted in repeated 10-min sessions. Instead, during TBFA each trial included a 1-min test segment, and a 1-min control segment for each condition of tangible, attention, and escape. Twenty discrete trials under each condition were conducted over a 5-day period. Four trials under each condition were conducted per day, and incorporated into the classroom routine. Results indicated that TBFA was successful in determining the function of behavior for both students. Sigafoos and Saggers noted that TBFA required minimal time and labor (less than 2 hours per child). The authors also suggested although 60 trials were dispersed over a period of 5 days, fewer trials over a shorter time period could be used. Another advantage noted was that time exposed to contingencies which may strengthen challenging behavior is reduced with a TBFA, and can be conducted "on the fly." However, authors noted carryover effects from test condition to control condition, so results should be interpreted with caution. In addition,

authors suggested future research should include comparing traditional and TBFA to determine correspondence.

To address Sigafoos and Saggers' (1995) recommendation, LaRue et al. (2010) compared results of TBFA to results of traditional FA on functions of challenging behavior of five participants diagnosed with ASD and ID. Challenging behavior included aggression, self-injurious behavior, disruption, spitting, inappropriate vocalizations, and hand stereotypy. Standard FA was conducted in therapy rooms, whereas TBFA was conducted in typical classroom and vocational settings with other students present. Both models of FA were conducted by the classroom teacher. Trials during the TBFA began with a 1 min test segment (EO present) and ended with a 1 min control segment (EO absent). Results indicated correspondence between both models of assessment was strong. In fact, exact correspondence was noted for four of five participants. The other participant had partial correspondence. Additionally, TBFA did not require recurring reinforcement of the targeted challenging behavior, and results were obtained in an average of 31.6 min compared to 208 min of the standard FA, resulting in 84.8% less time than the standard FA. Another advantage noted by LaRue et al. was that data collection was much less intensive for the trial-based model. Data collectors were only required to document presence or absence of behavior during the EO phases. This has implications for teachers being involved in data collection while conducting an FA.

To address the limitation of carryover effects from test segments to control segments during TBFAs, Bloom, Iwata, Fritz, Roscoe, and Carreau (2011) extended the Sigafoos and Saggers (1995) study by conducting TBFA with 10 students with developmental disabilities, hearing impairments, and speech delays exhibiting different

challenging behavior. Challenging behavior included aggression, self-injury, bizarre vocalizations, and inappropriate touching. Conditions included attention, tangible, demand, and ignore, and were conducted in the classroom by behavior analysts. Unlike Sigafoos and Saggers, the control segment for each trial was conducted first to avoid carryover of challenging behavior from test to control segments (i.e., from EO present to EO absent). In addition, Bloom et al.'s study included a test for automatic reinforcement. Sessions consisted of 4-min trials embedded during the school day, with 20 trials conducted for each condition. Each condition consisted of a 2-min control segment and a 2-min test segment. Reinforcement was provided contingent upon challenging behavior only. Bloom et al. noted main benefit of TBFA is each trial is brief in duration and is not as disruptive to the classroom routine as traditional FA. In addition, when compared to traditional FAs, correspondence for TBFA was noted for six of 10 participants. However, authors made several suggestions for future studies. Specifically, Bloom et al. suggested that longer test segments than control segments might improve precision (e.g., 1-min control, then 3-min test).

To further extend the research on using TBFA in classroom settings, Flynn, Lo, and Anderson (2011) conducted a single-case, multiple-baseline-across-participants research design to determine effects of functional communication training (FCT) on challenging behavior, academic responses, and mands of three middle school students with ASD. Before implementing FCT, Flynn et al. trained the special education teacher to implement TBFA during group instruction. Challenging behavior included elopement and inappropriate vocalizations. Conditions included attention, demand, tangible, and ignore. Each condition (including a test and control segment) lasted an average of 4 min. Results

from the FA indicated for two student participants, the function of behavior was attention from the teacher. The third participant's challenging behavior was determined to be reinforced by access to tangible and escape from academic demands. FCT procedures were then designed based on the function of challenging behavior for each student.

Summary

FA methods have been found to produce the most accurate outcomes for identifying functions of students' challenging behavior. Refining FA procedures for use in school settings is an ongoing process. Findings from previous studies indicate TBFA model is a feasible analysis method and may present advantages over the traditional FA method. The model also is promising in that its results provide more ecological validity as it is being conducted in the natural environment where the challenging behavior occurs. Even though the traditional FA or its variables have been conducted in the classroom settings, few studies have assessed teachers' ability to conduct FA with high procedural integrity in the classroom.

Teacher Training in Functional Analysis

Due to the complexity of FA procedures, teachers may lack the appropriate skills to accurately implement FA in classroom settings. There have been a handful of studies that have involved training teachers to conduct an FA (e.g., Ellingson, Miltenberger, Stricker, Galensky, & Barlinghouse 2000; Flynn, Lo, & Anderson, 2011). These studies on training staff to conduct FA have demonstrated that methods can be trained to very high levels of procedural integrity in very little time (Iwata et al., 2000). This is important to the field of education because teachers are the ones delivering instruction to students. Therefore, teachers (and not researchers) should be conducting behavioral assessments

and implementing interventions with their students. Studies such as the one by Iwata et al. suggest issue of complexity is not valid. Iwata et al. (2000) taught undergraduate students in a psychology laboratory course to conduct three FA conditions (i.e., attention, escape, play). The first phase of training consisted of students reading descriptions based on assessment conditions in the study by Iwata et al. (1982/1994), viewing videotaped simulations of each condition, and then concluding with a written test. The second phase of training involved role-playing, where one student conducted conditions and another student played the part of a child exhibiting challenging behavior. Sessions were videotaped to permit feedback. Results indicated students were able to master implementation of FA conditions within roughly 2 hours. However, performance in applied settings was not measured.

Moore et al. (2002) extended the findings of Iwata et al. (2000) by training three elementary school teachers to conduct FAs. Specifically, authors effectively taught teachers to conduct FA with three students (one diagnosed with a specific learning disability and two students without diagnoses) by using demand and attention conditions subsequent to extensive training. Reading materials, video demonstrations, written assessments, and performance feedback were used during training. All training sessions were individually conducted in the teacher's classroom during planning time. Probes were taken during classroom instruction. Results indicated teachers acquired FA skills and used them in their classrooms with 95% procedural integrity within approximately 20 sessions. Moore et al. were careful to note teachers were not taught to implement a control condition; therefore, it remained unknown whether teachers can implement a full FA during classroom instruction.

In another study, Wallace, Doney, Mintz-Resudek, and Tarbox (2004) assessed the effects of training on teachers' correct implementation of the attention, demand, and toy-play conditions using simulated analyses (e.g., teachers acted as therapists) during a 3-hr workshop. Following the workshop, teachers conducted FA in analogue settings. Results indicated two of three teachers met mastery criterion following training by conducting simulated analysis conditions with more than 90% procedural integrity. The third teacher required additional feedback to reach criterion. Additionally, although not measured directly, one teacher accurately implemented FA sessions with one of her students in the classroom. Limitations noted by Wallace et al. were that not all components of the FA were trained and systematic generalization probes to applied settings were not taken.

In addition to face-to-face training formats, teachers have also been taught FA procedures via teleconferencing (Barretto, Wacker, Harding, Lee, & Berg, 2006). In this study, a teacher with no prior training in conducting FA and interpreting results implemented all sessions (i.e., free play or control, escape, and alone) of a BFA with two young students through telemedicine evaluation. Telemedicine is a general term referring to providing mental health care from a distance (Grady et al., 2011). In this case, videoconferencing was used. During the BFA, a microphone clip was attached to a table in the middle of the room so that a behavior analyst (who served as the consultant) could listen. If low rates of challenging behavior occurred during a condition, sessions for that condition were repeated and followed by a test condition (Barretto et al., 2006). Results indicated function of the targeted behavior for both participants was correctly identified, and the teacher using telemedicine technology could conduct the BFA effectively.

Additionally, this study provided further support that FA is not too difficult to learn to implement.

Procedural Integrity

Procedural integrity provides information on the extent to which independent variables are implemented according to protocol. High levels of procedural integrity permit results of a study to be interpreted with confidence and allow for replication. Most studies on FA in school-based assessments have neither reported integrity data nor involved the teacher as the individual who conducted the FA (Shumate, 2008). Therefore, extending the literature base on training teachers to conduct FAs, as well as measuring procedural integrity of all FA conditions, is warranted.

Summary

Existing studies indicate that with preparation, school personnel can be taught skills necessary to conduct an FA in a school setting with high procedural integrity. Successful training models included role-play, videotapes, and performance feedback. However, limitations of these studies reveal experimenters did not train all of the components of conducting an FA. Particularly, school personnel in the previous studies were not taught critical skills such as data analysis and interpretation, implementing a control condition, as well as the ability to design specific interventions based on the results of the FA (e.g., Barretto et al., 2006; Iwata et al., 2000; Moore et al., 2002; Wallace et al., 2004). These skills are critical to designing successful function-based interventions.

Function-Based Interventions

In addition to the need to determine the function of a student's challenging behavior, teachers also need to effectively design and implement function-based interventions (FBI) for students in classroom settings to produce positive student outcomes (Scott & Kamps, 2007). Many classroom interventions may be ineffective because they are not based on the function of a students' behavior (Gresham et al., 2001). A substantial amount of research has shown behavioral interventions based on the function of behavior are more effective than interventions based on topography of behavior (e.g., Carr & Durand, 1985; Paclawskyj, Kurtz, & Connor, 2004).

FBI are interventions designed based on identified stimuli that maintain challenging behavior (Horner, 1994; Mueller, Edwards, & Trahant, 2003; Umbreit, Ferro, Liaupsin, & Lane, 2007). Interventions can be designed based on FA results, with the goal of teaching the student a more appropriate and efficient way of manding reinforcement (e.g., escaping a difficult task; Umbreit, Lane, & Dejud, 2004), as a way to reduce the challenging behavior.

There are a variety of FBI to address challenging behavior, including antecedent manipulation, punishment (e.g., timeout and overcorrection), non-contingent reinforcement (i.e., NCR; time-based schedule), response blocking, extinction, and reinforcement (Kahng, Iwata, & Lewin, 2002). In their review of 396 studies from 1964 to 2000 on interventions addressing self-injury, Kahng et al. (2002) found the majority of function-based interventions chosen were differential reinforcement procedures (42.2%). The authors indicated that this was due to the increasing trend of using functional assessments, as well as the demonstrated success of reducing self-injurious behavior.

For the classroom setting, the FBI selected for implementation usually involve a differential reinforcement procedure (Petscher, Rey, & Bailey, 2009). A differential reinforcement procedure is one in which the reinforcer is withheld following the display of challenging behavior and is provided contingent on a more appropriate behavior. For example, a student who mands for computer time by giving a picture symbol of a computer to his teacher is provided with the reinforcer of the computer, whereas computer time is not given when he bites his hand. The same condition applies for negative reinforcement. For example, a student will not be given a break from her work by throwing her textbook at the teacher, but will receive a break from work if she raises her hand to appropriately mand it. There are differential strategies that differ in the way the reinforcer is delivered, the way in which other behavior need to be exhibited, and at what frequency reinforcers are delivered. Regardless of the variations, each intervention that involves differential reinforcement affects behavior in similar ways. Specifically, each variation has a two-component system: extinction and differential positive reinforcement. Both components are described separately below, as well as differential negative reinforcement and noncontingent reinforcement procedures.

Extinction

Extinction involves the reinforcer identified in the FA being withheld and never delivered following the display of the targeted challenging behavior (Cooper, Heron, & Heward, 2007). The purpose of extinction is to reduce or totally eliminate the targeted challenging behavior. Extinction can involve withholding positive reinforcers (e.g., no longer providing attention for attention-maintained behavior) or negative reinforcers (e.g., escape extinction, preventing the student from escaping task demands; Iwata et al.,

1994). With escape extinction, the teacher can use a 3-step prompting hierarchy by providing a vocal prompt (e.g., “Josh, write your name.”). If Josh complies, the teacher delivers praise. If he does not comply within 5 s, the teacher provides a gestural prompt (e.g., “Josh, write your name” and points to the desired starting point). If he complies, the teacher delivers praise. If Josh is still noncompliant within 5 s after the gestural prompt, the teacher physically guides Josh’s pencil to write his name on the paper. No praise is delivered at this point. However, it is recommended that extinction be used in conjunction with another procedure, or challenging behavior can become much worse (Iwata et al., 1994). Further, Benoit and Mayer (1974) suggested that in order for extinction to be successful in reducing challenging behavior, the behavior needs to be tolerated temporarily, the worsening of behavior needs to be tolerated, and challenging behavior cannot be imitated by others. Otherwise, another behavior reduction strategy needs to be considered.

Two undesirable side effects of extinction procedures are often reported: extinction bursts and extinction-induced aggression. An extinction burst is a temporary increase in the frequency, magnitude, or length of the problem behavior as a result of the extinction procedure; whereas an extinction-induced aggression is an increase in aggression that occurs with the onset of extinction (Lerman & Iwata, 1995). Lerman, Iwata, and Wallace (1999) found that in children undergoing behavioral treatment at their clinic, extinction-only treatment packages resulted in an extinction burst 62% of the time and extinction-induced aggression 29% of the time. In contrast, when treatment packages included reinforcement components, extinction bursts occurred in only 15% of the cases and aggression in 15% of the cases. Thus, reinforcement-based intervention components

are often added to an intervention package to reduce these side effects. In addition, it is generally desirable to design an intervention plan that provides not only for reducing challenging behavior but also for replacing those behaviors with more socially appropriate behavior (Carr & Durand, 1985). Reinforcement-based methods, when used together with extinction, can be used to accomplish both goals.

Differential Positive Reinforcement

The second component of the differential reinforcement strategy is to reinforce other appropriate behavior. The reinforcer identified in the FA should be used. This second component not only provides access to the reinforcer identified in FA (but under new contingencies), but also evokes a new appropriate behavior, which can result in the acquisition and increased use of the new behavior. Therefore, this type of intervention has an instructive part to it, unlike using extinction in isolation. The three main types of differential reinforcement procedures are described below.

Differential reinforcement of other behavior (DRO). DRO is the system in which the reinforcer is withheld following the targeted challenging behavior, and is provided for the absence of the target challenging behavior (Reynolds, 1961; Repp & Deitz, 1974). For example, DRO can be used by ignoring the challenging behavior and increasing the provision of attention when the challenging behavior is not exhibited for some predetermined time when a student whose challenging behavior is maintained by attention. Theoretically, this procedure works by increasing reinforcement for any other behavior so the student learns challenging behavior does not recruit reinforcement, but other behavior do. In a study examining DRO as a single-component intervention, Daddario, Anhalt, and Barton (2007) examined the effectiveness of DRO in reducing

disruptive behavior of typically developing preschool children during circle time. Disruptive behavior included touching a peer or teacher with hands, fingers, arms, or feet. It also included poking, tackling, hitting, and kicking the teacher or peers. The study used an event recording system to monitor the disruptive behavior across the baseline and intervention conditions. During baseline, the teacher tallied instances of disruptive behavior on paper. During intervention, the teacher set a kitchen timer to the appropriate interval time (as determined by taking the average number of occurrences as derived from the baseline data) during circle time. When the timer beeped, the teacher delivered M&Ms to randomly selected students for not exhibiting disruptive behavior, and reset the timer. If disruptive behavior occurred at any point during the interval, the teacher ignored the disruptive behavior, set aside an M&M, and reset the timer. Results indicated a functional relation between the DRO procedure and a reduction in students' disruptive behavior.

Despite its effectiveness in reducing targeted challenging behavior, there are two disadvantages to using a DRO procedure. First, DRO is not designed to teach and/or increase any particular appropriate behavior. It merely reinforces the absence of certain undesired behavior. Second, when using a DRO procedure, one runs the risk of reinforcing untargeted, negative behavior since reinforcement is given at the end of an interval provided that the targeted undesired behavior has not occurred. This could mean reinforcing other types of inappropriate behavior. Therefore, it is important to include other strategies to teach or reinforce appropriate behavior when using the DRO procedure.

Differential reinforcement of alternative behavior (DRA). DRA is an intervention where the reinforcer is withheld following challenging behavior and only delivered following a predetermined desired, alternative behavior (Cooper et al., 2007). Unlike DRO, the alternative behavior must be demonstrated for reinforcement to be provided. For example, a teacher does not provide attention when a student throws her textbook, but provides attention only when the student raises her hand to recruit for teacher attention. In addition, academic responses can become the alternative response. For example, a student can earn the computer time for task completion, rather than for biting his hand.

When the DRA is used for a communicative response, the procedure is often known as Communication Training or Functional Communication Training (FCT: Carr & Durand, 1985). Basically, FCT is differential reinforcement of communication. FCT involves identifying the function of challenging behavior and teaching an adaptive request to access the identified reinforcer (or an adaptive alternative) appropriately. Carr and Durand (1985) were the first to discover the importance of teaching alternative replacement skills and how important it was for practitioners to connect the function of challenging behavior to designing the intervention. First, Carr and Durand found challenging behavior decreased when an appropriate functional mand was taught. Also, they found challenging behavior did not decrease when a non-functional mand was taught. Applied research has since replicated these findings and demonstrated the effectiveness of FCT to reduce a variety of challenging behavior (e.g., Flynn, Lo, & Anderson, 2011; Hanley, Iwata, & Thompson, 2001; Kelley, Lerman, & Van Camp, 2002; Worsdell, Iwata, Hanley, Thompson, & Kahng, 2000). For instance, a student will

not be given time to work on his favorite puzzle for banging his head, but he can get it by handing a picture of a puzzle to his teacher. This communicative response can be in any form that is currently in the student's repertoire (e.g., motor behavior, vocal behavior). DRA works by increasing reinforcement for another predetermined behavior so the student learns challenging behavior does not recruit reinforcement, but the appropriate alternative behavior does. This procedure is most effective when the chosen alternative behavior serves the same function (i.e., both are members of the same response class) as the behavior being replaced (Alberto & Troutman, 2009). Miltenberger (2001) suggested the following ideas for deciding if DRA is the suitable intervention to employ (a) the outcome of the intervention should be an increase in a predetermined alternative behavior, (b) the alternative behavior must be in the student's repertoire, and (c) a potent reinforcer must be available.

Unfortunately, many DRA procedures have the potential for low procedural integrity (Vollmer, Roane, Ringdahl, & Marcus, 1999). Vollmer et al. (1999) note it is unlikely all occurrences of alternative behavior will be reinforced, or all occurrences of challenging behavior will not recruit reinforcement. Therefore, access to reinforcement may be intermittently produced by both challenging behavior and alternative behavior. However, Vollmer et al. indicated DRA procedures may be effective, even with lower integrity. St. Peter Pipkin and Vollmer (2009) suggest that to make DRA more practical for teacher implementation, alternative behavior is sometimes reinforced on an interval schedule rather than a ratio schedule. Individuals who have a history with DRA ratio schedules may exhibit more appropriate behavior, even if planned contingencies for appropriate behavior and challenging behavior are changed to fixed-interval schedules.

This type of effect may make it possible to effectively reduce challenging behavior and increase appropriate behavior temporarily, even when the intervention cannot be immediately implemented with high integrity in the natural environment (St. Peter Pipkin & Vollmer, 2009).

Differential reinforcement of incompatible behavior (DRI). DRI is a schedule in which a reinforcer is provided for behavior that is incompatible with the targeted challenging behavior (Kazdin, 2001; Miltenberger, 2001). An example may involve a student being provided reinforcement for folding his hands in his lap rather than hitting another student. Although folding hands in lap can be considered an alternative response, DRI procedures require incompatibility between the targeted challenging behavior and the reinforced behavior. In other words, the student physically cannot demonstrate both behaviors at the same time. DRI works by increasing reinforcement for incompatible behavior so that the student learns that the challenging behavior does not recruit reinforcement, but the incompatible behavior does (Kazdin, 2001; Miltenberger, 2001). However, failure in providing a replacement behavior in the presence of DRI alone might increase the probability that another inappropriate challenging behavior will emerge to serve the same function, especially with individuals who have very limited repertoires of appropriate behavior (Northup et al., 1991).

Differential Negative Reinforcement and Noncontingent Reinforcement

The procedure for differential negative reinforcement is basically the same as for differential positive reinforcement. That is to say, withholding breaks from activities or anything else can be arranged just as can the provision of those breaks contingent on nonoccurrence of behavior (DNRO), alternative behavior (DNRA), and incompatible

behavior (DNRI). DNRA has been compared to procedures such as DNRO (e.g., Buckley & Newchok, 2006), and was found to produce longer-lasting reductive effects. DNRI has not been researched to the extent as other differential negative reinforcement procedures, but escape extinction and providing a break for a behavior incompatible with the target challenging behavior might work as well as DNRA and DNRO procedures (Mueller & Nkosi, 2009).

Noncontingent reinforcement (NCR) works as effectively as differential reinforcement procedures, but operates differently. NCR is actually an antecedent intervention that focuses on satiation rather than reinforcing an alternative behavior (Vollmer, Iwata, Smith, Zarcone, & Mazeleski, 1993). There has been a debate as to whether the NCR term is actually correct. Poling and Normand (1999) suggested the term really should be "fixed interval" schedule because reinforcement is defined as an operation in which occurrence of a behavior is followed by a change in environment, and as a result behavior increases in rate or is strengthened. Therefore, delivery of a "reinforcer" under a fixed-interval schedule did not represent reinforcement in the Vollmer et al. (1993) study because no measured behavior increased in frequency (Poling & Normand, 1999). Nevertheless, any stimulus can be delivered in NCR on a fixed-interval schedule. NCR can be used with tokens conditioned as secondary reinforcers that are later exchanged for reinforcers determined in an FA. By delivering the stimulus at fixed intervals, the EO that evokes the challenging behavior decreases because the student does not feel the "drive" to demonstrate the behavior to get the stimulus. In this case, NCR can work as an AO.

When NCR is applied to a negatively-reinforced event, escape is delivered on an FT schedule. Noncontingent Escape (NCE) has been determined in the literature as being effective in reducing very serious challenging behavior (e.g., Coleman & Holmes, 1998). For example, delivering breaks during work on a fixed-time schedule achieves the same reductive objectives as NCR with positive reinforcement. NCE breaks the connection between the target challenging behavior and reinforcer and reduces the student's motivation to exhibit challenging behavior by delivering "reinforcers" without displays of challenging behavior (Mueller & Nkosi, 2009; Vollmer, Marcus, & Ringdahl, 1995).

Summary

Although there are a variety of FBI available for selection (e.g., antecedent manipulation, punishment, response blocking, extinction, differential reinforcement), many teachers prefer to use positive reinforcement-based procedures (Tingstrom, 1990) and differential procedures instead of noncontingent systems (Mueller et al., 2003) due to potential of "reinforcing" an inappropriate behavior during NCR. In addition, Tingstrom noted teachers prefer simple, brief interventions that work with classroom routines. Differential reinforcement procedures are relatively easy to implement (with the exception of DRA, which may have the potential for low procedural integrity) and effective.

FBI for students with ASD or E/BD tend to focus on teaching alternative behavior, but can include a combination of interventions. An important consideration is that many students with ASD are partially or totally nonverbal. Choosing to increase communication skills with FCT is often the first option with students with ASD. Similarly, students with E/BD may benefit from DRA procedures to allow them to

develop appropriate alternative responses to the challenging behavior. Selecting appropriate interventions and training teachers to implement these interventions with high procedural integrity are important components to success of interventions.

Effective FBI for challenging behavior is an instructional procedure and therefore is made of the same evidence-based practices that also work for teaching work behavior. Specific alternative replacement behavior must be taught explicitly to the student by using modeling and providing opportunities to practice with immediate feedback. Also, instructional environments must be arranged to provide students multiple opportunities for success. This involves using prompts, cues, and consistency to maximize success and avoid failure (Scott, Anderson, & Spaulding, 2008).

Teacher Training In FBI

An emerging theme in the current literature on FA is to have the student's teacher conduct the FA and implement the FBI, rather than the researcher (e.g., Bessette & Wills, 2007; Ervin et al., 2001; Kamps, Wendland, & Culpepper, 2006; Scott et al., 2004; Wright-Gallo, Higbee, Reagon, & Davey, 2006). Training teachers to implement FBI with high procedural integrity is important when trying to create behavior change in their students. Teacher involvement in implementing interventions helps promote generalization of acquired skills by using the interventions across different settings (e.g., classroom, cafeteria), materials (e.g., math assignment, writing assignment), and people (e.g., different students). In addition, a teacher who delivers reinforcement to their students also can become a conditioned reinforcer, in that he or she has acquired the function of a reinforcer after being paired with a stimulus that functions as a reinforcer.

Even so, teacher involvement is still uncommon. For example, O'Neill and Stephenson (2009) reviewed the literature since 1997 on FBA and BIPs involving students identified as having or being at risk for E/BD in school settings, and determined that involving school personnel in all FBA procedures and BIP design is not common. Specifically, results indicated teachers were involved in three or more of the five FBA process categories in 22 out of the 23 studies (95%), but in only 5 (22%) studies were they involved in all of the five processes (i.e., indirect assessment, hypothesis formation, data collection, FA, and BIP). This may be due in part to inefficient training that does not address critical components required to correctly implement FBA (or FA) and function-based interventions. O'Neill and Stephenson also noted that in the FBA process, teachers were least involved in observational data collection. Direct observational data collection is important in FBA as it helps to provide data to validate hypotheses and to quantify the dimensions of the problem behavior (O'Neill & Stephenson, 2009). The authors suggested teacher's lack of involvement in data collection could be due to a need of an outside observer to record data while the target student's teacher is delivering instruction or negative teacher attitudes toward data collection.

Lalli, Browder, Mace, and Brown (1993) conducted one of the first studies on training teachers to conduct descriptive analyses and function-based interventions. Three teacher participants were trained through modeling and performance feedback. Training consisted of two 4-hr sessions with the teacher participants. Researchers provided teachers with a hypothesized function of challenging behavior and asked them to select an intervention based on function. They then discussed procedures for selecting an intervention based on the hypothesized function of a student's behavior, observing and

recording the target challenging behavior, conducting response blocking of the challenging behavior if it presented a physical risk, and using DRA. Then, one of the researchers selected an intervention and trained the teachers to use individualized procedures to reduce the frequency of students' challenging behavior. During training, the researcher provided instructions and modeled appropriate procedures, observed teachers' implementation of the procedures, and provided immediate performance feedback in the form of descriptive praise and error correction. Teacher participants also observed and recorded challenging behavior. Results indicated teachers' implementation of the intervention led to a decrease in challenging behavior. However, the study did not evaluate whether training and interventions were socially acceptable to teacher participants, nor were there any procedural integrity measures.

DiGennaro, Martens, and Kleinmann (2007) trained four teachers to implement function-based intervention packages to reduce challenging behavior of students with traumatic brain injury. Authors used a single-case, multiple-baseline-across-dyads research design to determine effects of goal setting and performance feedback on teachers' procedural integrity of intervention implementation. Teachers with low procedural integrity received additional consultation and support from trainers to practice missed steps. Findings indicated the training package of goal setting, performance feedback, and consultation resulted in high levels of procedural integrity. In addition, higher levels of procedural integrity were related to lower levels of student challenging behavior for three of the four teacher/student dyads. Finally, three of the four teachers also regarded performance feedback procedures as highly acceptable.

Mustian (2010) trained two general education teachers to conduct FBAs and implement function-based vs. nonfunction-based interventions with two African American students at risk for E/BD. Training consisted of four modules closely aligned with the phases of FBA (O'Neill et al., 1997), including ABA basics, Positive Behavior Support and FBA overview, the functional assessment interview, validating the interview through direct observation using an observation form, functional analysis hypotheses and manipulations, and designing and implementing BIPs. Each training module lasted 2-3 hr using a PowerPoint© format. The experimenter used model-lead-test procedures, multiple exemplars, and opportunities for teachers to practice newly acquired skills during each session. Results indicated teachers' designed and implemented function-based interventions resulted in greater decreases of student off-task behavior than nonfunction-based interventions. Additionally, descriptive results demonstrated both teachers were able to implement FBAs and function-based interventions with high levels of procedural integrity. Finally, social validity data suggested teachers felt FBAs and function-based interventions were socially important.

In another study, Flynn, Lo, and Anderson (2011) trained a special education classroom teacher to design FCT procedures for three students with ASD based on results of a TBFA. Training procedures included reviewing procedural checklists, conducting demonstrations, role-playing with the teacher, and providing performance feedback during a 1-hr session. In addition, 10-min review sessions were provided on an as-needed basis before each intervention session, with performance feedback given to the teacher after each session. Results indicated the teacher was able to implement FCT procedures with all three students with 98% procedural integrity. Challenging behavior decreased for

all students, and the number of academic responses and appropriate mands increased for all students. To address the issue of students manding during group instruction at unacceptable high rates, the authors also trained the teacher to thin the schedule of reinforcement for each student using a delay-to-reinforcement procedure. All schedules were thinned successfully without affecting academic responses. A limitation of this study is that data collection was completed by the first author and not the teacher.

Procedural Integrity

Examining the degree to which FBI are implemented with high procedural integrity in schools is important for several reasons. First, research suggests teachers fall short in implementing interventions with accuracy in spite of receiving a great deal of initial training (e.g., DiGennaro, Martens, & McIntyre, 2005). This is a waste of time and resources for both teachers and trainers. Second, previous research suggests students' challenging behavior are negatively associated with procedural integrity, meaning low levels of challenging behavior are correlated with high levels of procedural integrity (Wilder, Atwell, & Wine, 2006). Consequently, a teacher's failure to implement FBI may result in poor outcomes for students so challenging behavior will not decrease and/or appropriate behavior will not increase. Finally, recent legislation, such as IDEA (2004) mandates teachers be held accountable for their instruction. Thus, there has been an emphasis on evidence-based practices in school settings, as well as on precise intervention implementation.

Summary

Previous research demonstrates that with training that includes components such as practice, role-playing, and performance feedback, teachers can be taught skills

necessary to implement FBI in school settings. However, limitations of these studies indicate experimenters did include all necessary components of designing and implementing FBI, including data collection (e.g., Flynn et al., 2011) and social validity and procedural integrity measures (e.g., Lalli et al., 1993). These skills are critical to maintaining accurate implementation of function-based interventions, as well as to motivating teachers to continue to implement these interventions without resorting to non-effective procedures.

Summary of Review of the Literature

Students with ASD or E/BD often exhibit challenging behaviors that impede their learning or the learning of others. Function-based interventions based on results of an FBA conducted by teachers have been shown to be effective for students with a range of disabilities, including those with an ASD or E/BD (Ervin et al., 2001). However, one concern has been the lack of teachers' skill to conduct the entire FBA process with high procedural integrity (Scott et al., 2004). The lack of knowledge of the FBA process and operant conditioning of teachers are also barriers to application. Training in operant conditioning for teachers could address a number of barriers identified in the research. First, selecting appropriate function-based interventions matched to function would be enhanced, reducing the tendency of exclusionary strategies to be selected for escape maintained behavior (e.g., Scott et al., 2004), and lessen confusion when behavior maintained by multiple functions occur. Second, understanding FBA and operant conditioning might lessen negative teacher attitudes toward the FBA process (Hendrickson, Gable, Conroy, Fox, & Smith 1999). Third, data collection and analysis

may be optimized (Ervin et al., 2001). Finally, increased knowledge and involvement of teachers could increase the appropriate fit of interventions selected for the classroom.

Presently, teachers are involved in FBA through indirect assessment and through some collaboration around hypothesis statement development (O'Neill & Stephenson, 2009). However, teachers are less likely to be involved with direct data collection and are least likely to be involved in implementing FA to confirm hypotheses (O'Neill and Stephenson). This seems to be the area where teachers need most training and support, both in operant conditioning and in procedures for safely and accurately carrying out manipulations. More research into involving teachers in the FA design and implementation and FBI planning and implementation is warranted.

CHAPTER 3: METHOD

This chapter includes the methodology used for the current study. Information is provided on participants, settings, materials used, dependent variables, experimental design, intervention, interobserver agreement, procedural integrity, and social validity.

Participants and Settings

Participants in this study included 3 teacher/student triads in a middle school in a southeastern urban school district in the United States. Specific procedures for obtaining teacher and student participants are described below.

Teachers. A program specialist for the school district identified three middle school special education teacher participants who teach students with ASD or students with E/BD, and who needed additional support in behavioral assessment and intervention strategies. Teachers were also selected because they had limited or no prior experience or training in conducting FA. Consent to conduct research was obtained from the principal at the school (see Appendix A for the form). Once principal permission was obtained, potential teacher participants were told that the experimenter was evaluating a training package to help teachers analyze and address challenging behaviors in the classroom through the assessment of students' challenging behaviors. Three female teachers provided written consent to participate in the study (see Appendix B for the form). Each teacher completed a demographic form describing her years of experience, previous experience working with students demonstrating challenging behavior, previous

experience in conducting functional analysis, degree and level of education, and certifications (see Appendix C for the form). Teacher 1 held a B.A. in Special Education and Elementary Education. At the time of the study, she had 11 years of experience in teaching middle school students in a self-contained setting. She had no prior experience with students with ASD or E/BD, and no training in FA procedures or previous experience conducting FA. Teacher 2 held a Graduate Certificate in Special Education. She had 6 years of experience in teaching middle school students in a self-contained setting. She had prior experience working with students with ASD, and no training in FA procedures. She did have previous experience conducting an FBA for a project required in her certificate program. Teacher 3 held an M.Ed. in Special Education. She had 13 years of teaching experience in resource room settings; of which 10 were at the middle school level and 3 were in elementary school level. She had previously worked with students with ASD or E/BD, and no training in FA procedures or previous experience conducting FA. All three teachers held no additional certifications. See Table 1 for teacher participants' demographic information.

Table 1

Teacher Participant Demographics

Teacher	Highest Degree Earned	Years of Full-Time Teaching	Current Position	Previous Experience with Students with ASD or E/BD	Previous Professional Development or Training in FA	Previous Experience Conducting an FBA or FA with Students
1	B.A. in Special Education and Elementary Education	11 years in middle school	Self-contained teacher	None	None	None
2	B.A. + Graduate Certificate in Special Education	6 years in middle school	Self-contained teacher	Started teaching career as a 1:1 aide for a student with autism. Have taught many students with autism.	None	Completed an FBA as part of teaching certificate requirement. Created own data sheet to record behaviors.
3	M.Ed. in Special Education	10 years in elementary and 3 years in middle school	Resource Teacher	Volunteered at TEACCH at UNC Chapel Hill. Taught students with E/BD.	None	None

Note. ASD = autism spectrum disorders, E/BD = emotional/behavioral disorders, FA = functional analysis, FBA = functional behavioral assessment, TEACCH = Treatment and Education of Autistic and Related Communication Handicapped Children

Students. Each participating teacher completed a brief form (see Appendix D for the form) identifying two students who demonstrated high rates (i.e., high number of responses emitted during a particular amount of time), and/or duration (i.e., extended amount of time the response occurs) of challenging behavior in her classroom. Students identified by their teachers were selected for participation according to the following criteria.

1. Students had either a diagnosis of ASD or E/BD with an Individualized Education Program (IEP), regardless of whether these students had a Behavior Support Plan in place. Students with ASD or E/BD were the focus of this study due to the prevalence of challenging behaviors exhibited by these students, which consequently affected level of need for effective behavioral assessment and intervention strategies.
2. There was a clear description of challenging behavior according to the information provided by the teacher. Students were chosen based on the demonstration of high rates, duration, unacceptable response latencies, and/or high intensity of challenging behavior. Demonstration of challenging behavior was then verified through direct observations indicated in item 3 below.
3. The experimenter conducted direct observations of the occurrence, duration, and/or response latency of each student's challenging behavior (see Appendix E for the form, Left Panel). Two 30-min observations were conducted of each student. Instances of challenging behavior had to occur at least 10 times during each observation for a student to be selected for participation. Students who exhibited behaviors that were long in duration (i.e., lasting a total of at least 15

min out of a 30-min observation) or strong in intensity (e.g., forcefully slapping a peer) were also included. Finally, a response latency of more than 15 s for a response (e.g., student who began task 20 s after a teacher directive) was included.

4. Parents provided written parental consent to participate (see Appendix F for the form).
5. Students provided written assent to participate (see Appendix G).

Two students (i.e., Student A and Student B) in each class were selected for participation. Student B in each class was involved in the generalization measure (described later). Student 1A (in Teacher 1's class) was a 12-year-old Korean male student with a diagnosis of autism. His challenging behavior included vocal outbursts above conversational level and elopement (i.e., getting up and moving away from designated area without permission). Student 1B was a 12-year-old African American male with a diagnosis of autism. His challenging behavior included vocal outbursts above conversational level. Student 2A was an 11-year-old Hispanic male with a diagnosis of autism. His challenging behavior was vocal outbursts above conversational level. Student 2B was an 11-year-old African American male with a diagnosis of autism. His challenging behavior included giggling. Student 3A was an 11-year-old Hispanic male with a diagnosis of autism. His challenging behavior was self-stimulation (i.e., touching the genital area longer than 3 s). Finally, Student 3B was a 12-year-old Caucasian female with a diagnosis of E/BD (specifically, Oppositional Defiant Disorder). Her challenging behavior included vocal outbursts above conversational level. Table 2 reports target

student information including age reported in years, ethnic background/gender, disability diagnosis, and topographies of challenging behavior.

Table 2

Target Student Information Including Age Reported in Years, Ethnic Background/Gender, Disability Diagnosis, and Topographies of Challenging Behavior

Student	Age	Ethnicity/Gender	Disability Diagnosis	Topographies of Challenging Behavior
1A	12	Korean male	autism	Vocal outbursts (e.g., "Power Rangers!") above conversational level. Elopement (i.e., getting up and moving away from designated area without permission)
1B	12	African American male	autism	Vocal outbursts (e.g., "School is stupid!") above conversational level
2A	11	Hispanic male	autism	Vocal outbursts (e.g., "Guns!")
2B	11	African American male	autism	Giggling
3A	11	Hispanic male	autism	Self-stimulatory behavior (i.e., squeezing genital area) lasting more than 3 s
3B	12	Caucasian female	E/BD	Vocal outbursts (e.g., "You are so stupid!")

Settings. All training and implementation procedures occurred in a middle school in a large southeastern urban school district. The school district consisted of 88 elementary schools, 39 middle schools, 28 high schools, and 4 special separate schools for students with special needs. Total student enrollment for the 2011-2012 was 140,746, with 10.4% of these students receiving special education services. Ethnicities of students

included African American (41%), Caucasian (32%), Hispanic (17%), Asian (5%), Multi-racial (2%), and American Indian (.004%).

The middle school had 38.2% of students receiving special education services (i.e., students who had disabilities and students who were academically gifted). All data collection and intervention sessions occurred in the teachers' classrooms to which each participating teacher was assigned, and were conducted in each teacher's respective classroom 5 days per week. Teacher 1's class included only students with moderate to severe intellectual disability and/or autism. Including the two target students, there were 13 students in the class along with two teacher assistants. Data collection on TBFA and FBI implementation took place during the 30-min math group instruction. During instruction, students were seated in a horseshoe arrangement, facing the SMART Board™. Training took place in the same classroom after school. Teacher 2's class included only students with moderate to severe intellectual disability and/or autism. There were a total of 15 students, including the two target students. Teacher 2 also had two teacher assistants in the room. Data collection on TBFA and FBI implementation took place during the 30-min literacy group instruction with students being seated in a horseshoe arrangement, facing the SMART Board™. The teacher training took place in the same classroom after school. Finally, Teacher 3's class included 12 students with high-incidence disabilities (e.g., learning disabilities, E/BD, mild intellectual disability). Teacher 3 did not have a teacher assistant. Data collection on TBFA and FBI implementation took place during the 30-min social studies group instruction. During instruction, all students were seated facing the SMART Board™. The training for the teacher took place in the same classroom after school.

Materials

For the TBFA sessions, condition cards (i.e., control and test cards with the name of each condition to alert the teacher when each segment was beginning and ending) on white, letter-sized pieces of paper were created by the experimenter. In addition, teacher participants were given descriptions of each condition based on the article by Bloom et al. (2011) to use during TBFA sessions (see Appendix H). The DVD, Functional Analysis: A Guide for Understanding Challenging Behavior (Center for Autism Spectrum Disorders: Southern Illinois University Carbondale, 2005), was used during TBFA training. The experimenter developed and used a training checklist during both TBFA and FBI training sessions to ensure all training steps were completed (see Appendix I for the form). The experimenter also used her iPhone to videotape (and time) all TBFA and function-based intervention (FBI) sessions for data collection.

Social Validity

At the conclusion of the study, the teacher participants completed an adapted version of the Teacher Post-Intervention Acceptability and Importance of Effects Survey (see Appendix J for the form; Lane & Beebe-Frankenberger, 2004). The survey included 11 close-ended questions the teacher answered using a Likert-style scale from one (strongly disagree) to five (strongly agree). The close-ended questions addressed issues of acceptability, effects, and importance of training on both the TBFA and function-based intervention. Two open-ended questions provided the teachers with an opportunity to offer additional feedback regarding the usefulness of the training. The survey took approximately 10 min per teacher to complete.

Dependent Variables and Response Measurement

There were three dependent variables for this study. All observational sessions were videotaped for data collection purposes.

Teacher behaviors. To evaluate the efficacy of training and performance feedback, data were collected on teacher behaviors. Specifically, teachers' procedural integrity during both TBFA (Phase 1) and intervention sessions (Phase 2) were measured by the experimenter. For the TBFA sessions, each 30-min session was divided into approximately eight 4-min intervals (each TBFA condition was repeated twice), and teacher integrity was evaluated using a 54-step procedural integrity checklist (see Appendix K for the form), according to responses relevant to the condition and the behavior. Components of the procedural integrity checklist included each condition, teacher specific behaviors as antecedents and consequences to student behaviors, and whether each step was performed correctly or incorrectly. For the FBI sessions, teacher integrity was evaluated according to the accuracy in the intervention design (e.g., whether addressing the behavioral function), type of intervention selected, and teachers' accurate implementation of the intervention in the classroom (see Appendix E, Right Panel; and Appendix L). Components of the procedural integrity form included the intervention components and the number of steps completed correctly. Teacher procedural integrity was determined by percentage correct, calculated by dividing the number of steps implemented correctly by the total number of steps implemented, and multiplied by 100.

Student challenging behaviors. Individualized operational definitions were developed for each student's topography of challenging behavior. Vocal outbursts (Student 1A, Student 1B, Student 2A, Student 3B) were defined as utterances above

conversational level (e.g., “La-la-la!”). Elopement (Student 1A) was defined as getting up and moving away from designated area without permission. Giggling (Student 2B) was defined as laughing that appeared to serve no apparent function at the moment of the social context. Self-stimulation (Student 3A) was defined as hands touching the genital area longer than 3 s. To determine the function of behavior during TBFA sessions during Phase 1, observations were conducted using a 1-min continuous partial-interval recording procedure for control segments and a 3-min partial-interval recording procedure for test segments (The Florida Center on Self-Injury, 2007). Specifically, any time the targeted challenging behavior occurred during each interval, the “+” was circled. If the targeted challenging behavior did not occur during the interval, the “-“was circled. Partial interval recording is most appropriate for TBFA data collection because the experimenter was interested in behavior that occurred during any part of the interval and that typically did not consume the entire interval. It provides a conservative estimate of frequency of a challenging behavior with a stringent measure. The total percentage of challenging behavior can be calculated for each condition to facilitate comparison. To evaluate the effects of the function-based intervention on student behavior during phase 2, data were collected on students’ challenging behaviors and replacement behaviors (described below) during both pre-training and intervention conditions. Since all target challenging and replacement behaviors had a discrete beginning and end, an event recording method was used to record each occurrence of challenging behavior exhibited by the student during each 30-min session. The form used for recording the challenging behavior is presented in Appendix E.

Student replacement behaviors. The number of occurrences of replacement behavior demonstrated by students during pre-training and intervention conditions was recorded by the experimenter to determine the effects of FBI on students' appropriate replacement behavior. Replacement behaviors were individually identified for each student in consultation with the participating teacher after determining the function of behavior and each student's current response form upon completion of the TBFA. For Student 1A, the replacement behavior included verbally manding for a break (i.e., "Break, please?) at an appropriate conversational level to replace his challenging behavior of vocal outbursts and elopement to access a break. For Student 1B, the replacement behavior included raising his hand to mand teacher attention (i.e., quietly raising his hand without yelling out at the teacher to access her attention). Student 2A's replacement behavior included raising his hand to mand teacher attention (i.e., quietly raising his hand without yelling out at the teacher to access her attention). For Student 2B, the replacement behavior included using a picture symbol to mand for a break (i.e., holding up the picture symbol for the teacher to see instead of giggling to access a break). Student 3A's replacement behavior included squeezing a 2-inch rubber ball instead of touching his genital area to obtain automatic reinforcement. For Student 3B, the replacement behavior included verbally manding for a break (i.e., "May I have a break, please?") instead of yelling out to the teacher to mand for a break. Occurrences of replacement behaviors were collected using an event recording and were recorded using the form presented in Appendix E.

Experimental Design

A multielement research design was employed for the TBFA conditions (Kazdin, 1982). Specifically, four test conditions (i.e., Attention, Ignore, Tangible, Demand) were being compared to each other, as well as to a Control condition, to determine behavioral function for each student participant. Following the TBFA, an intervention evaluation phase was conducted using a multiple-probe-across-participants (i.e., teacher-student triads) research design (Horner & Baer, 1978) to examine each teacher's percentage of steps performed correctly during TBFA and FBI implementation sessions. The multiple-probe-across-participants design allowed the experimenter to introduce training to each teacher participant at staggered points in time and allowed the experimenter to examine if changes in the teacher behavior occurred when and only when the training took place. Further, this design allowed the experimenter to obtain frequent and systematic measures to examine each participant's behavioral change without exposing participants to prolonged baseline measurement (Horner & Baer, 1978). Due to the training schedule and focus on teacher behavior as the primary dependent, student behavior was evaluated using a delayed multiple-baseline-across-participants research design (Cooper et al., 2007).

Although standard FA results are typically presented and analyzed using a line graph in a multielement research design, TBFA data are usually presented and analyzed using a column graph. Therefore, in the current study, data analysis of TBFA results included visual analysis of percentage of challenging behavior during each condition using a column graph. Data analysis for teacher behavior and student behavior included visual analysis of data paths often used in single-case research design studies to

determine level, trend, variability, overlap, and immediacy of effects. After stable responding was achieved in the pre-training condition, the training was applied to one of the teacher participant with the most stable pre-training data while pre-training conditions were maintained for the other participants. After change was observed in the first teacher/student dyad (e.g., increases in teacher procedural integrity, increases in student replacement behavior, decreases in challenging behavior), the intervention was applied sequentially to each of the remaining teacher/student dyad in the design. There were at least five data points per phase of the study according to Kratochwill et al.'s (2010) recommendation for multiple-probe research designs without reservations.

Phase 1: Trial-based Functional Analysis (TBFA)

For Phase 1 of this study, the primary purpose was to determine the effects of training on teachers' ability to conduct TBFA with high procedural integrity. A secondary purpose was to identify the functions of challenging behavior for each student participant.

Procedures

TBFA pre-training. Each teacher participant conducted TBFA conditions (i.e., demand, attention, tangible, ignore, with a control segment for each condition) with Student A in their respective classroom. Teachers were given the descriptions of all conditions pertaining to TBFA procedures described in the Bloom et al. (2011) study and told to review them prior to conducting these TBFA sessions (see Appendix H). No specific training on the TBFA conditions was given to teachers. Prior to TBFA pre-training sessions, all three teachers enlarged their condition descriptions to two 36" x 36"

page dimensions (two conditions per page) and taped them to the wall for easy viewing during conditions.

During the TBFA pre-training condition, students were involved in their regular routine during all sessions. The experimenter randomized the sequence of all conditions for each TBFA session and visually prompted teachers to begin and end each condition by holding up a corresponding statement paper (e.g., Start "Attention" Condition, End "Attention" Condition). Teachers had access to a MotivAider® (a silent vibrating device to signal the end of a predetermined time such as 4 min) to assist with the timing of each segment within each TBFA condition. Each TBFA trial was approximately 4 min (or less) in duration; one min for the control segment and 3 min for the test segment. There were two trials of each condition within each session. Teachers viewed the condition descriptions (Appendix H) mounted on the wall as reminders during their implementation; however, no specific instruction, prompt, or any feedback from the experimenter was provided. The form used for data collection during each condition of the TBFA is presented in Appendix M. The teacher conducted the four conditions according to the following procedures.

Attention. The purpose of the attention condition was to determine if the function of behavior was to mand teacher attention. During the control segment, the teacher was near the student, and a reinforcing activity was available. The teacher delivered attention every 20 s throughout the segment on a fixed-interval schedule and was not to respond to the targeted challenging behavior. At the end of the 1 min control segment, the 3 min test segment began. The teacher moved away from the student and ignored him or her. If the student exhibited the targeted challenging behavior, the teacher moved close to the

student, issued a statement of concern and/or a reprimand, and the trial was terminated. If the student did not exhibit the targeted challenging behavior, the test segment continued until the 3-min period ended. If the student left his or her seat during the trial, the teacher remained close in proximity but did not interact with the student. If the student interacted with a peer or a staff member during this segment, the trial was considered unsuccessful and was noted on the data sheet. That trial was conducted at a later time.

Demand. The purpose of the demand condition was to determine if the function of behavior was to escape an aversive task. During the control segment, the student was seated with access to leisure items, but no work items. The teacher delivered attention every 20 s throughout the segment on a fixed-interval schedule and did not respond to the targeted challenging behavior. The student was not to be blocked from attempting to leave the work area, but if a demand was placed on the student during this time, the trial was considered unsuccessful and was noted on the data sheet. At the beginning of the test segment, the teacher initiated work using a three-step response prompting procedure (i.e., vocal prompt, model prompt, and physical prompt). If the student exhibited the targeted challenging behavior, the teacher terminated the session by removing the work demand and turning away without any verbal exchange. If the student attempted to leave his or her seat during this segment, the teacher blocked the attempt and continued prompting. If the student did not exhibit the targeted challenging behavior, the test segment continued until the 3-min period ended.

Tangible. The purpose of the tangible condition was to determine if the function of behavior was to obtain a preferred item or activity. Before teacher implementation of the tangible condition, the experimenter conducted one paired-stimulus (i.e., forced

choice) preference assessment (Fisher et al., 1992) with the student participant to identify a highly preferred item or activity (see Appendix N for the form). Each item was numbered, and the experimenter presented two numbered items simultaneously (one on the left, one on the right). Using a total of 30 trials, the experimenter calculated the percentage of trials that each item was selected by the student. Those items selected 80% or more of opportunities were considered to function as a tangible reinforcer, and were used in tangible conditions of the TBFA. During the control segment, the teacher delivered attention every 20 s throughout the segment on a fixed-interval schedule and did not respond to the targeted challenging behavior. At the beginning of the test segment, the teacher removed any preferred items from the student's reach for 3 min, but kept it in the student's view. If the targeted challenging behavior occurred, the teacher gave the item to the student immediately (with no verbal exchanges, eye contact, or physical contact) and the trial was terminated. If the student left his or her seat during the trial, the teacher remained close in proximity but did not interact with the student. If the student obtained a preferred item on his or own, and/or from another student or adult during this segment, the trial was considered unsuccessful and was noted on the data sheet. That trial was conducted at a later time. If the student did not exhibit the targeted challenging behavior, the test segment continued until the 3-min period ended.

Ignore. The purpose of the ignore condition was to determine if the function of behavior was automatic reinforcement (e.g., sensory consequences). Ignore trials consisted of two consecutive 2-min test segments in which the student was seated alone, with no access to leisure or work materials. The teacher did not provide verbal exchange or eye contact with the student. The teacher ignored all challenging behavior occurrences

and all appropriate behaviors. The student was allowed to leave the area; but if the student's actions interfered with the trial (e.g., interacted with a preferred item) the trial was considered unsuccessful and noted on the data sheet. That trial was conducted at a later time.

TBFA training. After the TBFA pre-training condition, the teacher participant attended a 2-hour training session with the experimenter. The training consisted of teaching and practicing with the teacher the accurate implementation of all TBFA conditions. The experimenter first explained the rationale for conducting the TBFA; and how doing this would help them select appropriate interventions that focus on replacement behaviors, DRA, and extinction to reduce the students' challenging behavior. Then, the experimenter explained the purpose of each TBFA condition and described the procedures for both control and test segments of each condition (Appendix H). The experimenter then provided a videotaped demonstration of each condition (Center for Autism Spectrum Disorders: Southern Illinois University Carbondale, 2005) and involved the teacher in role-playing. The participant alternated between playing the role of a student and the role of the teacher with the experimenter for each of the conditions until all roles and all conditions were practiced. After role-playing, the teacher watched one of her videotaped pre-training sessions and the experimenter provided feedback on teacher's implementation for training purposes. Then, the experimenter answered any questions pertaining to the TBFA conditions. Training continued until the teacher conducted one role-playing session for all four conditions with 100% accuracy, following the steps outlined in Appendix I. Finally, the experimenter trained the teacher to collect data on Student A's occurrence or nonoccurrence of challenging behavior by

watching one videotaped pre-training TBFA session and using the same data collection form used by the experimenter. The teacher's data were then compared to the experimenter's for an accuracy check (see Appendix L for the TBFA data collection form). Training on determining the behavioral function based on sample TBFA data was also provided to the teacher. Similarly, training on the data collection and data analysis continued until the teacher met the 100% accuracy criterion.

TBFA with feedback. Following the training, the teacher conducted TBFA with Student A in the classroom. Similar to the pre-training condition, students were involved in their regular routine during all sessions. The experimenter randomized the sequence of all conditions for each TBFA session and prompted teachers to begin and end each condition by holding up a corresponding statement paper. Teachers had access to a MotivAider® to assist with the timing of each segment within each TBFA condition. Each TBFA trial was 4 min (or less) in duration; one min for the control segment and 3 min for the test segment. Teachers viewed the condition descriptions mounted on the wall to serve as step-by-step reminders of the conditions during the implementation.

For each TBFA session, the experimenter monitored teachers' implementation integrity. Feedback and additional practice (e.g., verbal explanation, video demonstrations, role-playing) were provided to each teacher following the session if procedural integrity fell below 90% for any TBFA condition. If the teacher met or exceeded the 90% criterion, she was provided verbal praise with specific feedback on what she did correctly. Each feedback session lasted approximately 5 min. After the teacher completed at least five TBFA sessions with 90% accuracy, the experimenter reviewed the data with the teacher to determine the behavioral function for Student A. To

measure teacher's procedural integrity on data collection, the teacher also watched one randomly selected videotaped TBFA session with at least 90% implementation integrity and collected data on Student A's occurrence of challenging behavior. Teacher's data were compared to the experimenter's to determine integrity. For feasibility and practical reasons, teachers viewed only one videotaped session for data collection.

Generalization probes. After the TBFA was completed with Student A, the teacher participant conducted five TBFA sessions independently with Student B. All implementation procedures were the same as those described under pre-training TBFA. The purpose of the generalization probes with Student B was to determine teachers' transfer of skills on TBFA implementation to another student without experimenter's feedback. For practical reasons (e.g., teaching responsibilities), the teacher watched one out of the five videotaped TBFA sessions with Student B to collect the occurrences of the challenging behavior and to determine the behavioral function based on the data. The experimenter randomly selected one videotaped session with at least 90% teacher implementation accuracy for teacher's viewing to ensure correct identification of the function. The teacher's data collection and identification of the behavioral function was reported in the teacher's procedural integrity data. If none of the sessions meets the 90% implementation accuracy, one session with the highest accuracy level was selected for teacher's viewing. To ensure accuracy, the experimenter reviewed all five TBFA sessions, shared the data analysis results with the teacher, and provided feedback as needed to make a final determination about the function before moving on to Phase 2 of the study.

Phase 2: Function-based Intervention (FBI)

For Phase 2 of this study, the primary purpose was to determine the effects of training on teachers' ability to design and implement appropriate FBI with high procedural integrity. A secondary purpose was to measure the occurrences of challenging behavior and appropriate replacement behavior exhibited by each student participant before and during intervention.

Procedures

FBI pre-training. The primary purpose of FBI pre-training was to document teachers' responses to students' targeted challenging behavior based on their skills acquired from TBFA training when they are introduced the link between TBFA, replacement behavior, DRA, and extinction. The experimenter did not provide any performance feedback or training to teachers on how to select a replacement behavior, and implement DRA and extinction. The experimenter conducted direct behavioral observations of each teacher-Student A dyad prior to FBI training. All observations were 30 min in length. All direct behavioral observations were conducted in the same classroom in which the TBFA was implemented. Data included descriptions of teacher responses to challenging behaviors and replacement behaviors (see Appendix J). The secondary purpose of FBI pre-training condition was to document levels of students' challenging behaviors and replacement behaviors so comparisons could be made to post-intervention levels. Data provided occurrences of student's challenging and replacement behaviors. At least five baseline data points were collected to show stability before conducting the FBI training.

FBI training. The teacher participant attended a 1-hour FBI training session with the experimenter. Based on results of the TBFA for Student A, the maintaining variable for challenging behaviors (i.e., escape, attention, tangible, automatic reinforcement) was reviewed one-on-one with the teacher. The training focused on (a) explanation and discussion of two primary FBI procedures: a differential reinforcement of alternative behavior (DRA) and extinction; (b) design of a function-based intervention for Student A in collaboration with the teacher considering the contextual fit for the classroom; (c) explanation of how these procedures are appropriate for addressing the function of Student A's challenging behaviors; (d) modeling and practice of the intervention implantation via role-play with performance feedback; and (e) explanation and discussion of data collection method and data analysis to determine intervention effectiveness. For example, if the function of the behavior was manding teacher attention, the experimenter assisted the teacher in selecting an appropriate alternative mand for the student (e.g., the student will raise his or her hand instead of yelling at the teacher to get the teacher's attention). The DRA component, in this case, involved the teacher immediately responding to trained appropriate mands with adult attention when the student raised his or her hand without exhibiting the targeted challenging behavior. With the extinction component, the teacher used planned ignoring for attention-seeking behavior. The teacher did not move to actual implementation of the intervention until he or she has role-played one session of implementing the designed interventions with 100% accuracy. Additionally, the experimenter trained the teacher to collect data using the same event recording method employed by the experimenter on occurrences of challenging behavior and replacement behavior for Student A by watching a randomly selected videotape of

one FBI pre-training session. Training on data collection continued until the teacher achieved 100% accuracy.

FBI with feedback. The function-based intervention, designed in collaboration with the teachers during training, was implemented by the teachers with Students A in their respective classrooms. All sessions were 30 min in length. The decision to terminate the intervention was based on Kratochwill et al.'s (2010) recommendation of at least five data points, teacher's procedural integrity data of at least 90%, and an indication of an increase in the student's appropriate replacement behavior and a reduction in challenging behavior. This was determined based on a consensus of the experimenter and teacher through data analysis.

For each FBI session with Student A, the experimenter monitored teacher's implementation integrity. Feedback and additional practice (e.g., verbal explanation, video demonstrations, role-playing) were provided to the teacher following the session if the procedural integrity fell below 90% accuracy. If the teacher met or exceeded the 90% criteria, she was provided verbal praise with specific feedback on what she did correctly. To measure teacher's procedural integrity on data collection, the teacher also watched one randomly selected videotaped FBI session and collected data on Student A's occurrence of challenging behavior and replacement behavior. Teacher's data were compared to the experimenter's to determine integrity. For feasibility and practical reasons, teachers viewed only one videotaped session for data collection. After completing at least five sessions of the intervention, the teacher participant reviewed the data on both challenging behavior and replacement behavior with the experimenter to determine the effects of the intervention for Student A.

Generalization probes. After the TBFA was completed with Student B, the teacher participant independently designed an FBI plan (that was shared with the experimenter prior to implementation) to include DRA and extinction strategies with Student B in the classroom. This occurred at least one week after the FBI training with Student A was completed to ensure teachers had the skills for generalization measure. The purpose of the generalization probes with Student B was to determine teachers' transfer of skills on the design and implementation of FBI with another student without experimenter's feedback. For procedural integrity measure, the teacher participant also collected data on one randomly selected videotaped intervention session on the occurrence of challenging behavior and replacement behavior for Student B, and determined the effects of the intervention. Data were collected on the degree to which the teacher accurately implemented the intervention, collected data on Student B's challenging behavior and replacement behavior, and determined the effects of the intervention. Prior to implementation of the FBI, teachers shared their intervention with the experimenter to ensure that it was appropriately designed. Since all three teachers designed FBI that were appropriate in addressing behavioral function, and was appropriate given students' current communication response modes, no revision of the plans was needed. At least five function-based intervention sessions took place for generalization probes. See Table 3 for a summary of challenging behavior, behavioral function, and replacement behavior for each student.

Table 3

Summary of Challenging Behavior, Behavioral Function, and Replacement Behavior for Each Student

Student	Challenging Behavior	Behavioral Function	Replacement Behavior
1A	Vocal outbursts, elopement	Escape from academic demands	Vocal-verbally manding a break
1B	Vocal outbursts	Teacher attention	Quietly raising hand to mand teacher attention
2A	Vocal outbursts	Teacher attention	Quietly raising hand to mand teacher attention
2B	Giggling	Escape from academic demands	Manding a break w/picture symbol
3A	Self-stimulatory behavior	Automatic reinforcement	Squeezing a 2-inch rubber ball
3B	Vocal outbursts	Escape from academic demands	Vocal-verbally manding a break

Interobserver Agreement

Interobserver agreement (IOA) data for teacher behaviors were collected by a trained graduate student observer on 40% of TBFA and 30% of intervention implementation sessions across all teacher and student participants. The experimenter trained the observer in all data collection procedures. The second observer was provided with operational definitions of the dependent variables and data collection sheets. Before IOA data were collected on the TBFA and FBI sessions, the observer watched two

videotaped sessions with the experimenter and practiced on the data collection procedures with the experimenter's feedback. Training continued until the observer obtained 90% accuracy or better on the data collection.

During TBFA and intervention implementation sessions, a criterion for IOA was set such that sessions on which IOA was less than 80% were not to be used to make decisions about the stability of teacher integrity or student behavior. IOA was calculated using an item-by-item method (Cooper et al., 2007; Kazdin, 1982), which consisted of dividing the number of items with which both observers recorded the same outcome for the item by the total number of items for that session and multiplying that score by 100% to obtain a percentage. IOA data were also taken and reported on students' challenging behavior and replacement behavior during 30% across FBI pre-training and FBI conditions. The gross method was used to calculate the IOA because all students' challenging behavior and replacement behaviors were frequency-based (e.g., number of occurrences). IOA was calculated by dividing the smaller number of recorded events by the larger number and multiplied by 100 to obtain a percentage of IOA.

Procedural Integrity of Training

To ensure training sessions were conducted as purported, the experimenter followed a training checklist (see Appendix I) during all 2-hour TBFA training sessions and 1-hour FBI training sessions by placing the checklist in front of her and checking off each training step as she completed. There were 18 steps for the TBFA training and 13 steps for the FBI training. The checklist included an introduction and procedure section for both trainings. The introduction section of TBFA and FBI training focused on the overview and purpose of the training. The procedure section of TBFA training included

descriptions of challenging behaviors and their functions, purpose of FA and how it links to FBI, as well as overview of TBFA procedures, role-playing, performance feedback, data collection, and determining behavioral function based on TBFA results. The procedure section of FBI training included review of behavioral functions based on results of TBFA, teaching appropriate manding skills, reinforcement procedures, least-to-most prompting, extinction, role-playing with performance feedback, and data collection.

CHAPTER 4: RESULTS

This chapter presents study results in several sections. The first section presents results for interobserver agreement, followed by teacher behavior data of TBFA pre-training, TBFA with feedback, TFBA generalization, FBI pre-training, FBI with feedback, and FBI generalization for Students A and B. In addition, results from the TBFA for each student will be discussed. The second section includes FBI data on students' challenging behavior and appropriate replacement behavior. The final section reports results of the social validity questionnaire regarding teachers' perceptions of the training.

Interobserver Agreement

During TBFA sessions (pre-training, TBFA with feedback, and TBFA generalization), IOA was obtained on 40% (6/15) of sessions with Teachers 1, 2, and 3. IOA during sessions with Teacher 1 averaged 96.8% and ranged from 95% to 98.3%. During sessions with Teacher 2, IOA averaged 99% and ranged from 96.6% to 100%. Finally, IOA during sessions with Teacher 3 averaged 97%, and ranged between 95% and 100%.

Across the TBFA conditions, total IOA averaged as follows: IOA for Teacher Attention sessions was 99% (range 97% to 100%), for Demand sessions was 96% (range 95% to 97 %), for Ignore sessions was 100%, for Tangible sessions was 97 % (range 95% to 100 %), and for Control sessions was 97% (range 95% to 100%).

During FBI sessions across Student A and Student B, IOA was obtained on 30% (3/10) of sessions with Teachers 1, 2, and 3. IOA during sessions with Teacher 1 averaged 95% and ranged from 90% to 100%. During sessions with Teacher 2, IOA averaged 96% and ranged from 95% to 100%. Finally, IOA during sessions with Teacher 3 averaged 97%, and ranged between 95% and 100%.

Teacher Behavior of TBFA Conditions and FBI Implementation

Research Question 1: What was the effect of training and performance feedback on teachers' reliable implementation of conducting TBFA procedures with students with ASD or E/BD in a school setting?

Research Question 2: What was the effect of training and performance feedback on teachers' reliable implementation of function-based intervention procedures?

Results for teachers' procedural integrity before and after TBFA and FBI training for each teacher with Students A are presented in Figure 1. The graph illustrates results across TBFA pre-training, TBFA with feedback, FBI pre-training, and FBI with feedback conditions. Data for teacher behaviors are shown as percentage of steps completed correctly, defined as the number of steps correctly implemented divided by the total number of applicable steps and multiplied by 100. Results for all three teacher participants indicated a functional relation between the TBFA and FBI training with performance feedback and an increase in accurate implementation of TBFA and FBI for each Student A.

TBFA. Teachers' integrity of the TBFA procedures is presented across two conditions in Phase 1. The first condition, TBFA pre-training, represents the level of integrity with which teacher participants performed TBFA sessions with only written

descriptions as a guide. The second condition, TBFA with feedback, represents teacher participants' integrity during sessions with Student A after receiving training from the experimenter. Teachers also received performance feedback following each session during this condition (i.e., error correction if the implementation integrity fell below 90% accuracy and praise for 90% or higher accuracy). During TBFA pre-training condition with Student A, procedural integrity data were 0% for Teacher 1, 10% (range, 5-15%) for Teacher 2, and 3.3% (range, 0-5%) for Teacher 3. During TBFA with feedback condition with Student A, procedural integrity data were 96% (range, 90-100%) for Teacher 1, 98% (range, 90-100%) for Teacher 2, and 90% (across all sessions with no range) for Teacher 3. These data indicate that all three teachers were able to implement all conditions of the TBFA with high integrity during TBFA with feedback condition (i.e., at least 90%). In addition, the data indicate that after training, accurate implementation of TBFA occurred at higher levels for all teachers than before training, with no overlap in data paths between phases, and no variability in data. Therefore, data suggest there was a functional relation between training and teachers' accurate implementation of TBFA conditions. See Figure 1 for the graphic displays of the data for teachers' TBFA implementation in multiple probe design format for Students A.

Table 4 presents data on specific areas in which each teacher missed steps to be implemented in the TBFA with feedback condition across all five sessions, as well as the number of failed segments for each condition. All three teachers demonstrated accuracy in implementing Attention conditions. However, all three teachers demonstrated difficulty using a least-to-most prompting hierarchy during Demand conditions. During Ignore conditions, Teacher 3 demonstrated errors in providing eye contact to the target

student. Finally, Teacher 1 demonstrated errors when delivering the reinforcer to the target student and providing verbal exchange during the Tangible condition.

Table 4

Weaknesses in Integrity and Failed Segments during TBFA with Feedback Condition for Teachers 1, 2, and 3

Teacher	Condition	Weaknesses in integrity	Number of failed segments
1	Attention	n/a	1 (teacher assistant provided attention)
	Demand	Prompting hierarchy	0
	Ignore	n/a	2 (peer provided attention)
	Tangible	Returning tangible to student w/o verbal exchange	0
2	Attention	n/a	0
	Demand	Prompting hierarchy	0
	Ignore	n/a	0
	Tangible	n/a	1 (peer provided attention)
3	Attention	n/a	1 (peer provided attention)
	Demand	Prompting hierarchy	0
	Ignore	Making eye contact with student	1 (student accessed tangible)
	Tangible	n/a	0

A segment was marked "failed" when the target student interacted with a potential confounding stimulus in the environment (e.g., contacted peer attention during the test segment for attention). The segment was then implemented again. For Teacher 1, one of the teacher assistants inadvertently provided attention to the target student during the test segment of one of the Attention conditions. Additionally, during the Ignore condition, a peer provided attention to the target student during two test segments. For Teacher 2, a peer provided attention during one of the Tangible condition test segments. For Teacher 3, a peer provided attention to the target student during a test segment of the Attention condition. In addition, the target student accessed a tangible reinforcer (i.e., "squeezy ball") during one of the test segments of the Ignore condition.

For Teacher 1, implementation of TBFA took a total of 52 min for Student A across five sessions. For Teacher 2, implementation of TBFA took 56 min for Student A across five sessions. Teacher 3 implemented TBFA for a total of 80 min for Student A in five sessions. These data include reimplementation of failed test segments.

FBI. Procedural integrity data were also collected on teacher implementation of FBI. Teachers' integrity of the FBI implementation is presented in Figure 1 graphically (as shown in Phase 2). The first condition of Phase 2, FBI pre-training, represents the level of integrity with which teacher participants performed FBI sessions with only skills acquired from TBFA training when they were introduced the link between TBFA, replacement behavior, DRA, and extinction. The second condition of Phase 2, FBI with feedback, represents teacher participants' integrity during sessions with Student A after viewing the training with the experimenter. Teachers also received performance feedback following each session (i.e., error correction when the integrity fell below 90% accuracy

and verbal praise for 90% or higher accuracy) during this condition. During FBI with feedback with Student A, procedural integrity data were 92% (range, 90-95%) for Teacher 1, 100% for Teacher 2, and 90% (across all sessions) for Teacher 3.

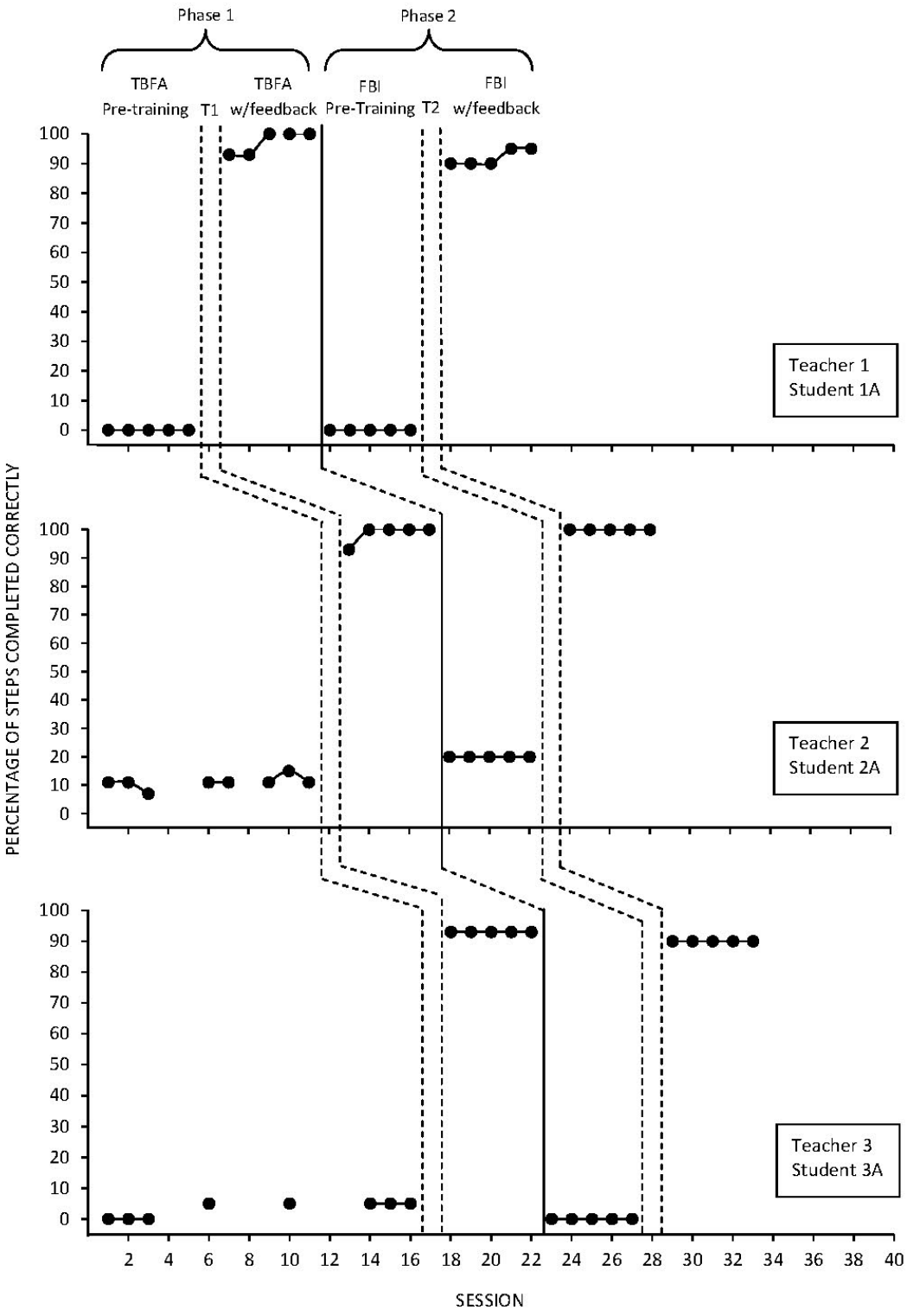

Figure 1. Percentage of steps completed correctly for Teachers 1, 2, and 3 with Students A. Note. TBFA = trial-based functional analysis, T1 = TBFA training, FBI = function-based intervention, T2 = FBI training.

Research Question 3: What was the effect of training and performance feedback on teachers' generalization of learned skills related to TBFA and FBI implementation to new students?

Results for teachers' generalized procedural integrity before and after TBFA and FBI training for each teacher with Students B are presented in Figure 2. The graph illustrates results across TBFA probe 1, TBFA probe 2 (after training was provided to the teacher with Student A), TBFA generalization, FBI probe, and FBI generalization conditions. Data for teacher behaviors are shown as percentage of steps completed correctly. The data indicated that all teachers generalized their skills in TBFA and FBI implementation with Students B, although Teacher 1 did not achieve the 90% accuracy mastery criterion for either the TBFA or FBI implementation.

TBFA. The TBFA generalization measure included three conditions. The first condition, TBFA Probe 1, represents the level of integrity with which teacher participants performed one TBFA session with only written descriptions as a guide before receiving training. The second condition, TBFA Probe 2, represents teacher participants' integrity during one session with Student B after receiving training for Student A from the experimenter. The third condition is TBFA generalization, which represents teachers' generalized implementation integrity with Student B after receiving training and performance feedback with Student A. Generalized procedural integrity data for Teacher 1 was 0% during Probe 1 and 100% during Probe 2. Procedural integrity data for Teacher 2 was 7% across both sessions during Probe 1 and 100% for Probe 2. Procedural integrity data for Teacher 3 was 1.5% (range, 0-3%) during Probe 1 and 93% during Probe 2. Procedural integrity data during TBFA generalization condition with Student B were

87% (range, 85-90%) for Teacher 1, 98% (range, 90-100%) for Teacher 2, and 96% (range, 90-100%) for Teacher 3.

These data indicate that Teachers 2 and 3 were able to generalize their skills from Student A to Student B and implemented all conditions of the TBFA with high integrity (i.e., at least 90%) after they received TBFA training and performance feedback from the experimenter. There was abrupt change in levels with no overlap in data paths before and after training (i.e., T1) and high stability within the TBFA generalization condition. Although Teacher 1 substantially improved her skills from Probe 1 to Probe 2 and TBFA generalization condition, she did not meet the mastery level. See Figure 2 for the graphic displays of the data for teachers' generalization TBFA implementation in multiple probe design format for Students B.

Table 4 presents data on specific areas in which each teacher missed steps to be implemented in the TBFA generalization condition across all five sessions, as well as the number of failed segments for each condition. Teacher 1 demonstrated weaknesses in all four conditions. Similar to TBFA with feedback conditions, all three teachers demonstrated difficulty using a least-to-most prompting hierarchy during Demand conditions. Teachers 1 and 3 demonstrated difficulty in the Ignore conditions.

Similar to TBFA with feedback condition, a segment was marked "failed" when the target student interacted with a potential confounding stimulus in the environment (e.g., contacted peer attention during the test segment for attention). The segment was then implemented again. For Teacher 1, a peer provided attention to the target student during the test segment of one of the Attention conditions. During the Ignore condition, a peer provided attention to the target student during one test segment. For Teacher 2, there

were no failed segments. Finally, for Teacher 3, a peer provided attention to the target student during a test segment of the Attention condition.

Table 4

Weaknesses in Integrity and Failed Segments during TBFA Generalization Condition for Teachers 1, 2, and 3

Teacher	Condition	Weaknesses in integrity	Number of failed segments
1	Attention	Did not provide attention contingent on challenging behavior	1 (peer provided attention)
	Demand	Prompting hierarchy	0
	Ignore	Provided verbal exchange	1 (peer provided attention)
	Tangible	Returning tangible to student w/o verbal exchange	0
2	Attention	n/a	0
	Demand	Prompting hierarchy	0
	Ignore	n/a	0
	Tangible	Returning tangible to student w/o verbal exchange	0
3	Attention	n/a	1 (peer provided attention)
	Demand	Prompting hierarchy	0
	Ignore	Provided verbal exchange	0
	Tangible	n/a	0

For Teacher 1, implementation of TBFA took a total of 66 min for Student B. For Teacher 2, implementation of TBFA took 120 min for Student B. Teacher 3 implemented TBFA for a total of 86 min for Student B. These data include reimplementation of failed test segments.

FBI. Procedural integrity data were also collected on teachers' generalized implementation of FBI with Students B. For the FBI generalization measure, data were collected across two conditions. The first condition, FBI probe, represents the level of integrity with which teacher participants performed one FBI session with Student B after receiving FBI training (T2) for Student A. The second condition, FBI generalization, represents teacher participants' integrity across five sessions of FBI implementation with Student B without any performance feedback. During FBI probe with Student B, procedural integrity data were 85% for Teacher 1, 100% for Teacher 2, and 90% for Teacher 3. During FBI generalization with Student B, procedural integrity data were 89% (range, 85-90%) for Teacher 1, 98% (range, 90-100%) for Teacher 2, and 92% (range, 90-95%) for Teacher 3. See Figure 2 for the generalization measure of teacher performance on implementation of FBI with Students B.

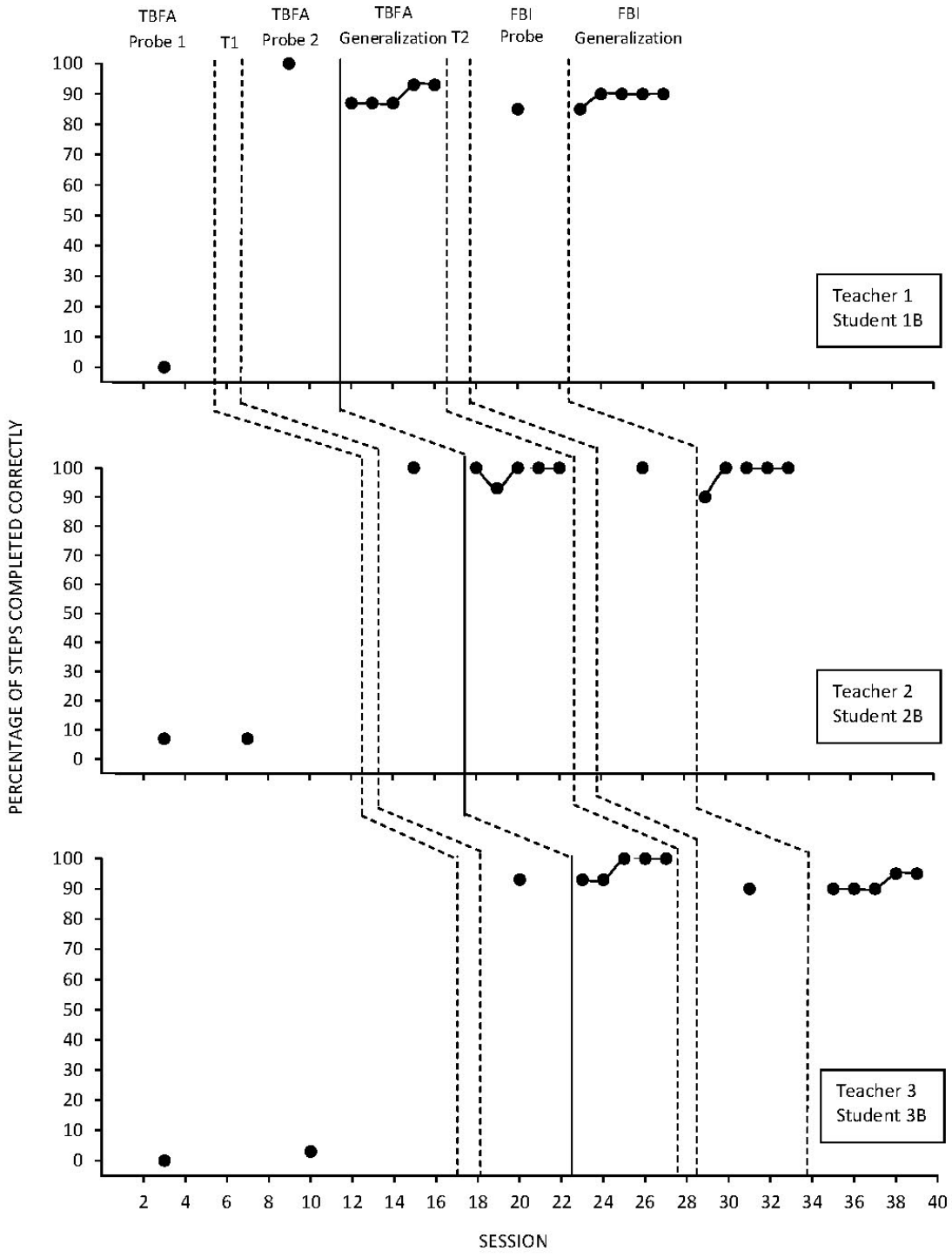

Figure 2. Percentage of steps completed correctly for Teachers 1, 2, and 3 with Students B. Note. TBFA = trial-based functional analysis, TBFA Probe 1 = TBFA pre-training with Student A, TBFA Probe 2 = TBFA w/feedback with Student A, T1 = TBFA training with Student A, FBI = function-based intervention, T2 = FBI training with Student A.

TBFA Results for Students A and B

TBFA were completed for all six student participants. Results from the TBFA were used to determine the function of behavior for each student, and to consequently develop an FBI. Prior to Teacher 1 implementing TBFA conditions with Student 1A, the experimenter conducted a preference assessment with the student (see Appendix N for the form). Results from the preference assessment indicated that the computer was the strongest reinforcer for Student 1A, and was used in the Tangible Condition. Results of the TBFA for Student 1A are presented in Figure 3. For Student 1A, vocal outbursts and elopement occurred during 17% of the observed test segments for the Attention Condition, 83% of the observed test segments during the Demand Condition, 30% of the observed intervals during the control and test segments of the Ignore Condition, and 30% of the observed test segments of the Tangible Condition. Based on these results, escape from work demands was identified as the maintaining variable for Student 1A's vocal outbursts and elopement.

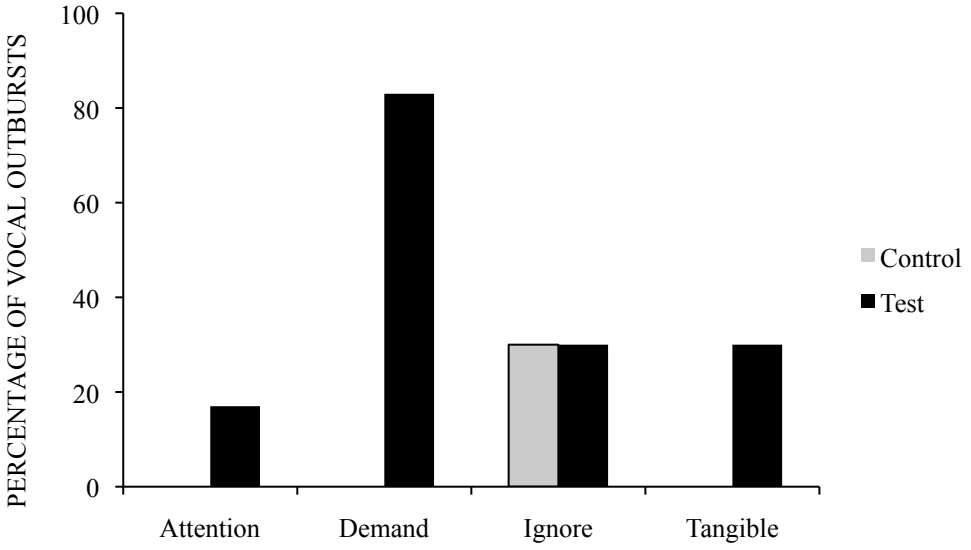

Figure 3. TBFA results for Student 1A for vocal outbursts and elopement.

Prior to Teacher 1 implementing TBFA conditions with Student 1B, the experimenter conducted a preference assessment with the student (see Appendix N for the form). Results from the preference assessment indicated that the computer was the strongest reinforcer for Student 1B, and was used in the Tangible Condition. Results of the TBFA for Student 1B are presented in Figure 4. For Student 1B, vocal outbursts occurred during 83% of the observed test segments for the Attention Condition, 17% of the observed test segments during the Demand Condition, 30% of the observed intervals during the control and test segments of the Ignore Condition, and 0% of the observed test segments of the Tangible Condition. Based on these results, access to teacher attention was identified as the maintaining variable for Student 1B's vocal outbursts.

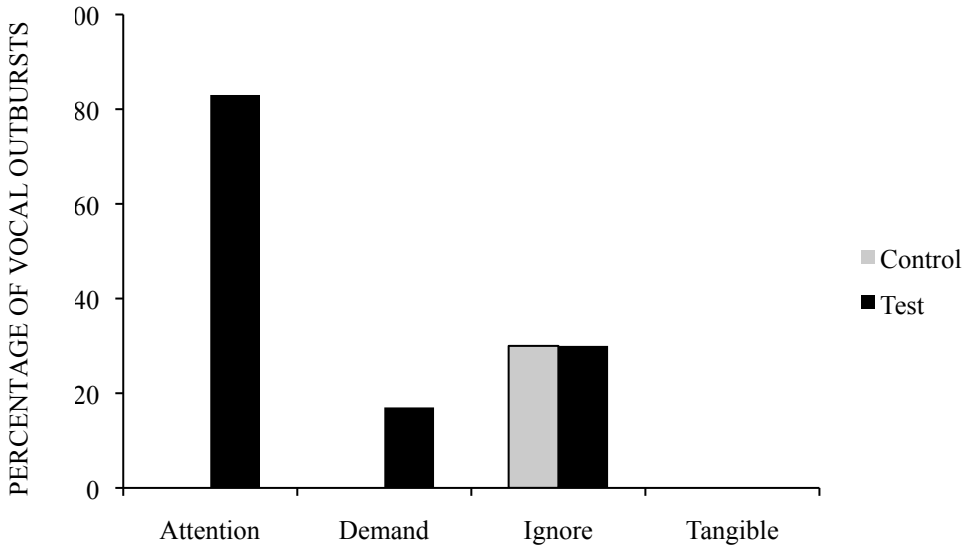

Figure 4. TBFA results for Student 1B for vocal outbursts.

Prior to Teacher 2 implementing TBFA conditions with Student 2A, the experimenter conducted a preference assessment with the student (see Appendix N for

the form). Results from the preference assessment indicated that the computer was the strongest reinforcer for Student 2A, and was used in the Tangible Condition. Results of the TBFA for Student 2A are presented in Figure 5. For Student 2A, vocal outbursts occurred during 100% of the observed test segments for the Attention Condition, 17% of the observed test segments during the Demand Condition, 17% of the observed intervals during the control and test segments of the Ignore Condition, and 17% of the observed test segments of the Tangible Condition. Based on these results, access to teacher attention was identified as the maintaining variable for Student 2A's vocal outbursts.

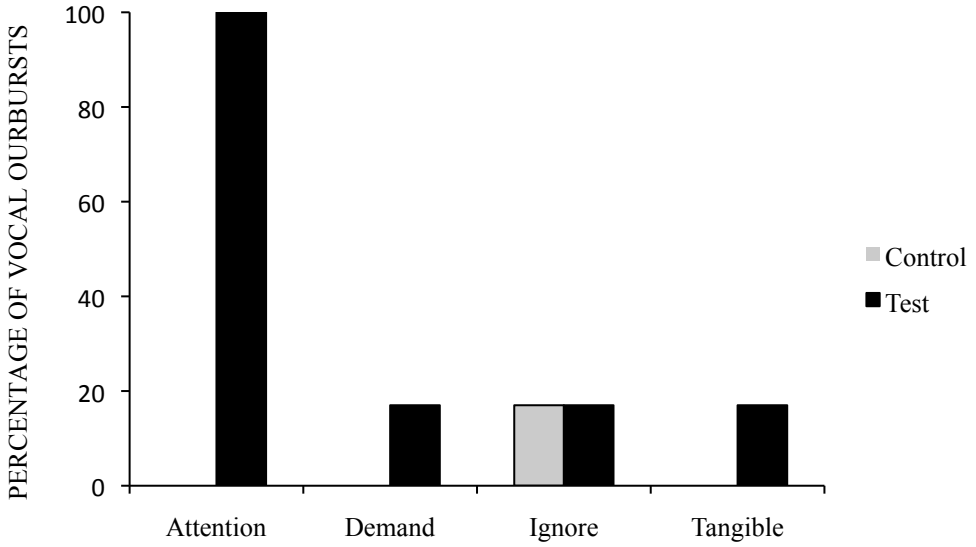

Figure 5. TBFA results for Student 2A for vocal outbursts.

Prior to Teacher 2 implementing TBFA conditions with Student 2B, the experimenter conducted a preference assessment with the student (see Appendix N for the form). Results from the preference assessment indicated that the computer was the strongest reinforcer for Student 2B, and was used in the Tangible Condition. Results of

the TBFA for Student 2B are presented in Figure 6. For Student 2B, giggling occurred during 0% of the observed test segments for the Attention Condition, 83% of the observed test segments during the Demand Condition, 17% of the observed intervals during the control and test segments of the Ignore Condition, and 0% of the observed test segments of the Tangible Condition. Based on these results, escape from work demands was identified as the maintaining variable for Student 2B's giggling.

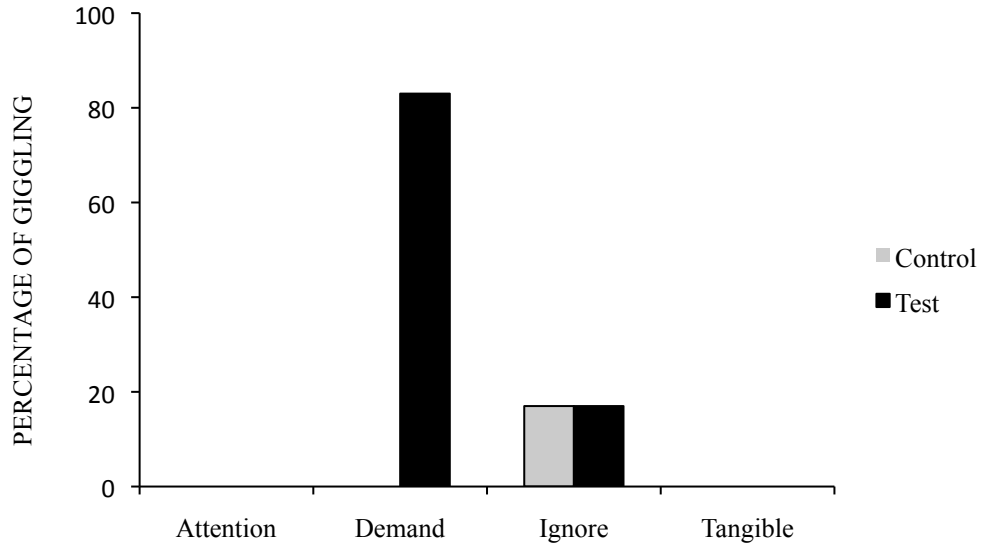

Figure 6. TBFA results for Student 2B for giggling.

Prior to Teacher 3 implementing TBFA conditions with Student 3A, the experimenter conducted a preference assessment with the student (see Appendix N for the form). Results from the preference assessment indicated that a small "squeezy ball" was the strongest reinforcer for Student 3A, and was used in the Tangible Condition. Results of the TBFA for Student 3A are presented in Figure 7. For Student 3A, self-stimulatory behavior (i.e., masturbation) occurred during 17% of the observed control

segments for the Attention Condition, 0% of the observed test segments during the Demand Condition, 83% of the observed intervals during the control and test segments of the Ignore Condition, and 0% of the observed test segments of the Tangible Condition. Based on these results, automatic reinforcement was identified as the maintaining variable for Student 3A's self-stimulatory behavior.

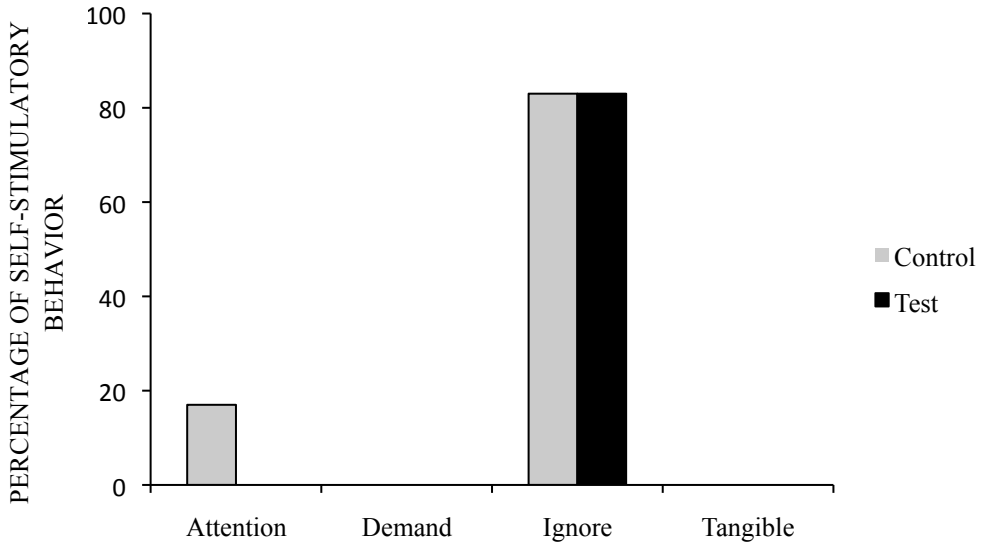

Figure 7. TBFA results for Student 3A for self-stimulatory behavior.

Finally, prior to Teacher 3 implementing TBFA conditions with Student 3B, the experimenter conducted a preference assessment with the student by asking her verbally. The student indicated that she preferred the computer as the strongest reinforcer, and therefore computer was used in the Tangible Condition. Results of the TBFA for Student 3B are presented in Figure 8. For Student 3B, vocal outbursts occurred during 30% of the observed test segments for the Attention Condition, 100% of the observed test segments during the Demand Condition, 0% of the observed intervals during the control and test

segments of the Ignore Condition, and 0% of the observed test segments of the Tangible Condition. Based on these results, escape from work demands was identified as the maintaining variable for Student 3B's vocal outbursts.

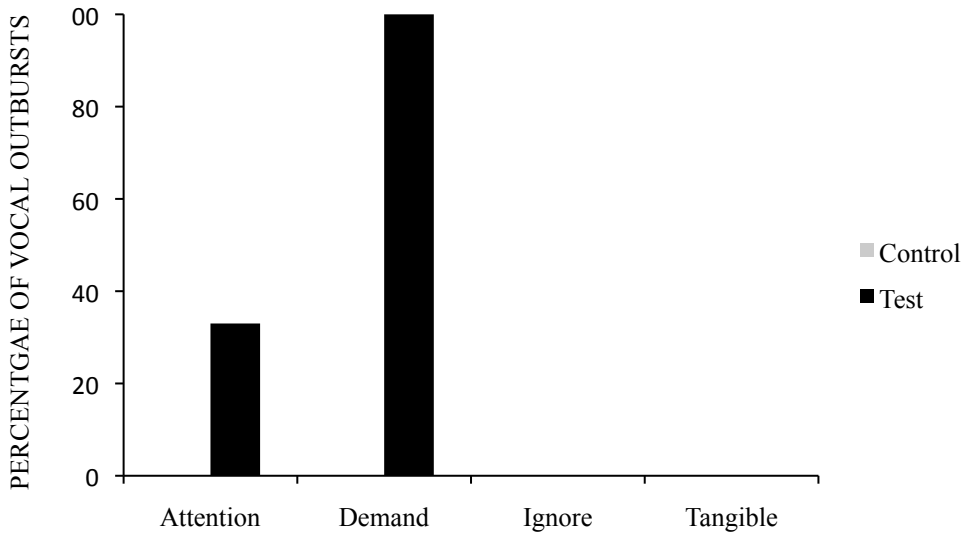

Figure 8. TBFA results for Student 3B for vocal outbursts.

FBI

Research Question 4: What was the effect of teacher-designed and delivered FBI based on the results of a TBFA conducted by teachers on the reduction of students' challenging behavior?

Research Question 5: What was the effect of teacher-designed and delivered FBI based on the results of a TBFA conducted by teachers on students' use of replacement behavior?

Results for challenging and replacement behaviors before and during FBI for each student are presented in Figure 9, which illustrates results across FBI pre-training, FBI

with feedback (Student A), and FBI generalization (Student B) conditions. Students A's data are presented in solid data points whereas Students B's data are presented in open data points. Data for both challenging and replacement behaviors are shown as number of occurrences. Results for all six student participants indicated a reduction in challenging behaviors and an increase in replacement behaviors.

Student 1A. Student 1A's targeted challenging behavior was vocal outbursts and elopement. The function of behavior for Student 1A was determined to be socially mediated negative reinforcement (i.e., escape from work demands). Prior to the intervention, the teacher would respond to the vocal outbursts by running over to the student and telling him, "Hush, you are too loud." When the student eloped, she would ignore the student and allow him to wander around the room. The FBI plan designed for Student 1A by Teacher 1 involved a DRA + extinction procedure during work activities. This included teaching the student to verbally mand appropriately for a break (i.e., "I need a break, please."). The schedule of differential reinforcement was set at a FR 1 schedule to establish the new response. Thus, every time Student 1A exhibited the appropriate mand, he was immediately allowed to leave the work area for 2 min. After the 2 min were up, he was redirected back to his work area. The extinction procedure consisted of two parts. When Student 1A exhibited vocal outbursts, his teacher used escape extinction (i.e., continued academic demands) and waited for the outbursts to stop, and then asked, "What do you want?" and prompted him to mand appropriately. When the student attempted to leave his desk without permission, the teacher employed an escape extinction procedure by physically blocking him from leaving his desk while prompting him to mand appropriately.

Figure 9 shows the graphed data of Student 1A's challenging behavior and replacement behavior. During FBI pre-training condition, Student 1A's challenging behavior ranged from 27 occurrences to 30 occurrences, with a mean of 28.6 occurrences. Data during this condition were slightly variable with an increasing trend. During the FBI with feedback condition, Student 1A's challenging behavior decreased to a low and stable level, with a range of 3 to 22 occurrences of challenging behavior and a mean of 10.4 occurrences and with a decreasing trend over five sessions.

During FBI pre-training condition, the number of Student 1A's replacement behaviors was zero. During the FBI with feedback condition, Student 1A's replacement behavior increased to a high and stable level, with a range of 7 occurrences to 27 occurrences and a mean of 19.4 occurrences. His replacement behavior during the FBI with feedback condition showed a rapid increasing trend.

Student 1B. Student 1B's targeted challenging behavior was vocal outbursts. The function of the behavior for Student 1B was determined to be socially mediated positive reinforcement (i.e., access to teacher attention). Prior to the intervention, the teacher would respond to the target behavior by running over to the student and telling him, "Hush, you are too loud." The FBI plan designed for Student 1B involved a DRA + extinction procedure to mand appropriately for attention. The schedule of differential reinforcement was set at an FR 1 schedule to establish the new response. Specifically, the teacher taught Student 1B to raise his hand and say, "Ms. _____" when he needed attention from the teacher. When he exhibited this response, the teacher immediately provided attention and/or assisted him with whatever task was at hand. If he manded

inappropriately (i.e., vocal outbursts), the teacher would wait for him to stop and prompt him to mand, “What do you want?”

According to the graphic display in Figure 9, Student 1B’s challenging behavior prior to the FBI implementation ranged from 24 to 30 occurrences, with a mean of 28.2 occurrences. Data during this condition were slightly variable. During the FBI implementation condition, Student 1B’s challenging behavior decreased to a low and stable level, with a range of 6 to 24 occurrences of challenging behavior and a mean of 11.4 occurrences. An extinction burst is noted on the second intervention session. However, his challenging behavior data stabilized and showed a much lower level during the last three FBI sessions when compared to the response level prior to the FBI implementation.

The number of Student 1B’s replacement behaviors was a range of zero to seven occurrences, with a mean of two occurrences prior to the FBI implementation. During the FBI condition, Student 1B’s replacement behavior increased to a high and stable level, with a range of 7 occurrences to 27 occurrences and a mean of 19.4 occurrences. His replacement behavior data stabilized and showed a higher response level during the last three FBI sessions.

Student 2A. Student 2A’s targeted challenging behavior was vocal outbursts. The function of behavior was determined to be access to socially mediated positive reinforcement (i.e., teacher attention). Prior to the intervention, when the student displayed the target behavior the teacher would reprimand him by telling him to stop. The FBI plan designed for Student 2A involved a DRA + extinction procedure. The schedule of differential reinforcement was an FR 1 schedule to reinforce the appropriate mand, and

planned ignoring was used to reduce the vocal outbursts. Student 2A appeared to enjoy assisting the teacher with helping her perform certain tasks (e.g., pass out papers), so she used this to have the student mand verbally, "Help?" When he manded appropriately, the teacher immediately gave him a task with which he offered help.

Graphed data of Student 2A's challenging behavior and replacement behaviors are depicted in Figure 9. During FBI pre-training condition, Student 2A's challenging behavior ranged from 24 occurrences to 27 occurrences, with a mean of 25.6 occurrences. Data during this condition were slightly variable. During the FBI with feedback condition, Student 2A's challenging behavior decreased dramatically to a low and stable level, with a range of zero to six occurrences of challenging behavior and a mean of 1.8 occurrences.

During FBI pre-training condition, the number of Student 2A's replacement behaviors was zero. During the FBI with feedback condition, Student 2A's replacement behavior increased to a high and stable level, with a range of 7 occurrences to 27 occurrences and a mean of 19.4 occurrences. This indicates clear changes in response level when compared to that during the FBI pre-training condition.

Student 2B. Student 2B's targeted challenging behavior was giggling. The function of behavior was determined to be socially mediated negative reinforcement (i.e., escape from work demands). Prior to the intervention, when the student displayed the target behavior during group work activities the teacher would allow him to sit back until group instruction was finished. The FBI plan designed for Student 2B included a DRA + extinction procedure. The schedule of differential reinforcement was an FR 1 schedule to reinforce the appropriate mand, and escape extinction (i.e., continuing academic

demands) was used to reduce the giggling behavior. The teacher taught the student to mand appropriately, “I need a break, please” using a picture symbol indicating a break. When he manded appropriately, she immediately let him leave the group for 2 min. After the 2 min were up, she redirected him back to the group.

According to Figure 9, Student 2B’s challenging behavior prior to FBI implementation ranged from 22 occurrences to 24 occurrences, with a mean of 23.6 occurrences. Data during this condition were stable. During the FBI condition, Student 2B’s challenging behavior decreased to a low level, with a range of 3 to 27 occurrences of challenging behavior and a mean of 13.8 occurrences. There was a rapid decreasing trend over the last four data points. An extinction burst is noted on the second intervention session.

Prior to the FBI implementation, the number of Student 2B’s replacement behaviors was zero. During the FBI condition, Student 2B’s replacement behavior increased dramatically to a high and stable level, with a range of 24 occurrences to 27 occurrences and a mean of 26.4 occurrences. There are clear changes in level between conditions, which indicate the effectiveness of the FBI on increasing Student 2B’s replacement behavior.

Student 3A. Student 3A’s targeted challenging behavior was self-stimulation (i.e., masturbation). The function of behavior was determined to be automatic positive reinforcement (i.e., sensory consequences). Prior to the intervention, when the student displayed the target behavior the teacher would ignore the student. The FBI plan designed for the student entailed a DRA procedure that included a small, 2-in therapy ball. When

the student attempted self-stimulation, the teacher redirected him to the therapy ball by quietly pointing to it.

Graphed data of Student 3A's challenging behavior and replacement behaviors are presented in Figure 9. During FBI pre-training condition, Student 3A's challenging behavior ranged from 22 occurrences to 25 occurrences, with a mean of 23.6 occurrences. Data during this condition were slightly variable. During the FBI with feedback condition, Student 3A's challenging behavior decreased to a low and stable level, with a range of 0 to 15 occurrences of challenging behavior and a mean of 10.4 occurrences. There was a rapid decreasing trend over the five sessions of FBI implementation.

During the FBI pre-training condition, the number of Student 3A's replacement behaviors was zero. During the FBI with feedback condition, Student 3A's replacement behavior increased to a high and stable level, with a range of 24 occurrences to 28 occurrences and a mean of 27.2 occurrences. There are clear changes in level that indicate the effectiveness of the FBI implementation on increasing Student 3A's replacement behavior.

Student 3B. Student 3B's target behavior was vocal outbursts. The function of behavior was determined to be socially mediated negative reinforcement (i.e., escape from work demands). Prior to the intervention, when the student displayed the target behavior the teacher would reduce the amount of work the student had to complete. The FBI plan designed for Student 3B included a DRA + extinction procedure. The schedule of differential reinforcement was an FR 1 schedule to reinforce the appropriate mand, and escape extinction (i.e., not providing a break) was used to reduce the vocal outbursts. The teacher taught the student to verbally mand appropriately, "I need a break, please." When

she manded appropriately, the teacher immediately let her sit quietly at her desk for 1-2 min. After the 1-2 min were up, the teacher redirected her back to her work.

Data for Student 3B's challenging behavior and replacement behaviors are shown in Figure 9. Prior to the FBI implementation, Student 3B's challenging behavior ranged from 22 occurrences to 24 occurrences, with a mean of 23.2 occurrences. Data during this condition were stable. During the FBI condition, Student 3B's challenging behavior decreased to a low level, with a range of 5 to 20 occurrences of challenging behavior and a mean of 13.6 occurrences in a decreasing trend.

The number of Student 3B's replacement behaviors prior to FBI implementation was zero. During the FBI condition, Student 3B's replacement behavior increased to a high and stable level, with a range of 15 occurrences to 20 occurrences and a mean of 18.6 occurrences. There was a clear change in level for Student 3B's replacement behavior during FBI implementation when compared to that prior to FBI implementation.

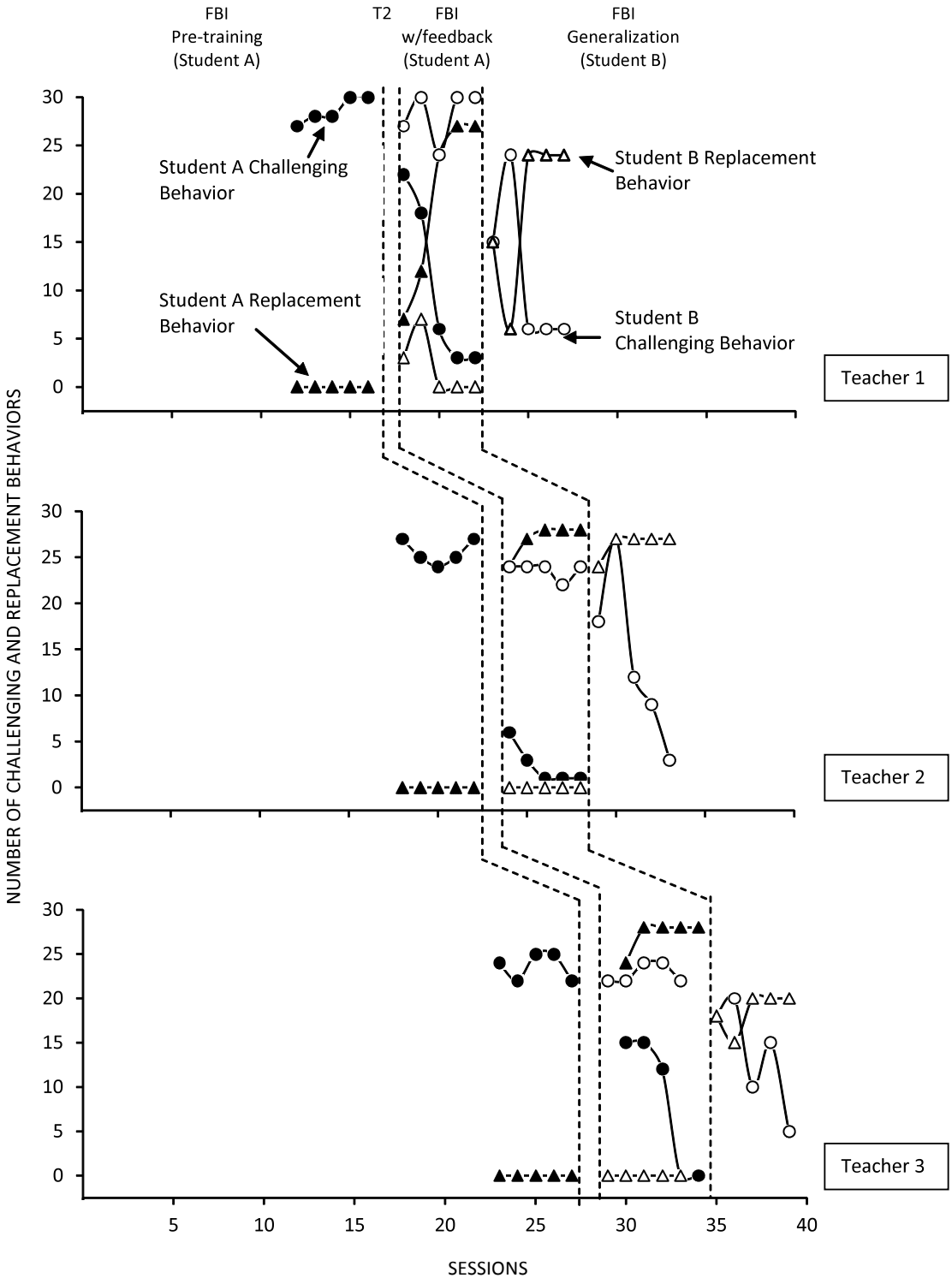

Figure 9. Number of challenging and replacement behavior for all six student participants.
Note. FBI = function-based intervention, T2 = FBI training with Student A.

Research Question 6: What was the effect of training on teachers' reliable identification of behavioral functions and accuracy of data collection during TBFA and function-based interventions?

Teacher 1. Teacher 1's accuracy of data collection during TBFA for Students A and B was 90% and 95%, respectively. For function-based interventions, her accuracy for both students was 95%. She was able to identify the function of behavior for both students.

Teacher 2. Teacher 2's accuracy of data collection during TBFA and function-based interventions for Students A and B was 100% for both students. In addition, she was able to accurately determine the function of behavior for both students.

Teacher 3. Teacher 3's accuracy of data collection during TBFA and function-based interventions for Students A and B was 90% for both students. She was able to identify the function of behavior for Student A independently, but needed assistance from the experimenter with determining the function of behavior for Student B.

Social Validity

Research Question 7: What were the classroom teachers' perspectives on the importance, acceptance, and effectiveness of the TBFA procedures and the subsequently designed function-based intervention plans?

One focus of the current study was to determine the impact of TBFA training and FBI on teacher perceptions regarding their importance, acceptance, and effectiveness. At the conclusion of the study, a social validity questionnaire was given to teacher participants to ascertain additional information about their perceptions of the TBFA and FBI training and implementation process and outcomes. The questionnaire (see Appendix

I) consisted of 11 Likert-style items, on which 5 indicated a high level of the descriptor being probed in each item, and 1 indicated a low level of that descriptor. After completing 8 weeks of intervention (both phases), all three teachers indicated overall satisfaction. All three teachers indicated that procedures for conducting TBFA were relatively easy to learn and implement in the classroom. Teachers 1 and 2 indicated that procedures for designing and conducting interventions were easy to learn, while Teacher 3 indicated that they were relatively easy to learn. Teacher 2 indicated that procedures for designing and conducting interventions were easy to implement. Teachers 1 and 2 indicated that the intervention increased their students' appropriate behavior overall, while Teacher 3 indicated a neutral response to that item. Further, Teacher 1 indicated that the intervention reduced her students' challenging behavior, while Teachers 2 and 3 indicated a neutral response to that item. Also, Teachers 1 and 2 indicated that their students appeared to respond to and like the intervention overall, while Teacher 3 indicated a neutral response. Overall, all three teachers reported that they would use the TBFA and intervention procedures again with other students and would recommend them to other teachers. Results from the first 11 social validity questions are shown in Table 5.

Table 5

Teacher Post-Intervention Acceptability and Importance of Effects Survey

Question	Teacher 1	Teacher 2	Teacher 3	Mean
Procedures for conducting TBFA were easy to learn.	4	4	4	4.0
Procedures for conducting the TBFA were easy to perform in the classroom.	5	4	4	4.3
Procedures for designing and conducting the intervention were easy to learn.	5	5	4	4.7
Procedures for designing and conducting the intervention were easy to perform.	4	5	4	4.3
The intervention increased my students' appropriate behavior.	4	4	3	3.7
The intervention decreased my students' challenging behavior.	5	3	3	3.7
My students appeared to like and respond to the intervention well.	5	4	3	4.0
I will use the TBFA again with my students.	5	5	4	4.7
I would recommend the TBFA to other teachers.	4	4	4	4.0
I will use the intervention again with the same students or other students.	4	5	4	4.3
I would recommend the intervention to other teachers.	5	5	4	4.7

The remaining two items on the questionnaire were open-ended. The first probed what the teachers liked about the TBFA and FBI training, and the second asked what they would change about the TBFA and FBI training. Descriptions of each teacher's responses are below.

For the first item, Teacher 1 indicated that she liked having a professional come to the classroom and offer support to the students with more behavioral needs. She also stated that she thought it was useful to receive assistance in devising a plan to redirect inappropriate behaviors. As for what she would change about the training, she indicated that she wished she had more planning time so that it would be easier for her and other teachers to implement. She also wished that training and support with these procedures could be ongoing. In addition, Teacher 1 indicated that Student 1A was displaying the targeted challenging behavior with the school nurse when she attempted to give him his medicine in the mornings. Teacher 1 provided the nurse with his FBI, and the nurse commented to the teacher that after implementing the FBI with Student 1A, he was more accepting of the medication.

Teacher 2 indicated that the TBFA and FBI procedures were fairly easy to implement and did not take away time from attending to her other students. She found it interesting to learn more about the function of behaviors. She stated that she did not have any recommendations for changes in the training.

Teacher 3 indicated that she liked having the experimenter teach her ways to increase student appropriate behaviors and decrease inappropriate behaviors. She also stated that the experimenter's feedback and ideas were useful in the classroom. Teacher 3 indicated that at the beginning of the study, she was considering trying to have Student

3A placed in a more restrictive setting due to him “touching himself” inappropriately. However, she revealed by the end of the intervention that she did not think he needed to be in a more restrictive setting. She had no suggestions for changing the training.

CHAPTER 5: DISCUSSION

Overview of Findings

The purpose of this study was to determine the effects of training and performance feedback on teachers' reliable implementation of TBFA procedures, accurate analysis of TBFA results, and accurate development and implementation of FBI for students with ASD or E/BD. In addition, this study sought to measure occurrences of students' challenging behavior and replacement behavior before and during the FBI implementation. Results of the current study indicate that the three middle school special education teacher participants were able to implement a TBFA with high procedural integrity during the TBFA with feedback condition, and two of the three teachers generalized skills acquired from training to other students with high procedural integrity (i.e., at least 90% accuracy). Further, the TBFA yielded important and useful information relevant to intervention planning for students who demonstrate persistent challenging behavior in the classroom setting. Findings and discussions are presented in this chapter, and are organized by the seven research questions presented earlier. Furthermore, limitations of the study, suggestions for future research, and implications for practice are discussed.

Effects of Intervention on Dependent Variables

Research Question 1: What was the effect of training and performance feedback on teachers' reliable implementation of conducting TBFA procedures with students with ASD or E/BD in a school setting?

Findings from the current study indicated a functional relation between training and teachers' reliable implementation of TBFA conditions during TBFA with feedback. All three teacher participants demonstrated consistent implementation of TBFA conditions during the TBFA with feedback condition. Specifically, procedural integrity data were 96% (range, 90-100%) for Teacher 1, 98% (range, 90-100%) for Teacher 2, and 90% (across all sessions with no range) for Teacher 3 (see Figure 1, Phase 1). These data on all three teachers' TBFA implementation integrity showed immediate increases in level when comparing data from the TBFA with feedback condition to those during pre-training TBFA condition.

Many studies on the ability of individuals unfamiliar with the theoretical principles of FA to conduct such analyses have not investigated the ability of teachers to carry out an FA within the classroom setting. The current study did so by measuring teachers' implementation of four FA experimental conditions (i.e., Attention, Demand, Ignore, Tangible) and the control condition. Results are consistent with those found from previous studies in that teachers did not demonstrate acceptable levels of procedural integrity until after training and performance feedback procedures were introduced (e.g., Moore et al., 2002; Wallace et al, 2004). In the current study, the provision of performance feedback at every session during TBFA with feedback condition was adequate in maintaining levels of integrity demonstrated by all three teachers. Essentially,

teachers were implementing TBFA at low levels during TBFA pre-training condition (see Figure 1, Phase 1) when given only descriptions of test conditions and no training or performance feedback. After one 2-hr training session that consisted of TBFA descriptions, videotaped sessions with multiple exemplars, modeling, role-playing, and performance feedback, teachers were able to increase accurate implementation of all four test conditions and control condition. In addition, the provision of performance feedback (i.e., error correction and/or verbal praise) after each session helped to maintain high integrity during TBFA with feedback sessions. Specifically, Teacher 1 required error correction during the first two sessions of the TBFA with feedback condition, and Teachers 2 and 3 needed error correction during only the first session.

Research Question 2: What was the effect of training and performance feedback on teachers' reliable implementation of FBI procedures?

In addition to the teachers' improved TFBA implementation accuracy, results from this study also indicate that training promoted these teachers' FBI implementation with high procedural integrity. Specifically, the 1-hr training that included review of behavioral function, instruction on teaching appropriate manding, modeling, role-playing, and performance feedback provided teachers with skills to implement FBI with high procedural integrity. Procedural integrity data after training were 92% (range, 90-95%) for Teacher 1, 100% for Teacher 2, and 90% (across all sessions) for Teacher 3 (see Figure 1, Phase 2). When given only a description of how TBFA results may affect the design of a FBI that includes DRA and extinction to use during FBI pre-training condition, all three teachers implemented FBI with low accuracy. Specifically, Teachers 1 and 3 conducted FBI with 0% integrity, while Teacher 2 maintained 20% integrity

across all FBI pre-training sessions. The current study addressed recommendations by Van Acker et al. (2005) by conducting training that included follow-up support (i.e., performance feedback) after initial training had been completed. Once receiving training, Teacher 1 required error correction during the first three sessions during FBI with feedback condition, Teacher 2 did not require error correction, and Teacher 3 required error correction during the first session. One reason that Teacher 1 required more error correction was that she did not deliver reinforcement immediately after the appropriate response was exhibited by the target student. During the first three sessions, Teacher 1 often did not provide reinforcement until up to 8 s after the correct response was exhibited. When implementing FBI, reinforcer delay is one very important variable in establishing a new response (Mace, 2010). In addition, Teacher 1 was not implementing the least-to-most prompting hierarchy consistently, a notable weakness that was found in the Tangible condition during TBFA. Teacher 3 required error correction on the prompting hierarchy as well, but only during the first session.

Collectively, result from this study contributed to the literature by collecting procedural integrity data on teachers' reliable implementation of TBFA and FBI. Most studies on FA in school settings involving behavioral assessments have neither reported integrity data nor involved teachers as the individuals who implemented the FA (Shumate, 2008). Of previous studies training teachers to implement FA, only a handful of studies involved teachers as the primary interventionists (e.g., Barretto et al., 2006; Ellingson et al., 2000; Flynn et al., 2011; Moore et al., 2002; Wallace et al., 2004), with most of them reporting procedural integrity on teacher implementation of FA (i.e.., Barretto et al., 2006; Ellingson et al., 2000; Moore et al., 2002; Wallace et al., 2004).

Additionally, most of these studies did not include measures of teachers' reliable design and implementation of FBI based on FA results and accurate data collection (e.g., Barretto et al., 2006; Moore et al., 2002; Wallace et al., 2004). This study provides initial evidence as to the feasibility and capability required to implement an FA and FBI by special education teachers and allows analysis of their impact on student behavior.

Research Question 3: What was the effect of training and performance feedback on teachers' generalization of learned skills related to TBFA and FBI implementation to new students?

One of the purposes of this study was to train special education teachers on the TBFA and FBI process and provide performance feedback to them when TBFA and FBI were implemented with Student A. After implementation of TBFA and FBI with Student A, each teacher was expected to conduct TBFA and FBI process again with a second student without additional training and performance feedback to ascertain whether teacher participants could generalize the newly learned TBFA skills to new students. Data show that two of three teachers (i.e., Teachers 2 and 3) were able to successfully generalize skills acquired during TBFA and FBI training and apply those skills to a second student with at least 90 % accuracy during which they received no performance feedback. Specifically, procedural integrity data during TBFA generalization condition with Student B were 87% (range, 85-90%) for Teacher 1, 98% (range, 90-100%) for Teacher 2, and 96% (range, 90-100%) for Teacher 3. Procedural integrity data were 89% (range, 85-90%) for Teacher 1, 98% (range, 90-100%) for Teacher 2, and 92% (range, 90-95%) for Teacher 3 during FBI generalization condition (see Figure 2 for both TBFA and FBI generalization conditions). Although Teacher 1 was able to demonstrate

acceptable levels of integrity during the TBFA with feedback phase, her level of integrity during implementation with Student B decreased below the 90% criteria during TBFA generalization (i.e., 87%, range, 85-90%) and FBI generalization (i.e., 89%, range, 85-90%). However, compared to TBFA pre-training and FBI pre-training, there was a noticeable increase in skills acquired in generalization measures for Teacher 1. The decreased skill level for Teacher 1 during the generalization conditions indicates the need to provide ongoing performance feedback and booster sessions. On the contrary, Teachers 2 and 3 maintained at least 90% implementation integrity during the generalization conditions for both TBFA and FBI implementation, indicating that the 1-2 hr of training with five sessions of performance feedback might have been sufficient to show their immediate transfer of the skills to a second student.

The main purpose of this research question was to determine if the training provided was enough so that teachers could implement TBFA and FBI with some support after training with Students A and could transfer the skills to Students B without additional support. Training that used multiple exemplars through modeling and role-playing in addition to descriptions of behavioral functions promoted higher accuracy in TBFA implementation than descriptions alone. Performance feedback was provided to teachers whether an error was made or not during the implementation process with Student A. Integrity results from the current study provide support for training special education teachers on the TBFA and FBI process and disprove the claim that the process is too complex for teachers to implement (Moore et al., 2002; Wallace et al., 2004). Additionally, teachers can generalize these skills to new students.

Stokes and Baer (1977) indicated multiple strategies when programming for generalization. Scheeler (2008) refined these strategies to focus on teacher training. First, Scheeler recommended that trainers use immediate feedback to promote skill acquisition. This feedback should include both positive and corrective feedback immediately after the skill was performed. In the current study, the experimenter provided both positive and corrective feedback immediately following each session. Teachers were told specifically what they did well as well as what they needed to improve. Next, Scheeler suggested that teachers should be trained to mastery on chosen skills. In the current study, criterion of at least 90% was set to demonstrate mastery of skills for both TBFA and FBI implementation. Other suggestions first made by Stokes and Baer and refined by Scheeler was to program for generalization through techniques such as programming common stimuli, sequential modification, training sufficient exemplars, introducing to natural maintaining contingencies, and mediating generalization. In this study, programming common stimuli was used in training by conducting it in the natural environment (i.e., teacher's classroom) using reinforcers that would typically be used in this setting. Additionally, written descriptions of test conditions for the TBFA were enlarged and mounted on the walls for teachers to refer to during TBFA pre-training, TBFA with feedback, and TBFA generalization sessions. Finally, training involved practice with "real" students. These served as discriminative stimuli to facilitate performance of teacher behaviors across training and performance sessions. The experimenter also used sufficient exemplars during training. Specifically, the experimenter provided teachers with examples, including potential student responses to antecedents used during TBFA test conditions, different topographies of behaviors that may be in the same response

class to serve the same behavioral function, what an extinction burst may look like, and using least-to-most prompting to promote the appropriate mand from the student. Finally, the experimenter also used natural maintaining contingencies to shape teacher behavior. For example, all three teachers indicated they enjoyed having the experimenter in class to provide training and feedback. They enjoyed having a new set of skills, which reinforced their teaching behavior by increasing their use of the skills. In addition, seeing students' behavior change was an important natural contingency.

Research Question 4: What was the effect of teacher-designed and delivered FBI based on the results of a TBFA conducted by teachers on the reduction of students' challenging behavior?

Findings from the current study indicate a reduction in challenging behavior for Students A and B. Specifically, data on all six students' challenging behavior showed immediate decreases in level when comparing data prior to FBI implementation with feedback for Students A. However, Student B's challenging behavior remained at high levels during the FBI with feedback for Students A condition. This suggests that although teachers had the skills to implement FBI with Student A during this condition, they could not effectively promote behavioral change in their Student B until they actually designed an FBI specific to Student B (see Figure 9). Additionally, two of three students exhibited extinction bursts after teacher implementation of FBI. This may point to those students' history of reinforcement with their respective teachers, and indicate the importance of teachers being consistent in delivering planned contingencies. Procedural integrity data indicate high accuracy in implementing the FBI plan for each student, which resulted in consistent implementation of these contingencies. Possibly, those teachers in particular

were discriminative stimuli themselves. The number of occurrences of challenging behavior for these students decreased overall, and these teachers became extinction stimuli (i.e., S-delta) for challenging behavior, as these behaviors were no longer reinforced.

This study supports the use of behavioral interventions based on TBFA results and individualized to the student as an effective means of reducing challenging behavior. Also, this study offers further evidence that behavioral function is critical in understanding and creating behavioral change in student behavior.

FBI for all six student participants included programmed reinforcement for alternative behavior, while extinction was implemented for all target challenging behavior. With regard to the DRA intervention, there was some overlap in the data (i.e., one data point for Students 1B and 2B) as a result of extinction burst. In addition, the FBI implemented altered the contingencies that had previously resulted in the student participants gaining the reinforcer (e.g., teacher attention, escape from academic demands), thus, interrupting the response-reinforcer contingency. This study supports and adds to previous research in that DRA + extinction is effective in reducing challenging behavior and increasing appropriate behavior (e.g., Carr & Durand, 1985; Flynn et al., 2011; Hanley, Iwata, & Thompson, 2001; Kelley et al., 2002; Worsdell et al., 2000).

Research Question 5: What was the effect of teacher-designed and delivered FBI based on the results of a TBFA conducted by teachers on students' use of replacement behavior?

During the FBI phases, DRA + extinction was the intervention chosen for each student. All six students' data indicated high levels of replacement behavior when the

FBI was implemented by their teachers (see Figure 9). Specifically, Student 1A's number of replacement behaviors increased from zero occurrences to a mean of 19.4 occurrences. Student 1B's number of replacement behaviors increased from zero occurrences to a mean of 19.4 occurrences. Student 2A's number of replacement behaviors increased from zero to a mean of 19.4 occurrences. Student 2B's number of replacement behaviors increased from zero to a mean of 26.4 occurrences. Student 3A's number of replacement behaviors increased from zero to a mean of 27.2 occurrences; whereas Student 3B's number of replacement behaviors increased from zero to a mean of 18.6 occurrences. Because these procedures involved students getting access to the same desired reinforcer as did the inappropriate behavior, they allowed all students to achieve the same behavioral function in a socially appropriate way. Teacher participants were able to arrange motivating conditions that established the effectiveness of reinforcers. They also delivered contingent reinforcers as soon as possible after the replacement behavior was exhibited. In addition, teachers were able to select a schedule of reinforcement that effectively competed with the schedule maintaining challenging behavior. These factors, in turn, successfully increased each student's use of the selected replacement behavior. This study lends support that DRA + extinction procedures linked to behavioral function can increase the use of replacement behavior.

Research Question 6: What was the effect of training on teachers' reliable identification of behavioral functions and accuracy of data collection during TBFA and FBI?

This study sought to determine if teachers could reliably identify behavioral functions and accurately collect data on one TBFA and one FBI session. Results indicated that all three teachers' accuracy of data collection was 90% or more, meeting

criteria. Additionally, two of three teachers were able to independently and correctly identify behavioral function of both student participants in their classrooms. Teacher 3 was able to correctly identify behavioral function of Student 3A independently, but initially disagreed with the data. However, after reviewing the data she agreed that the function of behavior for Student B was escape from academic demands. Nonetheless, this study lends support that teachers, with appropriate training, are able to reliably collect data on TBFA and FBI sessions and determine the function of behavior of their students.

Discussion of Social Validity Findings

Research Question 7: What were the classroom teachers' perspectives on the importance, acceptance, and effectiveness of the TBFA procedures and the subsequently designed FBI plans?

This study sought to investigate the social validity of TBFA and FBI training based on teachers' views regarding their importance, acceptability, and effectiveness. All three teachers indicated that receiving TBFA was important and that they would suggest the training to other teachers. All three teachers also reported that the procedures for conducting the TBFA and FBI were easy to learn and perform. Although indicating a somewhat lower score on the effectiveness of the FBI in decreasing challenging behavior and increasing replacement behavior, teachers generally believed that the intervention had a positive impact on students. However, it is important to note that after data collection was completed, the experimenter met with the teacher participants to go over the social validity questionnaire. During this time, the experimenter noticed that two of three teacher participants appeared to not be implementing the DRA + extinction procedure consistently, which could have some bearing on those scores. One reason for

this could be that teachers have multiple responsibilities, and when they are not being observed, reinforcement to continue to implement with high integrity may be unavailable. Another possible reason could be that during this time when the experimenter met with the teachers, the End-of Grade (EOG) testing was being conducted, which drew teachers' attention more toward administering the EOG testing, rather than continuing to implement the FBI procedures. Finally, another reason for this could be that teachers need ongoing support – longer than one week for performance feedback, as suggested by Englemann (1988), in order to promote maintenance in skills after training is withdrawn.

Overall, teacher participants felt the intervention had a positive impact on their skills. Teachers provided anecdotal data on the value of understanding human behavior through an operant approach. Although none of the teachers had any formal FA training prior to the study, all three acquired the skills taught during the 2-hr training and were able to generalize to a second student. However, Teacher 1 suggested on the social validity questionnaire that she would need ongoing support in order to continue implementing the TBFA and FBI with high procedural integrity.

Specific Contributions of this Study

The current study contributes to the literature in a number of ways: (a) it incorporated teachers as the primary implementers of both TBFA and FBI procedures, (b) middle school special education teachers were trained to conduct only a variation of an FA within the classroom setting without utilizing any indirect or direct observation methods, (c) it trained teachers to reliably identify behavioral functions and accurately collect data during TBFA and FBI, (d) FBI for each student was designed by the teacher after viewing the results of the TBFA, and (e) procedural integrity data were taken on

teacher implementation of both TBFA and FBI. These contributions are discussed in detail in the following paragraphs.

First, this study extends the research on training teachers to conduct an FA. One of the main challenges encountered in FA training has been the lack of focus on teacher implementation of a full FA (i.e., all conditions) and generalization. For example, Moore et al. (2002) were careful to note that in their study teachers were not taught to implement a control condition; therefore, it remained unknown whether teachers could implement a full FA during classroom instruction. In addition, Wallace et al. (2004) indicated that during their study not all components of the FA were trained and systematic generalization probes to applied settings were not taken. Results from the current study demonstrated that teacher participants not only were able to implement all test and control conditions, but they did so during regular classroom instruction and applied these skills to a second student. In addition, this study provides support that special education teachers can be trained in the FBI process to be the primary implementer. Scott et al. (2004) suggested that research conducted in school settings should focus on teachers' ability to reliably implement FBI within classroom settings. The current study addressed those suggestions, and results demonstrated that teachers can successfully serve as the primary change agents when implementing FBI with adequate training and support.

Second, there has been some debate as to whether indirect and direct measures are really needed if the only valid way of determining behavioral function is to conduct an FA. According to the literature, informant responses to rating scales or questionnaires are usually easily obtained, which is why they are most often used in applied settings (Ellingson Miltenberger, & Long, 1999). However, although indirect measures are more

convenient and an easier method to collect data, they have continually been shown to be unreliable in determining the function of behavior (e.g., Duker & Sigafoos, 1998; Zarcone, Rodgers, Iwata, Rourke, & Dorsey, 1991). Consequently, interventions that are designed based on these results are deficient.

Another measure for collecting data to determine the function of behavior is through direct methods (i.e., descriptive analysis), which include A-B-C recording and the scatterplot. Direct methods focus on observational data that are collected on the target behavior and the environmental stimuli (i.e., antecedents and consequences). This measure also has a tradition of being implemented in school settings as the way to determine the function of behavior. However, descriptive analysis provides information only on stimuli and their occurrences, and do not provide any information on the functional relation among these stimuli (Bijou et al., 1968). Bijou et al. (1968) noted that only an FA can do this. The current study adds to the limited literature that teachers not only can conduct an FA in the classroom, but can determine the behavioral function of each student's behavior without taking the extra time to use indirect and direct methods.

Third, this study adds to the literature that teachers can be trained to collect data and determine behavioral function. Each teacher participant collected data on one videotaped TBFA session and one videotaped FBI session. All three teachers met criteria in agreement with the experimenter's data. Two of the three teachers agreed with the experimenter on behavioral function. Teacher 3 initially disagreed with the experimenter on behavioral function for Student B (i.e., Teacher 3 thought the function of behavior for Student B was attention). However, after closely examining the data again, Teacher 3 realized that the behavioral function for Student 3B was escape from academic demands.

O'Neill and Stephenson (2009) found in their review of studies that teachers were least involved in the process of data collection to aid in determining behavioral function and making data-based decisions. There have only been a few studies that included training teachers to collect data (e.g., Lalli et al., 1993). This study is unique in that teachers collected data on their TBFA implementation and occurrences of student challenging behavior during FBI implementation. Ensuring teacher's skills in accurate data collection can help them improve their proficiency in making data-based decisions related to behavioral function and effects of the FBI.

Fourth, this study lends support to the literature that teachers have the ability to design an FBI based on behavioral function. An FBI for Students A was designed by the teachers in collaboration with the experimenter after viewing the results of the TBFA and was designed independently for Students B. There have been a handful of studies that have demonstrated teachers' ability to select an FBI (e.g., Lalli et al., 1993). However, the current study focused on teachers developing an FBI based on results of their implementation of an FA and not on descriptive analysis.

Finally, integrity data were collected 100% of all sessions as the primary dependent variable during this study to ascertain if special education teachers can implement TBFA and FBI with high integrity. Prior studies that involved teachers as primary implementers of FA and FBI often have not included integrity data on the process. The current study extended the literature by including teacher integrity data on both FA and FBI implementation.

Limitations and Suggestions for Future Research

Some of the limitations of the current study and suggestions for future research are discussed. First, one possible limitation of the current study was the decision to conduct the TBFA conditions during group instruction time. This could have confounded the TBFA results because the EO for escape was possibly present during all four test conditions. In order to discriminate the attention condition from other socially-mediated (i.e., Demand, Tangible) test conditions, teachers were instructed not to provide any verbal exchange during test segments except during the Attention condition. However, in school settings, academic demands (e.g., group instruction, independent seat work) are present throughout the school day. Therefore, in natural settings, it may be different to execute complete control as it could be done in an analog setting. Additionally, simultaneous and possible competing reinforcers (e.g., teacher attention, peer attention, preferred activities) for challenging behavior may be available. Thus, students exhibiting challenging behavior may be provided with escape from academic demands, while unintentionally being provided with an additional reinforcer. In the current study, although multiple functions are acknowledged, the experimenter focused on the most salient feature of the behavioral function (i.e., received highest percent of occurrences of challenging behavior) to address the potential issue of competing reinforcers. Even though multiple behavioral functions were not addressed in each student's FBI, the intervention developed to address the most salient function showed clear effectiveness in reducing challenging behavior and increasing replacement behavior. This further indicated the appropriateness of the targeted behavioral function for each student. Because student behavior may be reinforced by multiple stimuli, future research should

investigate multiple variables that may be maintaining challenging behavior in the classroom setting.

Second, this study did not focus on high-risk behavior (e.g., self-injury, aggression). Students who met participation criteria did not exhibit dangerous behaviors. Additionally, when conducting observations, the experimenter did not notice any of the other students exhibiting any high-risk behaviors. Therefore, it is unknown from this study whether these same teachers could implement TBFA and FBI with high integrity with students with more severe behavior. Teachers are understandably reluctant to evoke severe high-risk behavior. Although protective equipment has been used to address this issue, Smith and Churchill (2002) found that this equipment suppressed responding across all of FA conditions. Smith and Churchill suggested that oftentimes individuals who exhibit self-injurious or aggressive behavior also exhibit behavior that occurred directly before the targeted behavior. For example, an individual may threaten to engage in aggression before exhibiting aggression. In their study, Smith and Churchill compared results of FA of severe challenging behavior with FA of precursor behavior. Results indicated that FA of precursor behavior identified the same contingencies as those identified during FA of severe challenging behavior. However, interventions based on the results of the FA of precursor behavior were not analyzed. Future research should examine the effectiveness of training teachers to implement FA of precursor behavior and FBI based on those results when high-risk behavior is involved.

Third, one side effect that can occur from using a DRA procedure in a classroom is that students may exhibit an unacceptably high rate of the replacement behavior to gain access to the reinforcer, thus disrupting teacher instruction. For example, during the FBI

phase in the current study, Student 2A raised his hand to mand for teacher attention up to 28 times during a 30 min observation. This likely caused a decrease in academic engagement. Future studies should measure the frequency in which student participants exhibit the replacement behavior and record whether there are any potential negative effects if the frequency is unacceptably high. In addition, the current study did not include schedule thinning procedures to address the high rates of the replacement behavior. Future studies should focus on thinning schedules of reinforcement to arrive at an acceptable number of replacement behaviors (e.g., delay-to-reinforcement, reinforce magnitude).

Fourth, no maintenance data were collected at the end of the study. Research has shown that teachers' accurate use of behavioral interventions has demonstrated to rapidly decrease after initial training (Addison & Lerman, 2009). Consequently, a negative reinforcement function may exist between teacher responses and student challenging behavior. In the current study, the experimenter noted that after data collection was complete, two of three teachers appeared to be inconsistently implementing the programmed FBI with their students (e.g., neglecting to use planned ignoring for attention-maintained behavior). As mentioned previously, one reason could be due to teachers not receiving ongoing support after data collection was concluded. Future research should focus on similar studies including maintenance data, as well as EO of teachers' behavior regarding maintenance of skills acquired during behavioral intervention training.

Fifth, data were only collected during group instruction for all three teacher/student triads. It is unknown if the targeted challenging behaviors occurred during

other settings. For example, Student 2B exhibited challenging behavior (i.e., giggling) during group instruction. If the student exhibits the challenging behavior across settings (e.g., lunch, independent seatwork, recess) a different behavioral function could potentially be identified (e.g., automatic positive or negative reinforcement).

Sixth, there was a lack of overlapping data collection during FBI pre-training for students' behavior. According to Cooper et al. (2007), data from baseline begun after the intervention was applied to previous participants in a delayed multiple-baseline research design cannot be used to verify predictions based on earlier tiers of the design; however, if data collection is begun early enough for those data to be used to verify prediction made for the previous tier, then a prediction can be made. In the current study, the study was designed based on teacher behavior (the primary dependent variable) as well as training schedule. Because there was no overlapping data collection leading to the lack of verification of prediction, a functional relation between the teacher-designed interventions and student behavior cannot be determined. Future research should include designing a study that addresses this limitation.

Seventh, this study suggests an effective strategy for training teachers to assess challenging behavior using TBFA and to implement a DRA + extinction intervention to decrease challenging behavior and increase appropriate replacement behavior for students with ASD or E/BD. These results have important implications for school district support and propose several potential inquiries for future studies. For example, strategies included in the current study involved intensive and individualized performance feedback to teachers. Teachers not only were provided with initial training, but were provided with immediate feedback for five consecutive sessions during TBFA with feedback condition

and five consecutive sessions during FBI with feedback condition. Not much is known about the feasibility and cost of providing such intensive feedback to teachers on a larger scale. Using telemedicine (via videoconferencing) to deliver performance feedback is a potential method to reduce cost. School districts wanting to train teachers to conduct TBFA and FBI to reduce students' challenging behavior and increase appropriate behavior will potentially require guidance to effectively scale-up research-based staff training procedures (e.g., performance feedback). Schools may employ a combination of antecedent instruction (e.g., role-play) and consequence interventions (e.g., performance feedback) throughout the school year to monitor teacher performance and student outcomes. Research focusing on these factors would contribute significantly to the literature.

Eighth, no procedural integrity data were collected on the experimenter's training and accurate provision of performance feedback. The experimenter used a checklist to ensure that every step was conducted during training of both TBFA and FBI. Although no formal protocol for conducting TBFA currently exists, future studies should look at the link between procedural integrity data on the training and teacher performance and collect direct observation data to measure procedural integrity of the intervention delivery.

Finally, only DRA + extinction (i.e., planned ignoring, escape extinction) procedures were trained and implemented in the current study. Time-contingent reinforcer delivery schedules (e.g., NCR) may also be convenient procedures to implement because teachers do not have to wait on specific occurrences of challenging behavior to occur before delivering the reinforcer. These time-contingent schedules break

the response-reinforcer relation maintaining the challenging behavior, and can be conceptualized as a form of extinction (Mace, 2010). Lucynski and Hanley (2010) found in their study that children preferred FR 1 schedules of reinforcement over NCR; however, as the FR 1 schedules were thinned, the children preferred the NCR schedule. Future studies that focus on training teachers to design FBI that include selecting from various procedures should be conducted.

In spite of limitations, the current study builds on the limited research base examining the utility of FA and FBI procedures in middle school classrooms with students with ASD or E/BD exhibiting challenging behavior. Although teachers may consider TBFA as a method for determining the function of behavior that leads to the design of an FBI, future research in this area will be important in ascertaining the generality and stability of these findings.

Implications for Practice

Based on the findings from this study, several implications for practice can be made. First, these results add to the literature by providing further support of the effectiveness of FBI when the function is identified through the use of an FA (specifically, a TBFA). The use of FBI has reduced the use of punishment-based procedures (Pelios, Morren, Tesch, & Axelrod, 1999). Behavioral interventions that are based on the function of behavior are more likely to be effective because they alter maintaining contingencies rather than relying on attempts to change the EO.

Second, this study focused on conducting FA in the classroom. Surprisingly, none of the teacher participants in the current study had received training on FA implementation during their teacher licensure programs, although Teacher 2 had

completed an FBA for a project in one of her classes. Many teachers in a position to use FA (i.e., teachers of students prone to challenging behavior) often lack the necessary skills to implement it. Any teacher who provides academic and behavioral instruction to students with challenging behavior would benefit from FA and should be taught accurate implementation. Thus, it would seem necessary to provide this training within their teacher licensure program. In addition to initial training, teachers need ongoing support in behavioral assessment. Teachers in the current study had the skills to generalize to a second student (i.e., Student B) with different behaviors with different functions. However, Engelmann (1988) suggested that most teachers need to practice a new skill at last 12 times before becoming proficient at performing the skill, as well as having 6 months of effective supervision and practice in the classroom setting. As mentioned previously, performance feedback provided to teachers throughout the school year would potentially increase teachers' accurate implementation of behavioral assessments.

Third, TBFA implementation can significantly reduce time assessing behavior, yet yield accurate results. Similar to previous research (e.g., LaRue et al., 2010), TBFA required minimal time to implement. For example, assessment time across teachers ranged from 52 min to 86 min for Student A. In LaRue et al.'s study, standard FA took an average of 208 min to complete, while the TBFA took an average of 31.6 min to complete. In addition, a clear behavioral function for each student was determined through analysis of TBFA data. This suggests that teachers can assess behavior in minimal time without utilizing additional measures (i.e., indirect, direct observations) to accurately determine behavioral function.

Fourth, designing FBI based on the Matching Law focuses on the theory that all behavior is choice behavior (Mace, 2010). Specifically, Mace suggests that this choice is affected by four variables: reinforcer rate, reinforcer quality, reinforcer delay, and response effort. This includes designing FBI that successfully competes with the target response class on as many variables as possible. In addition to training on behavioral function, data collection, reinforcement procedures, and selecting FBI, teachers would benefit from training on the Matching Law and how it affects successful FBI implementation and student outcomes.

Finally, during the current study, teachers were only required to collect data on one TBFA session and one FBI session. It is unknown as to whether these teachers can be involved in ongoing data collection with responsibility in carrying out normal instruction. To be feasible and practical, teachers may videotape sessions with parental consent/student assent to make data collection more feasible or involve other school staff in assisting in data collection.

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APPENDIX A: PRINCIPAL CONSENT FORM FOR PARTICIPATION IN EDUCATIONAL RESEARCH

UNCCHARLOTTE
The University of North Carolina at Charlotte
9201 University City Boulevard
Charlotte, NC 28223-0001

Mr./Ms._____,

The following information is provided to ascertain whether _____ School would like to participate in a research-based study. As the principal of the school, you should be aware that you are free to decide not to participate or to withdraw at any time without consequences.

The purpose of the study is to determine the effects of training on teachers' ability to conduct a functional analysis and design function-based interventions to address the challenging behavior of students with autism spectrum disorders or emotional/behavioral disabilities. Anticipated outcomes will be teachers' increased confidence and ability to implement functional analyses and function-based interventions, a decrease in students' challenging behavior, and an increase in students' appropriate behavior. It will involve three teacher/student triads (i.e., three teachers and two students each). The investigator will train the teachers how to conduct a functional analysis to determine the function of students' challenging behavior. The investigator will then train the teachers to design and implement a behavior support intervention based on the results of the functional analysis.

The investigator will videotape sessions for data collection on the students' behavior, as well as steps completed correctly by the teachers. Data on students' challenging behavior, appropriate replacement behavior, and teachers' procedural integrity will be collected by the investigator 3-5 days per week during the regular classroom routine. The investigator will make all attempts to minimize any disruptions to your school. The videotapes of teachers will be used with confidentiality to collect data and for coaching purpose only. We may also use clips from the videos for teacher professional development to illustrate what we have learned from this study. The students may be referred to by their first name in the clip; all other identifying information will be removed. The videos will not be used for general publicity and will be destroyed three years after the study is finished. The investigator will also need educational information about the students, including IQ tests results, disability identification, adaptive behavior and/or other developmental assessments, and their individualized education program (IEP).

Do not hesitate to ask any questions prior to, during, or after about the study. After the study ends, the study results will be made available to you and the participating teachers. Confidentiality for the school, the students, and the teachers will be strictly maintained at all time.

There are no known risks or discomforts associated with this study. However, it is possible that unforeseeable risks do exist. The benefits include that teachers have increased skills in behavioral assessment and intervention strategies, and student participants with autism spectrum disorders or emotional and behavioral disabilities will have fewer challenging behavior and increased appropriate behavior skills.

Please sign this consent form if you agree for _____ School to participate in the study. You are signing it with the knowledge of the nature and purpose of this study. A copy of this form will be given to you for your records.

Respectfully,

Susan D. Flynn _____ Name
(please print)

Doctoral Student _____
(Signature/Date)

This study is approved for 1 year beginning on _____ and ending on _____ (day/month/year).

APPENDIX B: TEACHER INFORMED CONSENT FORM FOR PARTICIPATION IN EDUCATIONAL RESEARCH

The University of North Carolina at Charlotte
9201 University City Boulevard
Charlotte, NC 28223-0001

Union County Public Schools is invited to participate in a research study titled, *Teacher Implementation of Trial-Based Functional Analyses and Function-Based Interventions for Students with Challenging Behavior.* The purpose of this study is to determine teachers' ability to conduct classroom-based functional analyses to determine the function (reason) for their students' challenging behavior. This study will also focus on training teachers to collect behavioral data, as well as to interpret the results of the assessment data and design function-based interventions that will decrease students' challenging behavior and increase their appropriate behavior.

This study will include three teacher/student triads (three teachers and six students). The targeted student participants will have a diagnosis of either an autism spectrum disorder (ASD) or an emotional/behavioral disability (E/BD). Data will be collected by the principal investigator, Mrs. Susan Flynn. An associate professor, Dr. Ya-yu Lo, is the responsible faculty for this research study.

If you agree, the principal investigator will first train you on how to conduct a trial-based (classroom) functional analysis to determine the function of your students' challenging behavior during your regular classroom routine. If you agree, the principal investigator will then train you to analyze the results of the functional analysis, and consequently design and implement interventions based on the results of the analysis. Training for the functional analysis will last approximately one hour. The study implementation in the classroom will last approximately 30 minutes per session, daily for 8 weeks. Data will be collected throughout the course of the study to evaluate the effectiveness of the training. Sessions will be videotaped for the purposes of providing coaching to you and data collection on your implementation of the analysis and intervention, and students' challenging behavior and replacement behavior. We may also use clips from the videos for teacher professional development to illustrate what we have learned from this study. The students may be referred to by their first name in the clip; all other identifying information will be removed. The videos will not be used for general publicity and will be destroyed three years after the study is completed. The principal investigator will also access your student's educational record.

There are no foreseeable risks associated with this study. However, it is possible that unforeseeable risks do exist. Findings from this study may benefit your students and other students with disabilities as we better understand how to increase the appropriate behavior and decrease the challenging behavior of students with ASD or E/BD through training on functional analyses and function-based interventions.

At the end of the research study you will be asked to complete a short survey. This will provide information regarding your impression of the research (e.g., ease of implementation, usefulness to students). This survey will take about 10 minutes to complete.

You are considered a volunteer. Your decision to participate in this study is completely up to you and your confidentiality will be upheld at all times. If you choose to withdraw at any time, there will be no penalties. You will not be treated any differently if you decline to participate in the study or if a decision is made to cease participation once it has begun.

All information about you and each student's participation, including identity, is completely confidential. The following steps will be taken to ensure this confidentiality:

- Any data collected (including videos) will be kept in a locked cabinet in the principal investigator's office.
- Your name and the students' names will not be used in any final report or presentation of the data; instead all names will be replaced with pseudonyms.

UNC Charlotte wants to make sure that each research participant is treated in a fair and respectful manner. Contact the University's Research Compliance Office (704-687-3309) with questions in that regard. Please contact the principal researcher, Susan Flynn (704-622-9267), or Dr. Ya-yu Lo (704-687-8716), associate professor in the Special Education Program with any questions.

I have read the information in this consent form. I have had the chance to ask questions about this study, and those questions have been answered to my satisfaction. I am 18 years of age (or legally emancipated), and I agree to participate in this research study. I understand that I will receive a copy of this form after it has been signed by me and the principal investigator of this research study. I agree to participate in this research project.

_____ _____

Teacher's name (PRINT) Teacher's signature and date

_____

Investigator's signature and date

This study is approved for 1 year beginning on _____ and ending on _____ (day/month/year).

APPENDIX C: TEACHER PARTICIPANT DEMOGRAPHIC FORM

The following is a brief set of questions asking about your experiences as a special education teacher. Completion of this form provides me with information about your previous experience that may be helpful in designing and describing this research. Thank you for taking the time to complete this form accurately.

Teacher's Name:

Highest Degrees Earned:

Additional Certifications Earned (if any):

Years of Full-Time Teaching (after internship):

Preschool –
Elementary –
Middle School –
High School –
Other teaching experiences –

Current position; circle one:

Inclusion teacher Resource teacher Self-contained teacher

Please describe any previous experience working with students with autism spectrum disorders (ASD) or students with emotional and behavioral disabilities (E/BD):

Have you ever participated in professional development or training in conducting functional analyses (i.e., manipulating environmental events to determine function of behavior) of students' challenging behavior? If so, please describe this experience.

Have you ever conducted a functional behavioral assessment or functional analysis with your students? If so, please describe this experience.

APPENDIX D: INITIAL STUDENT PARTICIPANT IDENTIFICATION FORM

This research study is intended to investigate classroom variables that increase appropriate behavior in students with challenging behavior. The following questions are intended to identify students with whom this research would be appropriate. Please fill out one form for each student in your class who has exhibited challenging behavior so far during this academic year.

Challenging behavior should include behavior that have persisted thus far this year and for which you might have sought additional support or are *considering* seeking such support.

Your name - _____ **Grade level /Setting -** _____

Student name - _____ **Period -** _____

1. **Please describe each form (what does the behavior looks like) of the challenging behavior this student exhibits (e.g., yelling out, talking to peers, self-injurious behavior, etc.) in clear terms. Also describe the severity of the behavior (e.g., the level of disruption), as well as the rate.**

_____

_____

_____

2. **Does the behavior occur at any time during the period more than another? If so, please describe. Are there any "triggers" for the behavior? If so, please describe them. If there is more than one form of challenging behavior, please list the contexts for each individual behavior.**

_____

_____

_____

_____

3. **Please describe all the contexts in which you have seen the behavior occur (e.g., reading instruction, group work, cafeteria, hallway). If there is more than one form of challenging behavior, please list the contexts for each individual behavior.**

_____

_____

_____

_____

4. **To your knowledge, has this student exhibited these or similar behavior during past school years? If so, please describe what you know of the behavior prior to this school year.**

_____

_____

_____

APPENDIX E: DIRECT OBSERVATION OF STUDENT BEHAVIOR & FUNCTION-BASED INTERVENTION PROCEDURAL INTEGRITY FORM

Date: ____________ **Student:** ________________ **Teacher:** ____________________ **Observer:** ___________________

Description of target challenging behavior: ____
Function of behavior (if known, e.g., during baseline and intervention phases):______________________
Alternative/replacement behavior: ____

Student Behavior					**Teacher Behavior (Implementation Procedural Integrity)**								
Baseline or **Intervention (Circle one)**					**DRA + EXT**								
	Target Challenging Behavior		Replacement Behavior		Teacher teaches or reviews the replacement behavior in the environment where the challenging behavior occurs at the beginning of the session by • explaining and modeling the replacement behavior **Y N** • providing opportunities for student to practice the replacement behavior **Y N** • providing performance feedback such as verbal praise or reinforcer **Y N**								
Time of behavior instance	Mark each occurrence (and duration if is a focus)	Teacher response to challenging behavior	Mark each occurrence	Teacher response to replacement behavior	Teacher does not reinforce any instance of the challenging behavior (i.e., implements extinction).			Teacher prompts the student to use the replacement behavior using a least-to-most prompting system each time the student engages in the challenging behavior without using the replacement behavior.			Teacher immediately reinforces the student's use of replacement behavior using the FR1 reinforcement schedule.		
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
					Y	**N**	**N/A**	**Y**	**N**	**N/A**	**Y**	**N**	**N/A**
Total:					**Percent Correct = _____ (#s of Ys) / _____ (total number of Ys+Ns) x 100% = ______________**								

APPENDIX F: PARENT INFORMED CONSENT FORM FOR PARTICIPATION IN EDUCATIONAL RESEARCH

The University of North Carolina at Charlotte
9201 University City Boulevard
Charlotte, NC 28223-0001

Teacher Implementation of Trial-Based Functional Analysis and Function-Based Interventions for Students with Challenging Behavior

Your child is invited to participate in a research study from UNC Charlotte. This study is designed to meet the behavior support needs of students with autism spectrum disorders (ASD) or of students with emotional and behavioral disabilities (E/BD) with challenging behavior. If you accept this invitation, we will work with your child's teacher to better understand how to conduct behavioral assessment and design effective interventions for your child.

This study will involve training teachers to conduct behavioral assessments to determine how a student is behaving a certain way, and how to effectively address that behavior. A procedure called "functional analysis" will be used to find out what your child is trying to communicate with his or her behavior during the normal classroom routine. Your child's teacher will be trained how to conduct the functional analysis and then implement an intervention based on the results of the functional analysis, which will include teaching your child to appropriately communicate his or her needs using an appropriate replacement behavior (e.g., raising the hand to ask a question rather than yelling out).

A member of the research team at UNC Charlotte will collect data on your child receiving the intervention from your child's teacher 3-5 days per week for approximately two months during the 2011-2012 school year. Data will include your child's classroom inappropriate behavior, appropriate behavior, and the teacher's ability to conduct the analysis and design/implement effective interventions. The researcher will also videotape the implementation of the analysis and the intervention. There is nothing your child or your child's teacher will need to do differently as a result of being videotaped. The videotape will be used for data collection and to ensure the quality of the intervention. We will also need information about your child including individualized education program (IEP), IQ tests results, adaptive behavior, and/or other developmental assessments to help us design the most effective intervention. Therefore, we would like your permission for us to review your child's results from these assessments. All information from these assessments will be kept confidential. We may use clips from the videos for teacher coaching and professional development to illustrate what we have learned from this study. Your child may be referred to by their first name in the clip; all other identifying information will be removed. The videos will not be used for general publicity. No one other than the reseach team will be able to identify you and your child in any way. The videotapes will be destroyed three years after the study ends.

At least six teacher/students pairs will be selected for this study. Your decision to allow your child to participate in this study is completely voluntary. You may refuse to participate, and if you agree to participate you can stop at anytime. If you decline to participate or choose to stop, you

and your child will not be penalized and you will not lose any benefits to which you are otherwise entitled.

There are no foreseeable risks associated with this study. However, it is possible that unforeseeable risks do exist. Findings from this study may benefit your child and other students with disabilities as we better understand how to address the challenging behavior of students diagnosed with an ASD or E/BD.

If you have any questions about this project, please contact Susan Flynn at 704.622.9267 or Dr. Ya-yu Lo at 704.687.8716. UNC Charlotte is committed to ensuring that all research participants are treated in a fair and respectful manner. If you feel that you have been mistreated in any way, or have questions about research-related injuries during participation in this project, you should contact the Office of Research Services, Institutional Review Board for Research with Human Subjects (704.687.3311).

I have read the information above (or have had it read to me), I am at least 18 years of age (or legally emancipated), and I agree to allow my child to participate in this research project. My signature indicates that I have had the opportunity to ask questions about this study and my child's participation, and that my questions have been answered to my satisfaction; that I have decided to allow my child to participate; and, that I have received a copy of this form for my records.

_____

Student Name (PRINT)

_____ _____

Parent Name (PRINT) Parent Signature DATE

_____

Investigator Signature DATE

This study is approved for 1 year beginning on _____ and ending on _____ (day/month/year).

APPENDIX G: STUDENT ASSENT

The University of North Carolina at Charlotte
9201 University City Boulevard
Charlotte, NC 28223-0001

Teacher Implementation of Trial-Based Functional Analysis and Function-Based Interventions for Students with Challenging Behavior

You are being asked to join a research project. You will continue with your normal classroom routine. Project staff will come to visit you in your classroom and watch you learn new material. We also will help your teacher learn new ways of getting you to tell your teacher what you need in an appropriate way. We hope that this project will help you learn and tell others what you need in an appropriate way, but we cannot be sure that it will. There are no clear risks associated with this study, but it is possible that there are unknown risks.

You do not have to be in the study. Your grades will not be changed if you do not join the project. You can leave the project any time. No one will get mad if you leave the project. You will be videotaped during your normal classroom routine. These videotapes will be used to collect data. This will help everyone see what you are learning and to help you learn more. The videotapes will be destroyed three years after the study is finished. You can ask questions about the project any time. After the project is completed, I will write a report about your learning, but I will not use your name in the report.

I have read this or an adult has read this to me. My choice to join this research project is:

YES	NO
	

_____ _____

Student Name/Date Student Signature/Date

_____

Researcher's Signature/Date

This study is approved for 1 year beginning on _____ and ending on _____ (day/month/year)

APPENDIX H: DESCRIPTIONS FOR THE TRIAL-BASED FUNCTIONAL ANALYSIS CONDITIONS

1. **Attention Condition**:

   Purpose: to determine if the function of behavior is to get teacher attention

Control Segment (1 minute)

- Provide attention (e.g., "Good job," "Keep up the good work," "How are you doing?") to the student every 20 seconds.
- Provide preferred item/activity for your student to interact with.
- Do not give work/tasks to your student, or any other kind of demand.
- Do not respond to any challenging behavior.

Test Segment (3 minutes)

- Move away from student.
- Only provide attention for the target challenging behavior (do not provide attention for any other challenging behavior except the target behavior).
- If your student does not exhibit the target challenging behavior, continue to ignore the student until the test segment is finished.

2. **Demand Condition:**

   Purpose: to determine if the function of behavior is to escape an aversive task (e.g., work)

Control Segment (1 minute)

- Provide attention (e.g., "Good job," "Keep up the good work," "How are you doing?") to the student every 20 seconds.
- Provide preferred item/activity for your student to interact with.
- Do not give work/tasks to your student, or any other kind of demand.
- Do not respond to any challenging behavior.

Test Segment (3 minutes)

- Tell your student to work using a three-step prompting procedure:
  - **Tell** – tell your student what you want him or her to do. If compliance, give brief praise. If no compliance, then:
  - **Show** – demonstrate what you want your student to do. If compliance, give brief praise. If no compliance, then:
  - **Assist** – give physical guidance (e.g., hand-under-hand) to have student complete request. Do not provide praise at this point.
- If your student demonstrates the target challenging behavior at any time, remove work and turn away (do not talk to him or her).

3. Tangible Condition:

Purpose: to determine if the function of behavior is to obtain a preferred item or activity

Control Segment (1 minute)

- Provide attention (e.g., "Good job," "Keep up the good work," "How are you doing?") to the student every 20 seconds.
- Provide preferred item/activity for your student to interact with.
- Do not give work/tasks to your student, or any other kind of demand.
- Do not respond to any challenging behavior.

Test Segment (3 minutes)

- Removed the preferred item/activity, but keep it in your student's view.
- If your student exhibits the target challenging behavior, give back the item/activity to the student without verbal exchange or other attention.

4. Ignore Condition:

Purpose: to determine if the function of behavior is automatic reinforcement (e.g., sensory consequences)

Control/Test Segment (2 minutes)

- Have your student seated alone without access to materials, activities, or people.
- Ignore all challenging behavior and appropriate behavior.

Test Segment (2 minutes)

- Have your student seated alone without access to materials, activities, or people.
- Ignore all challenging behavior and appropriate behavior.

APPENDIX I: STEPS FOR IMPLEMENTING TEACHER TRAINING OF TBFA AND FBI PROCEDURES

Trainer (Experimenter) _____ Teacher _____

Phase 1TBFA	**Date:**
Introduction	
_____ **1)** Trainer greets the teacher.	
_____ **2)** Trainer reviews the purpose of the training session.	
_____ **3)** Trainer describes the training process.	
Procedure	
_____ **4)** The trainer defines topographies of challenging behaviors such as self-injury, aggression, and tantrums (Carr & Durand, 1985).	
5) The trainer describes various functions of behavior.	
_____ **a.** Socially mediated positive reinforcement	
_____ **b.** Socially mediated negative reinforcement	
_____ **c.** Automatic positive reinforcement	
_____ **d.** Automatic negative reinforcement	
_____ **6)** The trainer provides the purpose of functional analysis and how results link to effective FBI.	
_____ **7)** The trainer provides a brief overview of the steps in each of the four conditions of the TBFA.	
_____ **8)** The trainer shows the DVD on functional analysis procedures to the teacher.	
9) The trainer rehearses each step of TBFA procedures with the teacher through role-playing.	
_____ **a.** Attention	
_____ **b.** Tangible	
_____ **c.** Ignore	
_____ **d.** Demand	
_____ **10)** The trainer provides performance feedback.	
11) The trainer showed one of the videotaped pre-training sessions to the teacher and provided feedback.	
_____ a. The trainer trained the teacher to collect data on student behavior using same form as the trainer's.	
_____ b. The teacher's data were compared to the trainer's for accuracy check.	
_____ c. The trainer provided steps on how to determine behavioral function by looking at the data.	
_____ **12)** The trainer asked the teacher if he/she had any questions.	
Phase 2 FBI (DRA + Extinction)	**Date:**
Introduction	
_____ **1)** Trainer reviews the purpose of the training session.	
_____ **2)** Trainer describes the training process.	
_____ **3)** The trainer provides a summary of research on DRA + Extinction and its importance for students who have challenging behavior.	
Procedure	
_____ **4)** Based on TBFA results of TBFA, behavioral function was reviewed with the teacher.	

_____ **5)** The trainer instructs the teacher on how to teach the appropriate manding in the environment where the challenging behavior occurs.

_____ **6)** The trainer instructs the teacher on the least-to-most prompting system.

_____ **7)** The trainer instructs the teacher on how not to reinforce any instance of the challenging behavior (i.e., pausing after the learner uses the challenging behavior, asking, "What do you want?" and "prompting the learner to use the appropriate mand, providing immediate reinforcement for using the appropriate mand).

_____ **8)** The trainer models appropriate responses to appropriate student communicative attempts.

_____ **9)** The teacher is given opportunities to respond to attempts to communicate as modeled by the trainer.

_____ **10)** The trainer provides performance feedback.

_____ **11)** The trainer trained the teacher to collect data on one of the videotaped FBI pre-training sessions.

_____ **12)** The teacher's data were compared to the trainer's for accuracy check.

_____ **13)** The trainer asked the teacher if he/she had any questions.

APPENDIX J: TEACHER POST-INTERVENTION ACCEPTABILITY AND IMPORTANCE OF EFFECTS SURVEY

Teacher: _____ Date: _____

For each item, please circle the number that most closely represents your opinion about the training.

Item	Strongly Disagree 1	2	Neutral 3	4	Strongly Agree 5
Procedures for conducting the TBFA were easy to learn.	1	2	3	4	5
Procedures for conducting the TBFA were easy to perform in the classroom.	1	2	3	4	5
Procedures for designing and conducting the intervention were easy to learn.	1	2	3	4	5
Procedures for designing and conducting the intervention were easy to perform.	1	2	3	4	5
The intervention increased my students' appropriate behavior.	1	2	3	4	5
The intervention decreased my students' challenging behavior.	1	2	3	4	5
My students appeared to like and respond to the intervention well.	1	2	3	4	5
I will use the TBFA again with my students.	1	2	3	4	5
I would recommend the TBFA to other teachers.	1	2	3	4	5
I will use the intervention again with the same students or other students.	1	2	3	4	5
I would recommend the intervention to other teachers.	1	2	3	4	5

What did you like about the TBFA and intervention training (specify which aspects of the training that are useful to you)? Why?

What would you change about the TBFA and intervention training (specify which aspects of the training you perceived to be needing changes to make it more useful to you)? Why?

Adapted from Lane, K. L., & Beebe-Frankenberger, M. (2004). *School-based interventions: The tools you need to succeed*. Boston: Pearson/Allyn and Bacon.

APPENDIX K: PROCEDURAL INTEGRITY CHECKLIST FOR TBFA

Date: _____ **Teacher:** _____ **Student:** _____ **Time:** _____ ~ _____ **Observer:** _____

Order T1	Order T2	Condition	Segment	Teacher Integrity	Trial 1	Trial 2	# Correct
		Attention	**Control**	Provided attention every 20 s.	**Y N**	**Y N**	
				Provided preferred item/activity.	**Y N**	**Y N**	
				No work/tasks.	**Y N**	**Y N**	
				Teacher did not respond to challenging behavior.	**Y N**	**Y N**	
			Test	Teacher moved away.	**Y N**	**Y N**	
				Teacher provided attention contingent on challenging behavior.	**Y N**	**Y N**	_____ / **14**
				If no challenging behavior, teacher continued ignoring student.	**Y N**	**Y N**	
		Demand	**Control**	Provided attention every 20 s.	**Y N**	**Y N**	
				Provided preferred item/activity.	**Y N**	**Y N**	
				No work/tasks.	**Y N**	**Y N**	
				Teacher did not respond to challenging behavior.	**Y N**	**Y N**	
			Test	Teacher initiated work using a three-step prompting procedure.	**Y N**	**Y N**	
				Teacher removed work contingent on challenging behavior.	**Y N**	**Y N**	_____ / **14**
				Teacher turned away with no verbal exchange upon challenging behavior.	**Y N**	**Y N**	
		Tangible	**Control**	Provided attention every 20 s.	**Y N**	**Y N**	
				Provided preferred item/activity.	**Y N**	**Y N**	
				No work/tasks.	**Y N**	**Y N**	
				Teacher did not respond to challenging behavior.	**Y N**	**Y N**	
			Test	Teacher removed preferred item/activity.	**Y N**	**Y N**	
				Teacher kept preferred item/activity in student's view	**Y N**	**Y N**	_____ / **14**
				If challenging behavior, teacher gives back the item/activity.	**Y N**	**Y N**	
		Ignore	**Test**	Student is seated alone.	**Y N**	**Y N**	
				No access to leisure or work items.	**Y N**	**Y N**	
				Teacher ignored challenging behavior.	**Y N**	**Y N**	
			Test	Student is seated alone.	**Y N**	**Y N**	
				No access to leisure or work items.	**Y N**	**Y N**	_____ / **12**
				Teacher ignored challenging behavior.	**Y N**	**Y N**	
Total number of steps implemented correctly = /54 or _____%							

APPENDIX L: FUNCTION-BASED INTERVENTION DESIGN PROCEDURAL INTEGRITY FORM

Date: _____ **Student:** _____ **Teacher:**_____ **Observer:**_____

Description of target challenging behavior:

_____

_____

Function of behavior (if known, e.g., during baseline and intervention phases):_____

_____

Alternative/replacement behavior:

_____

_____

Design of Function-based Intervention (DRA + EXT)
(Occurs once during the training for function-based intervention)

Teacher selects a correct form of communication currently in student's verbal repertoire (e.g., verbalizations, signing).	**Y**	**N**
Teacher selects a replacement behavior that: 1. can be taught in a short amount of time, 2. allows the student to quickly learn the behavior and gain access to reinforcement, and 3. has a functional match to the target challenging behavior.	 **Y** **Y** **Y**	 **N** **N** **N**
Teacher documents correct implementation plan for extinction for the challenging behavior (i.e., withholding the previous reinforcer maintaining the challenging behavior).	**Y**	**N**
Teacher selects the FR1 reinforcement schedule based on establishing a new behavior.	**Y**	**N**
% Correct = ___/6 = _____%		

Note:

APPENDIX M: TRIAL-BASED (CLASSROOM) FUNCTIONAL ANALYSIS RECORDING FORM

Student's Name: _____Teacher: _____Date/Session: _____/_____

Behavior Definition (in specific, observable, measurable terms):
_____
_____
_____

Each trial consists of two segments (control, then test). **Control**: If no PB by the end of the one min, circle "-" and go to test. If PB occurs before one min, circle "+," end segment immediately, and go to test. **Test:** If no PB by the end of three min, circle "-" and end segment. If PB occurs before three min, deliver specified consequence, circle "+", and end segment. Summarize as % of each trial type with PB.

Attention: **Control:** Stand near student; deliver noncontingent attention (pleasant conversation, no tasks). Access to tangible is allowed.
Test: Stand near student but ignore (no tasks); deliver attention only following PB. **Access to tangible is allowed**.

Demand: **Control:** Observe while no task demands are present. Access to tangible is allowed.
Test: Deliver frequent prompts to engage in difficult work; remove work immediately following PB. **Access to tangible is allowed**.

Ignore: Two consecutive test segments are conducted. Observe when student is not working, and not interacting with others, and **no access to tangibles**.

Tangible: **Control:** Student has access to preferred item (tangible).
Test: Stand near student but hold tangible; deliver only following PB.

Trial	Attention				Demand				Ignore				Tangible			
	Control		Test		Control		Test		Test 1		Test 2		Control		Test	
1	+	–	+	–	+	–	+	–	+	–	+	–	+	–	+	–
Trial	Attention				Demand				Ignore				Tangible			
	Control		Test		Control		Test		Test 1		Test 2		Control		Test	
2	+	–	+	–	+	–	+	–	+	–	+	–	+	–	+	–
% PB																

Adapted from The Florida Center on Self-Injury, 2007

APPENDIX N: PREFERENCE ASSESSMENT FORM

Date: _____ Student: _____

Items to be assessed

Number	Item	Number	Item
1		4	
2		5	
3		6	

Instructions:

1. Present both numbered items simultaneously. Place the first item on your left. The second item on your right.
2. If the student doesn't select one, say, "take one."
3. Record as a selection any touch to an item. Circle the selected item.
4. If the item is an edible, allow the student to consume it before going on.
5. If the item is an activity, let the student play with it for 30 seconds.
6. Block any attempts to touch both items simultaneously.
7. If no response is made in 10 seconds, record "NR" and move to the next trial.
8. Be sure that the student has tasted or played with all items before assessing them.
9. Calculate the percentage of trials that each item was selected. Those items selected 80% or more of opportunities are most likely to function as tangible reinforcers, and will be used in the tangible condition.

Trial	Left	Right	Trial	Left	Right	Trial	Left	Right
1	1	2	11	5	2	21	3	5
2	3	2	12	4	3	22	6	2
3	2	6	13	1	5	23	1	4
4	1	3	14	5	3	24	4	5
5	6	5	15	4	1	25	6	3
6	3	6	16	2	5	26	2	4
7	2	3	17	4	2	27	2	1
8	5	1	18	5	4	28	6	4
9	4	6	19	6	1	29	3	1
10	5	6	20	3	4	30	1	6

Summary:

Item 1 Selected ___ out of 10 or ___ % of opportunities
Item 2 Selected ___ out of 10 or ___ % of opportunities
Item 3 Selected ___ out of 10 or ___ % of opportunities
Item 4 Selected ___ out of 10 or ___ % of opportunities
Item 5 Selected ___ out of 10 or ___ % of opportunities
Item 6 Selected ___ out of 10 or ___ % of opportunities