

FUNCTION-BASED INTERVENTIONS FOR YOUNG CHILDREN WITH
CHALLENGING BEHAVIOR: A REVIEW OF QUALITY AND A META-
ANALYSIS OF THE SINGLE-CASE RESEARCH LITERATURE

A Dissertation

by

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ABSTRACT

Large number of young children between the ages 3 and 5 years engages in challenging behaviors that affects their learning, social, and emotional development. Two studies were carried out to evaluate the strength of evidence and the overall effectiveness for function-based interventions (FBIs) to address young children's challenging behavior in early childhood settings. The first study consisted of a systematic literature review to determine if FBIs could be considered an evidence-based practice. Twenty-four single-subject research design studies met the inclusion criteria and were coded for key descriptive features. The review applied the What Works Clearinghouse (WWC) quality indicators and the Council for Exceptional Children (CEC) to the FBIs' literature. Results indicated that FBIs could be considered an evidence-based practice to address young children's challenging behavior based on the WWC quality indicators and a potentially evidence-based practice based on the CEC standards. Several strengths, weaknesses, and recommendations to improve the quality of the FBIs' literature were discussed.

The second study consisted of a meta-analysis of the single-case research to examine the overall effectiveness of the FBIs and analyze the results across six potential moderators related to the participants' and the intervention characteristics. Tau-U effect size index was used to determine the overall effectiveness of the FBIs. Results indicated that FBIs could effectively be used to reduce challenging behaviors in early childhood settings regardless of the intensity, function of the behavior, or intervention agent.

Multicomponent and antecedent-based interventions resulted in better outcomes when compared to consequence-based interventions. Implications for research and practice were discussed.

DEDICATION

To my life companion: Raid Zaini, without your encouragement and support this would not be possible.

To my wonderful children: Ghalyah, Yousef, and our new baby. Ghalyah, your hugs and encouraging words were always appreciated. Yousef, your smiles and love of learning kept me motivated until the end. Our new baby, you kept me on track and helped me finish in time.

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CHAPTER I

INTRODUCTION

Across the literature, researchers estimate 3 to 21% of young children between the ages of 2 and 6 years display challenging behavior. These behaviors interfere with their learning and social-emotional development (Achenbach & Edelbrock, 1981; Powell, Fixsen, Dunlap, Smith, & Fox, 2007). Moreover, the expulsion rates for preschoolers with challenging behavior are three times higher than the expulsion rates for other students of any age (Gilliam, 2005). Without effective interventions those children are more likely to continue to struggle and experience serious negative outcomes, such as poor academic achievement, peer rejection, depression, juvenile delinquency, and school dropout (Campbell, 1991; Gilliam & Shahrar, 2006). Thus, several researchers and educators have emphasized the need for identifying and implementing effective interventions supported by sound research to address these children's challenging behavior (Dunlap & Fox, 2011).

Function-based interventions (FBIs) have proven to be effective in addressing a wide variety of challenging behaviors across different age groups and settings (Dunlap & Fox, 2011; Umbreit, Ferro, Liaupsin, & Lane, 2007). FBIs focus on understanding the function (i.e., purpose) of the behavior and the factors influencing the occurrence of challenging behavior. Examples of these functions include getting the teacher's attention or escaping a demanding task (O'Neill, Horner, Albin, Storey, Sprague, & Newton, 1997).

In 1997, the Individuals with Disabilities Educational Act (IDEA) required implementing functional-behavioral assessments (FBA) to address students' challenging behavior before resorting to suspension and expulsion (IDEA, 1997). This mandate legally applies to young children in early childhood settings. Another equally important federal act is the No Child Left Behind Act (NCLB), which required implementing evidence-based practices (EBPs) with students (Odom et al., 2005). Given the prevalence of expulsion of young children with challenging behavior along with the IDEA and NCIB mandates, it is important to identify effective interventions that are evidence-based to address this issue.

This dissertation project aims to expand the literature by determining the effectiveness of FBIs literature and analyzing the quality of FBIs research to determine if FBIs to address young children's challenging behavior can be classified as an EBP. The dissertation is done in two-journal article format. The first study applies the What Works Clearinghouse (WWC) standards (Kratochwill et al., 2013) and the Council for Exceptional Children (CEC; 2014) quality indicators to the function-based literature to determine whether it meets the criteria for EBPs. The main research questions in the first study will focus on:

1. What are the descriptive characteristics of each study?
2. What is the quality of the single-subject research design FBIs for young children with challenging behavior as evaluated by the WWC standards?
3. What is the evidence of effects according to visual analysis based on WWC standards?

4. What is the quality of the single-subject research FBIs for young children with challenging behavior as evaluated by the CEC quality indicators?
5. Do FBIs have sufficient evidence to warrant classification as an EBP for young children with challenging behavior based on WWC and CEC standards?

The second study consists of a meta-analysis to identify an overall effect size for FBIs and specific effect sizes for each of the following potential moderators: (a) intensity of challenging behavior, (b) disability status, (c) FBA method, (d) function of the behavior, (e) type of FBI used, and (f) intervention agent?

The main research questions in the second study will focus on:

1. What are the descriptive characteristics for the FBIs designed to address young children's challenging behavior?
2. Overall, how effective are FBIs in addressing young children's challenging behavior in early childhood settings?
3. Is the intervention effectiveness related to the following participant characteristics:
(a) intensity of challenging behavior and (b) disability status?
4. Is the effectiveness of FBIs related to FBA features, including: (a) FBA method, (b) function of the behavior, (c) type of FBI used, and (d) intervention agent?
5. Is the effectiveness of FBIs related to the quality of single-subject research designs using WWC standards?

CHAPTER II

AN EXAMINATION OF THE QUALITY OF THE EVIDENCE BASE FOR FUNCTION-BASED INTERVENTIONS FOR YOUNG CHILDREN

Introduction

The prevalence of young children exhibiting challenging behavior is increasing (McCabe & Frede, 2007; Webster-Stratton, 2000). Without effective interventions, these behaviors tend to increase in rate and severity (Campbell & Ewing, 1990). Children with persistent challenging behavior are more likely to experience serious negative outcomes such as peer rejection, depression, juvenile delinquency, school dropout, and expulsion (Campbell, 1991; Gilliam & Shahar, 2006). Therefore, challenging behavior exhibited by young children demand immediate attention in the form of effective early interventions that are supported by research findings (Campbell & Ewing, 1990).

Functional Behavior Assessment

Functional behavior assessment (FBA) is defined as, “a systematic process of identifying problem behaviors and the events that (a) reliably predict occurrence and nonoccurrence of those behaviors and (b) maintain the behaviors across time” (Sugai et al., 2000, p. 137). FBA procedures include indirect measures (e.g., reviewing records, interviews, rating scales), direct measures (A-B-C recording, scatter plot), and in some cases, experimental functional analysis. The current literature suggests that interventions based on identifying the function of the challenging behavior (i.e., why the behavior is happening) are effective in preventing or decreasing the occurrence of challenging

behavior (Division for Early Childhood; 2007; Dunlap et al., 2006; Umbreit, Ferro, Liaupsin, & Lane, 2007).

A large body of literature also suggests the function-based interventions (FBIs) are effective in addressing different types of challenging behaviors exhibited by young children at different early childhood settings. FBIs have been used successfully to address aggression (Boyajian, DuPaul, Handler, Eckert, & McGoey, 2001), disruptive behavior (Nahgahgwon, Umbreit, Liaupsin, & Turton, 2010), non-compliance (Umbreit & Blair, 1997), and self-injurious behavior (Marcus & Vollmer, 1996). Furthermore, FBIs have been implemented in different settings such as preschool classrooms (Boyajian et al., 2001), Head Start centers (Park & Scott, 2009), and community childcare programs (Blair, Fox, & Lentini, 2010). The *Division for Early Childhood* has described FBIs procedures as an *effective practice* (Sandall, McLean, & Smith, 2000). Additionally, FBIs have been described as a “best practice” to address any challenging behavior in applied behavior analysis (Austin, Carr, & Agnew, 1999).

Evidence-Based Practices

Evidence-based practices (EBPs) are defined as “practices supported by multiple, high-quality studies that utilize research designs from which causality can be inferred and that demonstrate meaningful effects on student outcomes” (Cook & Cook, 2013, p. 73). Several federally funded projects have been developed to help guide the development and the dissemination of effective preventive and early intervention strategies to address young children’s challenging behavior before it become chronic and difficult to change (Dunlap et al., 2006). The No Child Left Behind Act (NCLB)

mandates implementing EBPs with students (Odom et al., 2005). Moreover, in 2004, the reauthorization of the Individual with Disabilities Education Act (IDEA) mandated conducting FBAs and implementing FBIs if the challenging behavior was related to students' disability (Umbreit et al., 2007). Furthermore, schools are required to implement FBIs prior to removing a student from his/her current placement (IDEA, 2004).

The Role of Single-Case Research in Identifying Evidence-Based Practices

This review focuses on studies employing single-case research (SCR) methodology due to the fact that SCR is the most commonly used research methodology in special education and has a critical role in the development of EBPs (Horner, Carr, Halle, McGee, Odom, & Wolery, 2005). SCR designs provide repeated and convincing patterns of effects between the introduction of an intervention and the change in the outcome variables (Horner & Kratochwill, 2012). In their definition of SCR, Horner et al., (2005) highlighted the important role SCR plays in determining EBPs. As the authors stated, "single-case research is a rigorous, scientific methodology used to define basic principles of behavior and establish evidence-based practices" (p. 165).

While SCR demonstrates reasonable internal validity, its external validity is limited (Horner et al., 2005). Therefore, systematic reviews of SCR treatments' effects are crucial to address its external validity limitation because different researchers replicate the intervention effects and the evidence is aggregated over time (Horner et al., 2005; Kratochwill et al., 2014). Given the increasing rates of challenging behavior, the reauthorization of IDEA in 2004 emphasizes the use of FBA and the NCLB

recommendation to implement EBPs; it is necessary to know if FBIs are considered an EBPs to address challenging behavior exhibited by young children.

Previous Reviews

Several studies have examined the quality of behavioral interventions to address challenging behavior. Seven previous reviews will be summarized. The reviews are divided into two categories. The first consists of three studies that examined general behavioral interventions including, FBIs, and the second consists of four studies specific to evaluating the quality of FBIs. Within each category, some studies specified the evaluation criteria used to examine studies while some studies did not use specific standards.

Reviews of General Interventions Including Function-Based Interventions

In an early attempt to evaluate the quality of behavioral intervention studies, Scotti, Evans, Meyer, and Walker (1991) examined 403 studies published between 1976 and 1987. All of the reviewed studies employed SCR and conducted behavioral interventions to address participants' challenging behavior. In their review, the authors did not use evaluation criteria; however, the authors referred to the criteria as "important characteristics of accepted clinical and research practices" (p. 236). Examples of the "accepted clinical and research practices," included: (a) objective recording on target behavior, (b) experimental control, (c) generalization and maintenance of the treatment effects, and (d) interventions based on FBA data. The authors indicated that the reviewed studies often did not adhere to the "accepted research practices." The authors noted less than one third of the studies reported generalization data, less than one half of the studies

collected maintenance data, and those who did measured the maintenance in a short period of time. Furthermore, less than one quarter of the studies reported conducting FBAs. Studies that conducted FBAs mostly used descriptive methods (e.g., anecdotal reports) rather than experimental functional analysis.

Odom and Strain (2002) used the *Division of Early Childhood (DEC) Recommended Practices* to evaluate the strength of evidence for early interventions and early childhood special education interventions. The review included 184 SCR studies published between 1990 and 1998. No distinctions were made between the FBIs and positive behavior support strategies. Moreover, prompting, FBIs and positive behavior support strategies were among the most implemented practices. In studies that implemented FBIs and positive behavior support strategies, generalization and social validity data were collected in about 10% of the studies, maintenance data were collected in 30% of the studies and less than 2% of the studies measured fidelity of implementation.

Dunlap et al. (2006) evaluated the degree of evidence related to several prevention and early interventions practices to address young children's challenging behavior. The authors used Dunst, Trivette, and Cutspec's (2002) definition of EBPs: "practices that are informed by research, in which the characteristics and consequences of environmental variables are empirically established and the relationship directly informs what a practitioner can do to produce a desired outcome"(p. 31). Dunlap et al., used an aggregation of descriptive, quasi-experimental, and experimental peer reviewed studies using single-case designs to come up with a conclusion that FBIs are effective strategies

to reduce challenging behaviors exhibited by young children.

Reviews Specific to Function-Based Interventions

Heckaman, Conroy, Fox and Chait (2000) examined FBI research on students with or at-risk for emotional and behavioral disorders (EBD) who exhibited challenging behavior. The review included 22 studies published between 1991 and 1999. The authors focused on identifying trends in the design and application of FBIs, and the extent in which researchers collected and reported measures of fidelity of implementation, generalization, maintenance, and social validity. Similar to Scotti et al. (1991), no packaged evaluation criteria were used to evaluate the studies. Results showed neither a clear trend in the type of FBIs used nor a rationale for selecting the interventions. Fidelity of implementation and social validity data were collected for half of the studies. Furthermore, a very small percentage of the studies (9%) collected generalization and maintenance data.

Lane, Kalberg, and Shepcaro (2009) examined the quality and the strength of evidence for FBIs for students EBD using the quality indicators proposed by Horner et al. (2005). The review includes 12 SCR studies published between 1981 and 2006. Results indicated that even though FBIs for middle and secondary school students with EBD hold promise. However, only one of the 12 studies met all of the three components regarding the quality of describing participants and settings. In addition, when assessed using Horner et al.'s quality indicators, FBIs for students with EBD could not be considered an EBP at the time of the evaluation.

Gage, Lewis, and Stichter (2012) conducted a meta-analysis on FBIs for students

with or at-risk for EBDs in school settings. The authors examined 69 SCR studies published between 1992 and 2010. The meta-analysis aimed to evaluate the effectiveness of the FBIs and determine whether the studies quality characteristics would have an impact on the results. The authors used Horner et al. (2005) criteria to evaluate the quality of the studies. Results indicated that FBIs reduced the participants' challenging behavior by 70%. In addition, interventions based on experimental functional analysis were more effective compared to interventions based on descriptive assessments. Additionally, the majority of the studies met Horner et al.'s quality indicators and the studies design quality was not related to the intervention's effectiveness.

Wood, Oakes, Fetting, and Lane (2015) conducted a review to examine the evidence-base for a systematic approach to FBIs developed by Umbreit et al. (2007). The review applied the CEC standards to 12 studies. Seven studies met all the quality indicators indicating strong designs or methodologically sound designs. However, these seven studies represented less than 20 students. Thus, Umbreit et al.'s systematic FBIs approach (2007) was classified as potentially EBP.

Gaps in the literature based on the previous reviews. While previous reviews contribute to the behavioral interventions literature, little is known about the state of evidence of FBIs designed specifically to address young children's challenging behavior in early childhood school settings. For example, Scotti et al. (1991), Odom and Strain (2002), and Dunlap et al. (2004) reviews examined the quality of different behavioral interventions that were not exclusive to FBIs. Moreover, reviews that examined the

quality of evidence for FBIs either included older participants (e.g., Gage et al., 2012; Lane et al., 2009) or focused on a specific population, such as students with or at-risk for EBD. Finally, a systematic evaluation of the evidence of FBIs using rigorous standards is lacking. Lane et al. (2009) and Gage et al. (2012) applied Horner et al.'s (2005) quality indicators and Odom and Strain (2000) used the DEC criteria to evaluate intervention research. However, other reviews did not use a specific evaluation criteria (e.g., Dunlap et al., 2004; Scotti et al., 1991), which limit their usefulness in identifying EBPs for young children.

Horner et al. (2005) reported quality indicators to evaluate FBIs include the replication of experimental control, conducted by different research teams, and with a sufficient number of participants to imply generalization of effects. However, Horner et al.'s quality indicators are still with limitations. For example, they lack measures of effect sizes for the evaluated interventions WWC standards address this by including both design measures, statistical analysis/measures of effect sizes, and evidence-criteria (Horner & Kratochwill, 2012).

None of the previous studies used the WWC (2013) standards to examine the strength of evidence for FBIs. Recently, there has been an increasing attention given to standards developed by WWC for SCR designs (Horner & Kratochwill, 2012). For several reasons, such as (a) WWC standards aim to encourage the implementation of high quality SCR, (b) the standards serve as a guide that provides protocols for evaluating experimental control (internal validity), (c) it combines traditional methods to evaluate SCR (visual analysis) along with statistical analysis or effect sizes measures

(Kratochwill, & Levin, 2014), (d) it provides procedures for conducting meta-analyses of single-case literature (Horner & Kratochwill, 2012), and (e) most importantly, WWC standards inform educators about the levels of support any intervention has and its expected outcomes. Thus, the WWC standards serve as model for professional decision making by helping practitioners match the best available practices with their clients' needs and values (Slocum, Detrich, Wilczynski, Spencer, Lewis, & Wolfe, 2014).

In this qualitative review, the function-based literature for young children will be evaluated using a rubric adapted by Maggin, Briesch, and Chafouleas (2012) to WWC criteria for EBPs (Kratochwill et al., 2013) along with the CEC quality indicators for SCR (CEC, 2014). The decision to use two standards to evaluate the quality of FBIs research was reached in order to provide a comprehensive evaluation of the quality of SCR FBIs studies. The WWC standards focus on experimental control and visual analysis of the graphs. On the other hand, the CEC quality indicators includes items related to experimental control and visual analyses it focuses on providing sufficient descriptive information regarding the participants, settings, intervention agents, implementation fidelity, and description of the intervention. Therefore, the two standards complement each other.

Purpose and Research Questions

Given federal mandates to implement FBIs and EBPs to address the increasing rates of challenging behavior, and the gaps in the literature, it is necessary to know if FBIs are considered an EBP to address challenging behavior exhibited by young children.

The following research questions were developed to guide the proposed review:

1. What are the descriptive characteristics of each study?
2. What is the quality of the FBI's research for young children with challenging behavior as evaluated by the WWC standards?
3. What is the evidence of FBI's effect on young children's challenging behavior according to visual analysis?
4. What is the quality of the FBI's research for young children with challenging behavior as evaluated by the CEC quality indicators?
5. Do FBI's have sufficient evidence to warrant classification as an EBP for young children with challenging behavior based on WWC and CEC standards?

Method

Potential studies for inclusion in this study were located using three steps: (a) electronic database searches, (b) hand searches, and (c) ancestral searches.

Electronic Database Searches

A systematic search was conducted in EBSCO within the following four databases: Education Resource Information Center (ERIC), PsychINFO, Academic Search Complete, and Education Full Text. Within each of the databases, the search was conducted using two search strings. The first of these strings contained keywords associated with the intervention: (a) assessment-based intervention, (b) behavior* modification, (c) functional behavior assessment, (d) functional analysis, (e) structural analysis, (f) functional communication training, (g) prespecified reinforcers, (h) non-contingent reinforcer*, (i) differential reinforcer*, and (j) choice interventions. The

second of these strings contained keywords associated with the participants: (a) young children, (b) preschool education, and (c) preschool*. All keywords within each of the strings were joined with the Boolean operator *OR*. In addition, the two search strings were combined using the Boolean operator *AND*. The publication year for each of the strings were not restricted. However, each of the searches (i.e., each of the individual strings and the final combined search) was limited to studies published in English and were peer-reviewed. A total of 1,435 studies were identified using the electronic searches. After removing duplicates, all identified studies were exported to RefWorks for screening of titles and abstracts. Initial inclusion criteria consisted of FBI to address young children's challenging behavior.

Hand Searches

Hand searches were conducted in journals that published two or more studies meeting the initial inclusion criteria. Journal searched were: *Behavioral Disorder*, *Education and Treatment of Young Children*, *Journal of Applied Behavior Analysis*, *Journal of Behavioral Education*, *Journal of Early Intervention*, and *Topics in Early Childhood Special Education*. The same electronic search procedures and criteria were used in hand searches. All eligible studies identified from hand searches were exported to RefWorks and included in the directory created from the electronic searches.

Ancestral Searches

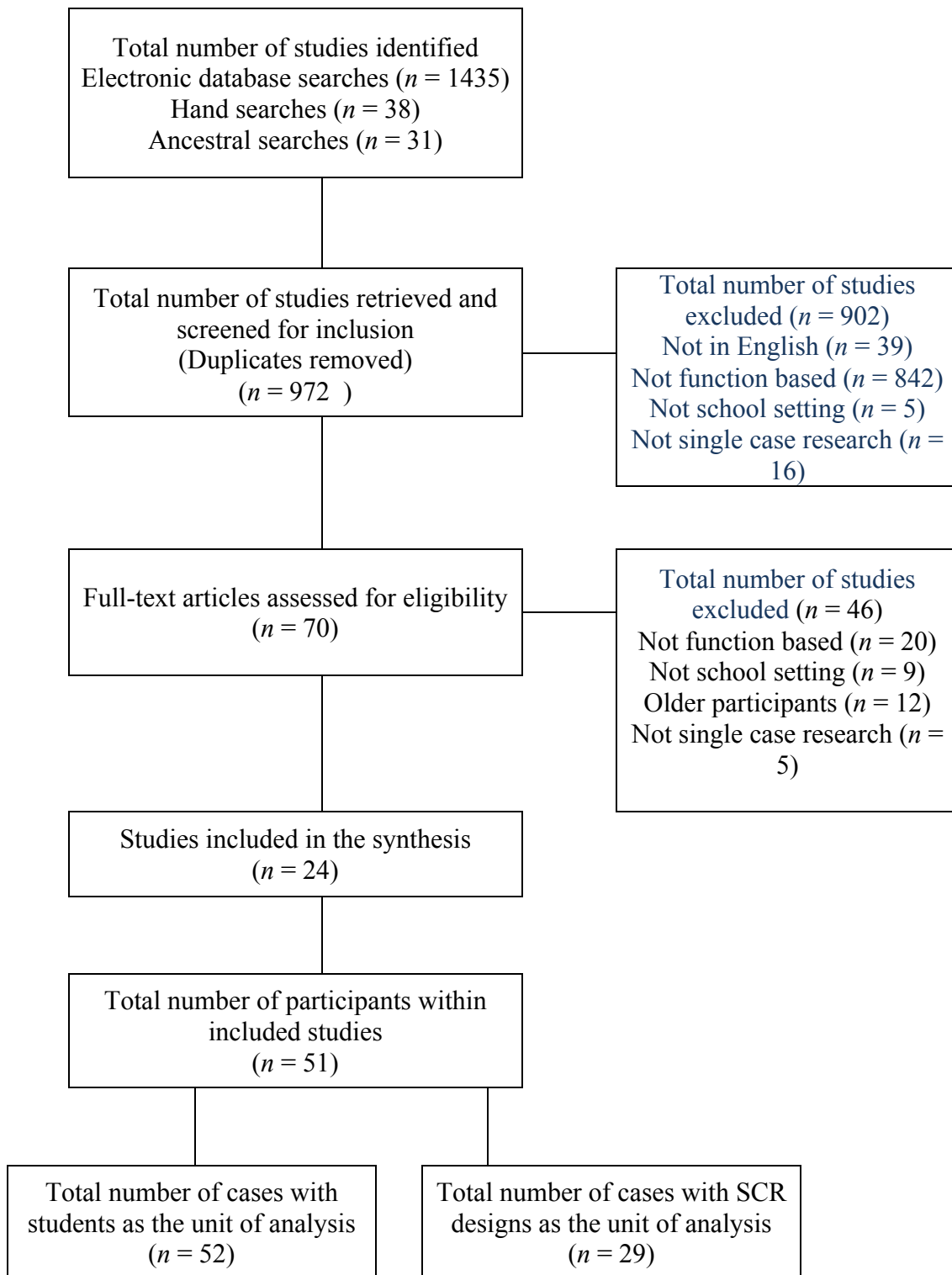
Two types of ancestral searches were conducted using the same initial inclusion criteria described in the electronic database searches. First, the reference lists of all eligible studies were screened. Second, all references included in previous reviews were

screened. Specifically, the reference lists of the following six reviews were screened: Conroy, Dunlap, Clarke, and Alter (2005), Gage, Lewis, and Stichter (2012), Goh and Bambara (2010), Harvey, Boer, Meyer, and Evans (2009), Wood, Blair, and Ferro (2009), and Wood, Drogan, and Janney (2014). From these three steps, 70 studies were eligible for full text screening using the following inclusion criteria.

Criteria for Study Inclusion

To be included in this review, studies had to meet the following six criteria: (a) all the participants in the study had to be described as young children between the ages three and five, (b) the independent variable had to be described as an individualized FBA, (c) the study must target challenging behavior as an outcome measure, (d) the study had to be conducted in an early childhood educational setting (e.g., preschool, day care, and early childhood special education classroom), (e) the study had to be classified as an experimental single-case research design (e.g., alternating treatment, reversal, or multiple-baseline design), and (f) the study must have presented data in graphical display that included baseline and intervention phases necessary to calculate effect sizes. A total of 24 studies met these inclusion criteria. Figure 1 illustrates the results of the literature searches and screening process.

Figure 1. Results of the literature search and inclusion screening



Publication Bias

The current review focused only on peer-reviewed studies. Thus, publication bias might be a possibility due to the exclusion of dissertations and studies without statistically significant results. The Egger's test (Egger, Smith, Schneider, & Minder, 1997) within WinPepi software (Abramson, 2011) was used to test for publication bias. In addition, heterogeneity of study results was measured using Higgins and Thompson's H and I^2 statistics (Higgins and Thompson, 2002). The Heterogeneity analysis did not suggest notable heterogeneity ($H = 1.3$, $CI_{95\%} [1.1-1.7]$). Yet, the Edger's test results suggested a possible publication bias.

An additional sensitivity analyses indicated that one study seemed to have an impact on the results. Specifically, the Ingvarsson et al. (2009) study presented wide range of effect sizes that skewed the results. While the Ingvarsson et al.'s study met all inclusion criteria; it was unique to the other included studies. Included studies either examined the effects of FBI on challenging behavior or compared the effectiveness of FBIs to other non-FBIs. The study by Ingvarsson and colleagues examined the effects of two densities of reinforcements (high density vs. low density) and two contingencies of reinforcements (contingent vs. non-contingent reinforcements) to address the participants' challenging behavior. The study used an alternating treatment design, an ABAB design, and included 30 phase contrasts. Given that four reinforcement conditions were manipulated and many of those conditions were not compared to baseline phases, not all phase contrasts were included in the analyses. Furthermore, many of those included phase contrasts presented small effect sizes because the authors

altered the reinforcement contingency and density at subsequent phases to improve participants' challenging behaviors. In addition, the Ingvarsson et al.'s study contained large number of phase contrasts (30 phase contrasts) compared to the other studies, and since that those contrasts presented wide range of effect sizes it might have skewed the results.

Descriptive Coding Procedures

The identified studies were summarized within three categories: (a) study characteristics, (b) participants and setting characteristics, and (c) additional study features. Study characteristics. Four items were used to describe the salient characteristics for each of the studies. These items included: (a) authors, (b) publication year, (c) publication journal, and (d) SCR design. Participants and setting characteristics. Six items were used to describe the participants and the settings in each of the studies. These items included (a) gender, (b) age, (c) ethnicity, (d) social economic status, (e) disability status, and (f) setting. Additional study Features. Five items were used to describe additional study features: (a) assessing and reporting inter-observer agreement results (IOA), (b) including measures of fidelity of implementation, (c) including social validity measures, (d) assessing for maintenance of intervention results, and (e) assessing for generalization of intervention effects to other contexts.

Coding Procedures

What Works Clearinghouse. All studies were evaluated using a rubric adapted by Maggin et al. (2012) to WWC standards. The evaluation included: (a) an initial evaluation using design standards for eligible studies, (b) a subsequent evaluation for

intervention's effects determined by visually analyzing the graphs and considering the ratio of effects to non-effects, and (c) a classification as an EBP if the studies met design standards and provided evidence of effects.

Design standards. The initial evaluation consisted of appraising the studies based on the following five criteria: (a) independent variables are systematically manipulated by the researcher, (b) outcome variables are measured repeatedly and over time, (c) inter-observer agreement (IOA) is collected for a minimum of 20% across all baseline and intervention conditions, (d) IOA meets the threshold for the statistical analysis conducted, and (e) design provides a minimum of three demonstrations of intervention effects at three different points in time or phase contrasts. These five criteria were scored on a dichotomous scale (e.g., present or not present). Studies failing to meet any of these standards were coded as *does not meet design standards*. Studies meeting the five design standards were evaluated on the number of data points in each phase. This criterion is scored on a three-point scale to differentiate between studies meeting *standards without reservations* and studies *meeting standards with reservations*. Thus, possible ratings for this criterion include: *meeting the standards without reservation*, *meeting the standards with reservation*, or *not meeting the standards*.

Visual analysis and evidence of effects. Studies meeting the design standards, with or without reservations, were visually analyzed for evidence of effects. Specifically, visual analysis consisted of evaluating the data within each phase based on changes in: (a) level, (b) trend, and (c) variability. Furthermore, the differences between phase characteristics was evaluated for: (a) immediacy of effects, (b) overlap, and (c)

consistency of data in similar phases. To ensure consistency and systematic judgment of visual analysis of graphs, the visual analysis was conducted using a protocol described by Gast and Spriggs (2010) and quantitative values to support the judgments of the reviewers regarding the evidence of effects were assigned. For example, WWC standards for visual analysis involve baseline analysis for variability consistency. The Gast and Spriggs' (2010) protocol adds a quantitative analysis to this criterion by specifying a baseline level. This level is considered stable if 80% of the data points fall within a 25% range of the median level for all values in the baseline. Additionally, WWC standards for visual analysis to identify between phases effect includes low overlap between baseline and treatment phases to document experimental effects. Visual analysis was scored in a dichotomous scale (e.g., present or not present).

After visually analyzing the graphs, the ratio of phase contrasts with and without effects was examined. According to the WWC rubric, a ratio greater than 3:1 indicates the studies provide *evidence without reservations*; a ratio equal to 3:1 indicates the studies provide *evidence with reservations*, and a ratio less than 3:1 indicates the studies provide *no evidence of effects*.

Determination of evidence-based practices. After completion of the first two steps, classification as an EBP was made using the number of studies meeting the design standards and providing evidence of intervention effects. Therefore, the classification of EBP was determined using the “5-3-20 criterion” for SCR systematic reviews (Kratochwill et al., 2013). According to WWC, FBIs for young children would be considered an EBP if there are at least five different studies conducted by three different

research teams with a minimum of 20 participant cases, providing evidence with or without reservations.

CEC Quality Indicators

To supplement the WWC standards, the rubric for EBPs in special education developed by the Council for Exceptional Children (CEC, 2014) was used to rate the identified studies. The CEC evaluation procedures consisted of three-steps: (a) identification of methodologically sound studies, (b) classification of effects, and (c) classification of the strength of evidence. Similar to the coding of WWC standards, the coding for the CEC quality indicators were conducted using a bifurcated process.

Identification of methodologically sound studies. All studies were evaluated by applying the following eight criteria to the 24 studies. Studies were considered meeting all of the quality indicators if it provided sufficient information regarding: (a) critical features of the context or setting, (b) participants to which the results may be generalized, (c) intervention agent, (d) independent variable to allow replications, (e) implementation fidelity (f) internal validity, (g) outcome measures, and (h) data analysis. Each of the quality indicators was scored on a dichotomous scale. Studies not meeting all of the quality indicators were not included in the classification of effects.

Classification of effects. Studies meeting all of the eight methodological quality indicators were evaluated for effect. The classification for effect was based on the number and the ratio of participants with an established functional relationship between the independent and the dependent variables. In addition, the direction of the functional relationships as demonstrated by visual analysis of changes in levels, trends, variability,

immediacy of effects, and overlap of data points across the phases was considered for effects classification. Possible classification of effect included: (a) *positive effects* if a functional relationship between the independent and the dependent variables resulted in therapeutic changes in the dependent variable for 75% of the cases, (b) *negative effects* if a functional relationship between the independent and the dependent variables resulted in nontherapeutic changes in the dependent variable for 75% of the cases, and (c) *neutral or mixed effects* if the effects were neither positive nor negative.

Determination of evidence-based practices. Finally, EBPs were determined on the ratio of methodologically sound studies with positive effects supporting the practice to studies with neutral or mixed effects. The practice was classified as (a) *evidence-based practice* if supported by five methodologically sound SCR studies with positive effects and a minimum of 20 participants across the studies, (b) *potentially evidence-based* if supported by two to four methodologically sound SCR studies with positive effects, (c) *mixed evidence* if the studies did not meet the criteria for EBP or potentially evidence-based practices, (d) *insufficient evidence* when the available research did not meet any of the other criteria for evidence-based, and (e) *negative evidence* when the number of methodologically sound studies with negative effects outnumbered the number of methodologically sound studies with positive effects.

Reliability

Reliability was measured for the inclusion screening, descriptive coding, and the quality appraisal coding. Reliability was calculated using the following percentage of

agreement formula: $[(\text{sum of agreement} / \text{total number of agreements} + \text{disagreements}) * 100]$.

Reliability for inclusion. Two reviewers independently applied the inclusion/exclusion criteria to all of the identified studies ($n = 70$). Reliability for inclusion reached 94%. In cases of disagreements regarding the decision to include/exclude a study, the two reviewers discussed the discrepancy until they came to agreement. Final agreement for inclusion reached 100%.

Reliability for descriptive coding. One reviewer coded all 24 studies for descriptive characteristics. One third of the studies ($n = 8$) were randomly selected and coded for reliability by a graduate student trained in descriptive coding. The overall agreement between the reviewer and the graduate student was 93% (range 73% to 100%). Reliability for participant characteristics was 88%. Reliability for additional study features (IOA, fidelity, social validity, maintenance and generalization) was 95%. Final agreement for descriptive coding reached 100%.

Reliability for quality appraisal. One reviewer applied the WWC quality indicators and the CEC standards to all of the 24 studies. One third of the studies ($n = 8$) were randomly selected and coded for reliability by a graduate student trained in quality appraisal. The main percentage agreement across all WWC standards was 91%, with 94% agreement on items related to coding on design standers ($M = 94\%$, range, 71 to 100%). Agreement on visual analysis and overall effects reached 89% ($M = 92\%$, range, 83% to 100%). The main percentage agreement across all CEC standards was 87%

(range 78% to 100%). In cases of disagreements, the two reviewers discussed the discrepancy until they came to agreement. Final agreement reached 100%.

Results

Study Characteristics

The first research question focused on describing the salient features of the included studies. A total of 24 studies met the criteria for inclusion in the review. The studies were published between 1995 and 2014. An increasing trend in the publication of FBIs research was noted. Seven of the included studies were published in the *Journal of Applied Behavior Analysis*, followed by the *Education and Treatment of Children*, *Behavioral Disorders*, and *Topics in Early Childhood Disorders* with three to four studies published in each journal. The remainder of the studies were published in the following journals with two or less studies per journal: *Beyond Behavior*, *Focus on Autism and Other Developmental Disabilities*, *Journal of Behavioral Education*, and *The Behavior Analyst Today*.

The 24 studies included 29 SCR designs. While the majority of the studies used one design per article, Bloom et al. (2013), Ingvarsson et al. (2009), and Vollmer & Marcus (1996) used two designs and Payne et al. (2014) used three designs per study, bringing the total of SCR designs to 29 designs. Of those 29, the most commonly used design was ABAB reversal design ($n = 9$, 31%), followed by multiple-baseline design ($n = 7$, 24%), AB design ($n = 4$, 14%), and alternating-treatment design ($n = 4$, 14%). Fewer studies used multiple-treatment design ($n = 2$, 7%), BAB design ($n = 2$, 7%), and ABA design ($n = 1$, 3%). Table 1 presents an overview of the descriptive information for

each of the studies, including the authors, SCR designs, number of participants, settings, dependent, and independent variables.

Participants and setting characteristics. A total of 51 participants were included in the 24 studies with the number of participants ranging from 1 to 4 per study. The majority of the participants were male ($n = 40$, 78%) with fewer female ($n = 11$, 22%). Participants' ages ranged from 3 to 5 years with an average age of 4 years ($SD = 0.7$ years). While all of the studies reported participants' gender, only seven studies (30%) reported the participants' ethnicity, representing 21 participants (41%). Of those participants, 11 were African American (22%), five were Caucasian (10%), four were Hispanic (7%), and one was Native American (2%). Social economic status (SES) was measured in five of the 24 studies (21%) representing 15 participants (29%). Of those 15 participants, the majority was reported to be from low SES ($n = 12$, 23%) with fewer participants from lower to upper middle class SES ($n = 3$, 6%).

Disability status. Fourteen of the participants (27%) were typically developing. However, most participants were with disabilities ($n = 37$, 73%). Of those participants with disabilities, 13 had developmental delay (26%), four had an intellectual disability (8%), four had ADHD or were at-risk for ADHD (8%), three had a speech or a language impairment (6%). Twelve participants (25%) had more than one type of disability (e.g., speech impermanent and an intellectual disability).

Table 1. Summary of the Participants' Information

Study	N	Age	Gender	Setting	Disability	Target behavior
Bellone et al. (2014)	1	4	M	All in Head Start	All are typically developing	Engagement & out of area behavior
	2	3	M			Engagement & inappropriate vocalization
	3	4	M			Engagement & off-task
	4	4	M			Engagement & inappropriate vocalization
Blair et al. (2010)	1	4	M	All in special education classrooms	Language developmental delay ADHD Pervasive developmental disorder	Engagement & problem behavior
	2	4	M			Engagement & problem behavior
	3	3	M			Engagement & problem behavior
Bloom et al. (2013)	1	5	M	General education University-based preschool University-based preschool	All with developmental & intellectual disabilities	Problem behavior & communication responses
	2	4	M			Problem behavior & communication responses
	3	4	M			Mouthing
Boyajian et al. (2001)	1	5	M	Daycare center Preschool classroom Daycare center	All at-risk for ADHD	Engagement, aggression, use of mands
	2	5	M			Aggression & use of mands
	3	5	M			Engagement & aggression
Calloway & Simpson (1998)	1	4	M	All in special education classrooms	Language & cognitive delay Speech-language delay Developmental delay	Aggression
	2	4	M			Non-compliance
	3	3	M			Leaving assigned area
Duda et al. (2004)	1	3	F	All in community-based preschool	Down syndrome Developmental and language delay	Engagement & problem behavior
	2	3	F			Engagement & problem behavior
Dufrene et al. (2007)	1	5	M	Head Start University-based preschool Head Start	Typically developing Typically developing Developmental delay	Aggression
	2	5	M			Non-compliance
	3	5	F			Aggression
Durán et al. (2013)	1	4	M	Head Start	Typically developing	Aggression & use of independent mands
Gibson et al. (2010)	1	4	M	A half-day inclusive preschool program	Autism	Elopement
Hines & Simonsen (2008)	1	4	M	Half-day preschool	Autism	Use of picture cards, problem behavior, & engagement
Ingvarsson et al. (2009)	1	4	F	University-based preschool	No disability No disability Language delay	Disruptive behavior & noncompliance
	2	4	M			Disruptive behavior & noncompliance
	3	3	M			Disruptive behavior & noncompliance
Ishuin (2009)	1	4	M	Preschool program	Typically developing	Non-compliance
Lambert et al. (2012)	1	4	F	A combination of general and special education classroom	Developmental delay	Aggression & alternative responses
	2	4	F			Tantrums & alternative responses
	3	4	M			Aggression & alternative responses
Lang et al. (2010)	1	4	M	A combination of general and special education classroom	Asperger Syndrome	Elopement
Marcus & Vollmer (1995)	1	5	F	Not provided	Down syndrome, language/speech delay	Disruptive behavior & compliance

Table 1. Continued

Study	N	Age	Gender	Setting	Disability	Target behavior
Marcus & Vollmer (1996)	1	5	F	Non-categorical public school	Intellectual disability	SIB & appropriate mand
	2	4	M	Public integrated school	Intellectual disability, language delay	Aggression
	3	5	M	Non-categorical public school	Autism	Tantrums & appropriate mand
May & Howe (2013)	1	4	F	Special education early childhood program	Developmental delay & speech impairment	Off-task behavior
Park & Scott (2009)	1	5	M	All in Head Start	All with clinical range for externalizing behavior	Disruptive behavior
	2	4	M			On-task behavior
	3	4	F			Disruptive behavior
Payne et al. (2014)	1	4	M	All in university-based preschool	No disability Learning disability	Aggression & appropriate mands
	2	4	F			Aggression, compliance, & appropriate mands
Perrin et al. (2008)	1	3	M	Private preschool for children with autism	All with autism	Elopement
	2	3	M			Elopement
Tiger et al. (2006)	1	5	M	University-based preschool	Developmental delay	Hand mouthing
Umbreit & Blair (1997)	1	4	M	Private childcare center	Typically developing	Aggression & noncompliance)
Wilder et al. (2007)	1	3	M	Not provided	All are typically developing	Non-compliance
	2	3	M			Non-compliance
Wood et al. (2010)	1	4	M	All in inclusive preschool classroom	Language delay & fine motor deficits Down syndrome & language delay Autism & language delay	Disruptive behavior
	2	4	M			Disruptive behavior
	3	5	M			Disruptive behavior

Setting. Settings were reported in 22 studies, representing 48 participants (94%). Thirteen Participants were educated in special education programs (25%), 12 were educated in preschools/daycares or general education preschools (23%), 10 were educated in Head Start programs (20%), nine were educated in university-based preschools (18%), and four were educated in both general education and special education programs (8%). The setting was not reported in two studies (6%).

Additional study features. IOA were measured and reported in all of the studies. In general, the IOA was measured between 20% to 56% across baseline and intervention sessions and the results ranged between 78% and 100%. One of the studies measured IOA for less than 20% of the sessions with one of the three participants included in the study (Marcus & Vollmer, 1996). Fidelity of implementation was measured in 14 studies (58%) and reported results between 55% and 100%. Social validity data was measured in five studies (21%). Similarly, maintenance data was collected in five studies (21%). Four of the five studies collected maintenance data in one to six weeks after the intervention and one study collected maintenance data to the following school year (Bloom & Samaha, 2013). Generalization data was collected in only three studies (13%). Generalization contexts were center activities and outdoor play (Blair et al., 2013) and to another teacher (Payne et al., 2014; Tiger et al., 2006).

WWC Design Standards

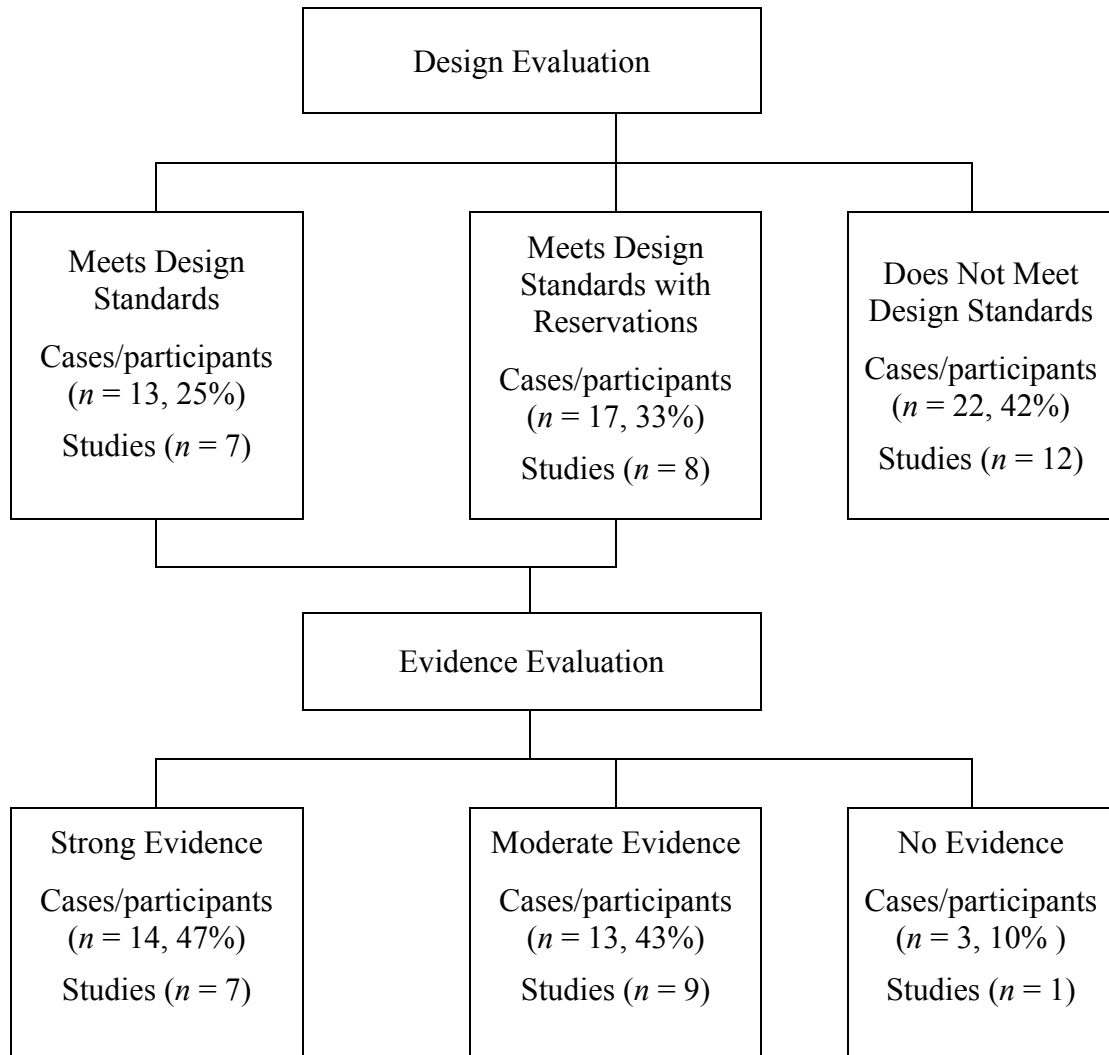
The second research question focused on evaluating the quality of SCR FBIs for young children with challenging behavior. A total of 52 participant cases were evaluated using the WWC design standards. While the number of participants included in the 24

studies was 51, one study (Payne et al., 2014) used two designs to evaluate the effects of FBI on one participant's challenging behaviors. Thus, the same participant was counted twice, making the total of participant cases 52. Thirty cases (57.7%) met the design standards with ($n = 17$, 32.7%) or without reservations ($n = 13$, 25%). The remaining cases ($n = 22$, 42%) did not meet design standards. Of those 22 cases that did not meet design standards, 12 cases included less than three demonstrations of effects (55%), nine cases (41%) had less than three data-points per phase, and one case (4%) failed to collect IOA.

WWC Visual Analysis and Evidence Standards

The third research question examined the evidence of effects according to WWC visual analysis procedures. The 30 participant cases meeting design standards “with or without reservations” were evaluated visually using the standards for evidence of effects. A total of 17 cases (57%) representing nine studies demonstrated strong evidence. Ten cases (33%) representing eight studies demonstrated moderate evidence of effects. Finally, three cases (10%) coming from one study (Ingvarsson et al., 2009) demonstrated no evidence of intervention effects. Figure 2 provides an overview of the WWC design and evidence standards application.

Figure 2. Overview of the WWC design and evidence standards application



CEC Standards

The fourth research question examined the degree in which the studies included in this review met the quality indicators identified by CEC (2014) and of those studies, which support the use of FBIS as an EBP to address young children's challenging behavior. The evaluation procedures consisted of three-steps: (a) identification of methodologically sound studies, (b) classification of effects, and (c) classification of the strength of evidence. Similar to WWC evaluation, the CEC evaluation was conducted using a bifurcated method.

Identification of Methodologically Sound Studies

Context and setting description. The majority of the studies ($n = 18$, 75%) met the quality indicator for describing context and setting. The rest of the studies included less than three details regarding where the intervention took place. For example, Hines and Simonsen (2008) reported that the study was conducted at a preschool program that met daily.

Participant description. All of the 24 studies provided sufficient information regarding the demographics of all the 51 participants. However, only 16 studies (67%) provided sufficient information regarding the participants' disability or risk status. The other 8 studies that did not meet this criterion provided limited information regarding the participants' disability status and the risk factors associated with their challenging behavior, such as reporting that two participant were diagnosed with autism and engaged in elopement during academic and less structured activities (Perrin et al., 2010).

Intervention agent description. Only nine studies (38%) provided sufficient information about the intervention agent, such as age, gender, qualifications, and years of experience. The other 15 studies either did not provide any information or provided limited information about the intervention agent. For example, Hines & Simonsen (2008) reported that a paraprofessional implemented the intervention without any further details about the paraprofessional's background. A similar pattern was observed across the studies in describing training or qualifications required to implement the intervention. Only 11 studies (46%) reported sufficient information regarding the intervention agent's training. The other 13 studies not meeting this criterion either did not report any training or reported that training was provided without any additional details. For example, Wilder et al. (2007) reported that a graduate student research assistant served as a therapist who implemented the intervention without providing any additional details regarding the training the graduate received prior to implementing the intervention.

Description of the intervention. Twenty-two studies (92%) met the first component, description of detailed intervention procedure and intervention agent's actions. Studies that did not meet this criterion provided limited information on the intervention, such as the intervention type with one or two details. For example, Ishuin (2009) reported that the intervention for the participant's non-compliance consisted of 2 min differential reinforcement of other behavior (DRO) using a continuous schedule of reinforcement and a timer was used for consistency purposes. In addition, all of the 24

studies met the second component by providing sufficient description of materials (when used), or cited sources that provide this information.

Implementation fidelity. The implementation fidelity criteria involved three components: (a) assessing and reporting implementation fidelity relating to adherence to the intervention procedures, (b) assessing and reporting implementation fidelity relating to adherence to the dosage or exposure to the intervention, (c) and assessing and reporting intervention fidelity regularly throughout the intervention and for each intervention agent. Fourteen studies (58%) met the first component by assessing and reporting that the intervention agent adhered to the intervention using reliable measures. The other 10 studies that did not meet this criterion failed to measure implementation fidelity.

A similar pattern was observed with the second and the third components. Only 13 studies (54%) met those components by assessing and reporting fidelity results related to dosage or exposure to the intervention and assessing and reporting fidelity of implementation throughout the intervention and across all the participants. Studies that did not meet these components either failed to provide this information or did not report fidelity results across all the participants. For example, Ingvarsson et al. (2009) reported fidelity results for two of the three participants.

Internal validity. The internal validity criteria involved five components: (a) the researcher controls and systematically manipulates the independent variable, (b) the study provides sufficient information about the baseline condition, (c) participants have no access to intervention during baseline conditions, (d) the design provides a minimum

of three demonstrations of effects, and (e) all baseline phases include a minimum of three data-points. All of the 24 studies met the criteria for the first component by indicating that the researcher systematically manipulated the independent variables. Eighteen studies (75%) met the criteria for the second and the third components by providing detailed information regarding baseline conditions to allow replication and imply no access to intervention during baseline phases. The other six studies that did not meet the criteria for this component either just mentioned that the first phase consisted of baseline condition or provided limited information to describe it. For example, Duda et al. (2004) reported that the first phase collected baseline data, the second phase consisted of implementing the intervention, and the third phase (second baseline) consisted of withdrawing the intervention. Fewer studies met the fourth component. Only 16 studies (67%) used methodologically sound designs that provided a minimum of three demonstrations of effects. The other eight studies (33%) used SCR designs that provided less than three demonstrations of effects like BAB, ABA, and AB designs. Finally, 17 studies (71%) met the criteria for a minimum of three data-points during baseline phase. The other studies not meeting this component included fewer data-points during baseline phases. For example, Marcus and Vollmer (1996) included only two data-points during the second baseline phase.

Outcome measures. The outcome measure criteria involved five components: (a) the outcomes are socially important, (b) the study provide sufficient information regarding measurement of the outcome variables (dependent variables), (c) the study reports results across all of the outcome measures, (d) the frequency and the timing of

the outcome measures are appropriate, and (e) the study measures inter-observer reliability and the results meet the threshold. All of the studies met the criteria for the first and the third component by measuring socially important outcomes, and by reporting the results of the intervention across all of the outcome measures. All of the studies, except one (Calloway & Simpson, 1998), provided operational definitions and adequate details for each outcome measure. Only 20 studies (83%) met the fourth criteria: measuring outcome variables at an appropriate frequency and timing by using including more than three demonstrations of effects and more than three data-points per phase. The other four studies not meeting this component used designs with less than three demonstrations of effects or included few data-points per phase. For example, Hines and Simonsen (2008) used an AB design and Duda et al. (2004) included two-data points in the second baseline. Finally, 21 studies (88%) met the last criterion by measuring and reporting IOA results meeting the threshold. The other three studies not meeting this component either failed to measure IOA or measured it for less than 20% of the sessions. For example, Hines and Simonsen (2008) measured IOA for only 12% of the intervention sessions.

Data analysis. All of the 24 studies met this criterion by providing SCR graphs representing all outcome measures across all of the participants.

Effects classification. Four of the included studies (16.6%) met all of the eight methodologically sound criteria (Bellone et al., 2014; Blair et al., 2010; Gibson et al., 2010; Wood et al., 2011). Those studies were also eligible for effects classification. All of the four studies demonstrated positive effects by documenting a functional

relationship between the dependent and the independent variables for a minimum of 75% of the participant cases with a minimum of three participants per study.

Determination of Evidence-Based Practices

The final research question focused on determining if FBIs to address young children's challenging behavior can be classified as an EBP based on WWC standards and CEC quality indicators. Table 2 provides a summary of the applications of WWC standards and CEC Quality indicators.

WWC standards. Overall, FBIs to address young children's challenging behavior in preschool settings can be classified as an EBP. This is possible because the interventions meet the requirements for EBP using the "5-3-20 criterion" for SCR systematic reviews (Kratochwill et al., 2013). There were 13 different studies conducted by more than three different research teams with 27 participant cases (see Appendix D) meeting the WWC standards with or without reservations for EBPs.

CEC quality indicators. The CEC quality indicators required five methodologically sound SCR with positive effects and a minimum of 20 participants for an intervention to be considered an EBP. However, only four studies representing 17 participants met all of the methodologically sound criteria and provided positive effects. Thus, FBIs to address young children's challenging behavior at preschool settings cannot be considered an EBP. Yet, it can be classified as a potentially EBP as two to four methodologically sound SCRs showed with positive effects (CEC, 2014).

Table 2. Summary of the Applications of WWC and CEC Quality Indicators

WWC Design Standards	Participant cases that met design standards	
	<i>n</i>	%
1.0 Independent variable is systematically manipulated	52	100
2.0 Dependent variable		
2.1. Measured systematically by more than one assessor	52	100%
2.2 IOA is collected on a minimum of 20% of the data points in each condition	51	98%
2.3. IOA meets minimum threshold	51	98%
3.0 A minimum of three demonstrations of effects	40	77%
4.0 A minimum of three data-points in each phase	37	71%
Total number of participants cases that meet design standards	30	58%
CEC Quality Indicator	Studies that met quality indicators	
	<i>n</i>	%
1.0 Context and setting description	18	75%
2.0 Participants description		
2.1 demographics	24	100%
2.2 disability/risk status	16	67%
3.0 Intervention agent description		
3.1 role/backgrounds	9	38%
3.2 training	11	46%
4.0 Description of intervention		
4.1 intervention procedure	22	92%
4.2 materials (if relevant)	24	100%
5.0 Implementation fidelity		
5.1 assessed and reported	14	58%
5.2 dosage/exposure assessed and reported	13	54%
5.3 assessed regularly for each intervention agent	13	54%
6.0 Internal validity		
6.1 independent variable is systematically manipulated	24	100%
6.2 baseline description	18	75%
6.3 no/limited access to intervention during baseline	18	75%
6.4 three demonstrations of effects	16	67%
6.5 baseline: a minimum of three data-points	17	71%
7.0 Outcome measures		
7.1 socially important	24	100%
7.2 sufficient description of dependent variable	23	96%
7.3 reported results on all measures	24	100%
7.4 frequency/timing of outcome measures	20	83%
7.5 IOA measured repeatedly	21	88%
8.0 Data analysis		
8.1 SCR graph	24	100%
Total number of studies that meet all CEC quality indicators	4	17%

Discussion

The purpose of this review was to determine if FBIs can be considered as an EBP to address challenging behavior exhibited by young children. The WWC standards and CEC quality indicators have been applied to the 24 identified studies that met inclusion criteria. The following research questions were posed: (a) What are the descriptive characteristics of each study?, (b) What is the quality of the SCR FBIs research for young children with challenging behavior as evaluated by the WWC standards?, (c) What is the evidence of an effect according to visual analysis? (d) What is the quality of the SCR FBIs research for young children with challenging behavior as evaluated by the CEC standards?, and (f) Do FBIs have sufficient evidence to warrant classification as an EBP for young children with challenging behavior based on WWC and CEC standards?

The first research question focused on the descriptive characteristics of the included studies. Consistent with Conroy et al. (2005), an increasing trend exists in the publication of studies focusing on FBIs to address young children's challenging behavior. This finding might be explained by the reauthorization of the IDEA mandate that require conducting FBA and implementing FBIs if the challenging behavior was related to students' disabilities (Umbreit et al., 2007). Furthermore, this increasing trend might also be explained by the IDEA requirement to implement FBIs prior to removing students from their current placement (IDEA, 2004).

One encouraging finding is that the FBIs were conducted at a variety of educational settings (e.g., Head Start, university-based programs, general education and special education classrooms). Not surprisingly, the majority of the participants were

males with disabilities. This may result from males following an “early starter” path of challenging behaviors at an early age (Nagin & Tremblay, 1999) and that disability status may increase the risk of engaging in challenging behaviors (Campbell, 1995).

Findings indicated some areas of weaknesses in reporting participants’ information, specifically reporting of ethnicity and social-economic status. These weaknesses have been reported by other researchers (e.g., Conroy et al., 2005). Other weaknesses include the limited number of studies that reported validity data, as well as maintenance and generalization data. These findings are consistent with previous research (e.g., Odom & Strain, 2002; Wood et al., 2015). For example, Odom and Strain (2002) found that social validity and generalization data were reported in less than 10% of the studies included in their review.

The second research question focused on examining the quality of studies by applying the WWC standards. When applying the WWC standards, 30 (58%) of the 52 participant cases met the design standards. In general, several strengths and weaknesses were noted. In terms of methodology, the following strengths have been identified: (a) the independent variable was systematically manipulated, (b) the dependent variable was measured repeatedly by more than one assessor, and (c) the IOA was collected on a minimum of 20% of the data-points and meets the threshold. In terms of methodology weaknesses, two areas have been noted: (a) cases with less than three demonstrations of effects and (b) cases with less than three data-points in some phases. This result, however, might be explained by the fact that almost one third of the studies had not used strong SCR designs (e.g., AB, ABA, BAB designs) and several studies collected only

two data-points in the second baseline phase. None of the previous reviews applied WWC standards to FBIs, thus comparison with previous reviews is not possible.

The third research question focused on determining the strength of evidence for FBIs according to visual analysis. The current review found that all studies, except for one (Ingvarsson et al., 2009), provided either moderate or strong evidence of effects. These results are consistent with the general belief that FBI have been found to be effective (Dunlap et al., 2006; Gage, et al., 2012).

The fourth research question focused on evaluating the quality of studies by applying CEC quality indicators. When applying the CEC indicators, the following strengths were noted: (a) sufficient information regarding the intervention procedures and materials, (b) independent variables were systematically manipulated, (c) all of the outcome measures were socially important, and (d) the outcome results were reported on all measures. Furthermore, the following weaknesses were noted: (a) less than half of the studies reported sufficient information regarding the intervention agent (e.g., role, background information, and training) and (b) less than 60% of the studies measured and reported implementation fidelity. These findings differ from findings from Wood et al. (2015). Results differ from Wood et al.'s (2015) in terms of the percentage of studies that reported sufficient information regarding both intervention agents and implementation fidelity. Wood et al.'s application of CEC standards to the Umbriet et al. (2007) systematic approach to FBIs for young children suggested more than 80% of the studies met the intervention agent indicator and all of the studies met the fidelity of

implementation indicator. This might result from Wood et al. (2015) focus on a specific approach to FBIs while the current review was not limited to the same FBI approach.

The final research question focused on determining whether FBIs for young children with challenging behaviors can be considered an EBP through an application of WWC and CEC standards for EBP. Unfortunately, none of the previous reviews applied WWC standards to FBIs designed to address challenging behaviors exhibited by young children, thus comparison to other previous reviews is not possible. Application of the WWC standards, however, suggested that FBIs could be considered an EBP. Yet, when applying the CEC standards, only four studies, with less than 20 participants, met all of the standards. Thus, based on the CEC evidence-based standards, FBIs to address young children's challenging behaviors in early childhood settings can be considered a potentially EBP. This classification is consistent with Wood et al. (2015), which suggested that the systematic approach to FBIs developed by Umbreit et al. (2007) is also a potentially EBP. Seven of the reviewed studies met all of the CEC standards; however, those seven studies included only a total of 14 participants. The CEC standards acknowledge that studies published before the publication of the quality indicators might not meet all quality indicators, this will limit the number of studies eligible for EBP classification/evaluation.

Limitations

In order to fully evaluate the findings of this review, it is important to consider these findings within the context of the following limitations. First, the current review included only peer-reviewed studies. This decision excluded the grey literature (e.g.,

dissertations, presentations, and unpublished studies) from the review. Second, unfortunately, there is no consensus on standards in the field for visual analysis. Thus, a rubric using Gast and Spriggs (2010) was created, and the author utilized an online training tool (<http://singlecase.org>) to insure consistency in the coding. Third, when applying the WWC standards, one study (Payne et al., 2014) used two designs to evaluate the effects of FBI on one participant's challenging behaviors. Thus, the same participant was counted twice which might have a slight impact on the results.

Current research highlights the lack of clear procedures for applying WWC and CEC standards (Maggin, Briesch, and Chafouleas. 2012). As a result, the analyses reflect my interpretation of both standards. For example, the seventh criterion of the CEC standards requires that outcome measures in studies must be socially important. However, I coded studies in my review as meeting this criterion regardless of whether they included a social validity measure.

Requiring studies to meet all CEC standards to be eligible for evidence-based evaluation may have limited the number eligible studies meeting the standards. However, this conservative approach ensures “only the highest quality and the most trust worthy” studies are included when identifying evidence-based practices (Cook et al., 2014, p. 2).

Implication for Research

In the current review, only a limited number of studies reported participants' SES and ethnicity. It is important to include this information for making generalizable statements and determining the quality of studies. Furthermore, large number of the

studies used SCR with less than three demonstrations of effects (e.g., ABA, BAB).

Future research needs to use SCR that provides strong experimental control.

Furthermore, it is important to collect more than three data-points across all conditions to document a pattern of behavioral change. Without this addressing these issues, future researchers will continue to struggle in meeting standards for EBPs. In addition, a limited number of studies reported social validity necessary to understand how teachers perceive FBIs and if they are likely to implement FBIs in the future. In future research, maintenance and generalization data needs to be included to determine if the improvement in young children's challenging behaviors are likely to maintain and generalize to other contexts.

Implication for Practice

The current review supports the use of FBIs as an EBP as a promising or EBP to address the behaviors of young children whose behavior is not responsive to class wide or small group interventions. The FBIs were implemented across multiple early childhood settings, such as preschools, day cares, university-based programs, and special education classes. Thus, teachers in these environments should consider the use of FBIs. In addition, early childhood practitioners might consider FBIS when dealing with challenging behaviors regardless of the participants' disability status. The FBIs were implemented with typically developing children as well as children with disability. When conducting FBAs or implementing FBIs, it is important to measure and report fidelity of implementation related to the training and dosage and exposure to the intervention. Finally, when training early childhood practitioners implement FBIs, it is

necessary to provide detailed information regarding the intervention agent role/backgrounds and the training procedures used (e.g., training methods, intensity, duration, and location) to allow for replication of the training methods used and generalization of the results.

CHAPTER III

EXAMINING THE EFFICACY OF FUNCTION-BASED INTERVENTIONS FOR
YOUNG CHILDREN: A META-ANALYSIS OF SINGLE-CASE RESEARCH

Introduction

There is a need in the literature to identify effective behavioral interventions for young children described as displaying challenging behavior (Conroy & Davis, 2000). Research has shown that between 3 and 21% of young children between the ages of 2 to 6 years exhibit challenging behavior that impairs their early learning and social functioning (Achenbach & Edelbrock, 1981; Powell, Fixsen, Dunlap, Smith, & Fox, 2007). Other studies have reported similar prevalence data. For example, Webster-Stratton (2000) estimated as much as 25% of preschool-age children met the criteria for oppositional defiant disorder. In another study, Webster-Stratton and Hammond (1998) reported that one third of the children in Head Start classrooms engaged in a challenging behavior once every 6 minutes. The authors estimated a minimum of 36 incidents of challenging behavior typically occurs each hour in preschool classrooms.

There is widespread agreement on several aspects of challenging behavior among young children. First, the number of young children exhibiting challenging behavior is generally increasing (McCabe & Frede, 2007, Tremblay et al., 2002; Webster-Stratton, 1997). Second, the early onset of challenging behavior is a strong predictor for a variety of negative outcomes that have long-term consequences with the potential to impact quality of life (Campbell, 1991; McCabe & Frede, 2007). Third, if left untreated, these

challenging behaviors tend to increase in rate and severity (Campbell & Ewing, 1990).

In a recent attempt to identify common challenging behavior at preschool settings, Snell et al. (2012) surveyed 78 Head Start staff members regarding their perceptions about challenging behavior exhibited by their children. Results from Snell et al. (2012) indicated that externalizing behaviors were a major concern to staff members with more than half of staff members reporting that noncompliance and defiant behaviors were common in their classrooms. Examples of noncompliant and defiant behaviors included refusing to do what was asked, lack of cooperation, and being disrespectful. In addition, 50% of the staff members reported that aggression and bullying were the second most common type of behaviors they face in their classrooms. Aggressive behaviors identified by the staff members in Snell et al. (2012) included hurting others, destroying property, hitting, kicking, pinching, spiting, and biting. The same percentage of the teachers (50%) reported that disruptive and impulsive behaviors, such as throwing items, crying, whining, name calling, touching others, and hyperactive attention-seeking were also common in their classrooms.

Negative Effects Associated with Challenging Behaviors

Children with early displays of challenging behavior are more likely to experience depression, drug use, juvenile delinquency, suicidal attempts and school dropout (Campbell, 1991; Tremblay et al., 2002). Furthermore, Gilliam (2005) reported that preschoolers with persistent challenging behavior were three times more likely to be expelled from school compared to all K-12 students regardless of challenging behaviors. Additionally, in a nationally representative sample of nearly 4000 preschool classrooms,

around 10% of pre-kindergarten teachers reported expelling at least one preschooler in the past 12 months and around 20% of those teachers reported expelling more than one child (Gilliam & Shahar, 2006).

Such an early onset of challenging behavior is considered a strong predictor of a series of negative outcomes that continue through school and adulthood (Campbell & Ewing, 1990). Children identified by their parents as “hard-to-manage” between ages 3 and 4 are 50% more likely to continue to have challenging behavior throughout their elementary school years and into early adolescence (Campbell, Breaux, Ewing & Szumowski, 1986). Specifically, at age six, half of those children met the criteria for attention deficit/hyperactivity disorder (ADHD) and continued to be more disruptive in the classroom. At age nine, almost 50% of those children met the *Diagnostic and Statistical Manual of Mental Disorder* (3rd ed., *DSM-III*, American Psychiatric Association, 1980) criteria for an externalizing disorder (ADHD, and or oppositional disorder or conduct disorder) compared with only 16% of the children in the control group. Moreover, some of those children who did not meet the DSM-III criteria for a disorder were still described as having significant problems that interfered with their learning (Campbell et al., 1986).

The effects of children’s challenging behavior reciprocally impact the teaching behaviors of classroom teachers. Not surprisingly, the relationship between teachers and those children who display challenging behavior tends to be negative and punitive in nature (Lewis, Romi, Qui, & Katz, 2005; Strain, Lambert, Kerr, Stragg, & Lenker, 1983). Moreover, teachers rate challenging behavior as their top concern and one of the

reasons that led to them to leaving the profession (Ingersoll, 2001). In addition, a large number of early childhood teachers reported their frustration, lack of preparation, and use of effective behavioral management strategies. Those teachers viewed children's behavior as having adverse effects on them and the other children (Westling, 2010). As a result, these teachers tend to spend the majority of their time correcting inappropriate behaviors exhibited by a small number of children at the expense of valuable instructional time that could be used to support learning of the majority of the children (Fox, Dunlap, Hemmeter, Joseph, & Strain, 2003).

Given the prominence and the undesirable life-long trajectory for children with challenging behavior along with its effects on teachers' satisfaction and disciplinary practices, effective intervention becomes crucial (Powell et al., 2007). Furthermore, effective interventions programs are needed to alleviate the risks associated with challenging behaviors and are considered a protective factor against negative outcomes (McCabe & Frede, 2007). Tremblay et al. (2002) highlighted the importance of intervention programs that target very young children as an effective approach to decrease the risks associated with chronic challenging behavior. As the researchers stated, "...most children learn alternatives to physical aggression during their preschool years. Therefore, this period of childhood is probably the best window of opportunity for helping children at-risk of becoming chronic physical aggressors to learn to regulate their comportment" (Tremblay et al., 2002, p. 4).

Function-Based Interventions

Function-based interventions (FBIs) are a promising empirically supported approach with a growing research base on addressing challenging behavior of young children (e.g., Dunlap & Fox, 2011; O’Neill et al., 1997, Umbreit et al., 2007). FBIs are based on functional behavioral assessment (FBA) and/or functional analysis data. The contributions of FBIs to the challenging behavior literature is highlighted by Dunlap and Fox (2011) who noted that conceptualizing challenging behaviors as serving a purpose represents a paradigm change in the understanding and treatment of challenging behavior.

Sugai et al. (2000) defined an FBA as “a systematic process of identifying problem behaviors and the events that (a) reliably predict occurrence and nonoccurrence of those behaviors and (b) maintain the behaviors across time” (p. 137). Thus, an intervention may be defined as "functional" when it directly addresses the operant functions of the target behavior (Wightman, Julio, & Ortega, 2014). Even though there are several variations to the steps to conduct FBAs, an FBA often consists of a combination of direct methods, indirect methods, and in some cases, experimental functional-analysis to gather the necessary information. Direct methods are inclusive of strategies, such as scatterplot data (Touchette, MacDonald, & Langer, 1985) and descriptive assessment of environmental antecedents and consequences . On the other hand, indirect methods are commonly used by practitioners, which include interviews, rating scales, and reviewing child records. Some commonly used indirect methods include, the Functional Analysis Interview (O’Neill et al., 1997), the Motivation

Assessment Scale (MAS; Durand & Crimmins, 1992), and the Problem Behavior Questionnaire (Lewis, Scott, & Sugai, 1994). Finally, functional analysis is an experimental manipulation of the antecedents and consequences that influence the behavior (O'Neill et al., 1997). Researchers recommend using both direct and indirect methods to be comprehensive and gather sufficient information to create an accurate hypothesis that explains the behavior (O'Neill et al., 1997).

Current FBI research is largely based on Carr's (1977) analysis of environmental factors that influence self-injurious behavior of individuals with developmental disabilities. Carr posited that all challenging behaviors are directly related to a set of predictable consequences (e.g., gaining attention, avoiding a demanding task) that serve to increase the likelihood of the behavior. Furthermore, he suggested that understanding these consequences allows for designing more effective, efficient, and individualized interventions (Carr, 1977). Carr's work led to the development of functional analysis (e.g., Iwata, Dorsey, Slifer, Bauman, & Richman, 1994), FBA (e.g., O'Neill et al., 1997), and trial-based functional analysis (Sigafos & Sagers, 1995).

Functional Analysis

Functional analysis is a systematic experimental method that consists of a series of test conditions designed to manipulate environmental variables, antecedents, and consequences and to document their effects on the target behavior (Hanley, Iwata, & McCord, 2003). Functional analysis is conducted to (a) develop a hypothesis of the function of a specific challenging behavior (e.g., to obtain teacher attention or a tangible item), (b) confirm a hypothesis resulting from an FBA. For example, if FBA data

suggested that a child exhibits challenging behavior to obtain his teacher's attention, functional analysis would test this hypothesis by placing the child in a situation where teacher attention is provided then removed and document the effects of teacher attention on the child's behavior, (c) to refine the hypothesis from FBA. For example, if FBA data suggested that a child engages in challenging behavior to escape a demanding task, functional analysis would test different types of demanding tasks to identify specific tasks associated with the challenging behavior, and (d) to clarify inconclusive FBA results, such as in instances where FBA results in multiple hypotheses that do not clearly explain the function of the behavior (Alberto & Troutman, 2009).

Functional analysis conditions. Typical functional analysis includes the following conditions (a) an attention condition, where a therapist provides attention only upon the occurrence of the challenging behavior and ignores all other behaviors, (b) an escape condition, where the therapist present a series of low-preferred activities and remove these activities upon the occurrence of the target behavior, (c) a play condition where the child has access to attention and highly preferred activities. The play condition serves as a control condition. Thus, any challenging behavior would be ignored, (d) a tangible condition, where the child has is provided with his/her preferred item (e.g., favorite toy) contingent on the occurrence of the challenging behavior, and (e) and alone condition where no attention, leisure activities, or demands are presented. The alone condition is designed to test for automatically reinforced behaviors, such as, self-injurious behavior or hand flapping (Alberto & Troutman, 2009).

FBI's are considered effective strategies to address challenging behavior (DEC,

2007; Dunlap et al., 2006; Umbreit, Ferro, Liaupsin, & Lane, 2007). Conducting FBAs enhances the effectiveness, relevance, and the efficacy of the interventions or behavior support plans (Dunlap & Fox, 2011; O'Neill et al., 1997). Furthermore, a large body of research documents that interventions preceded by functional analysis result in better outcomes (e.g., Harvey, Boer, Meyer, & Evans, 2009; Scotti, Evans, Meyer, & Walker, 1991). A number of studies have demonstrated the effectiveness of FBAs. FBA have been used successfully to reduce challenging behavior (e.g., Lane, Smither, Huseman, Guffey, & Fox, 2007; Storey, Lawry, Ashworth, Danko, & Strain, 1994), elopement (e.g., Gibson, Pennington, Stenhoff, & Hopper, 2010; Perrin, Perrin, Hill, & DiNovi, 2008), non-compliance (Wilder, Harris, Reagan, & Rasey, 2007) and off-task behavior (Bellone, Dufrene, Tingstrom, Daniel, & Barry, 2014; May & Howe, 2013).

Several factors contribute to the effectiveness of FBAs. First, FBAs targets the function of the challenging behavior (why it occurs) versus the focus on the topography of the challenging behavior (what it looks like). By understanding the purpose of the challenging behavior, practitioners are more likely to design effective interventions that directly address the critical elements that trigger the problem, thus minimize or prevent the behavior from occurring (Conroy, Davis, Fox, & Brown, 2002). Second, FBAs considers each child's individual differences and the environmental factors that surround each child before developing the intervention that most likely meets his/her unique needs (Dunlap & Fox, 2011; Umbreit et al., 2007). Finally, FBAs can teach an appropriate replacement behavior that serve the same function that maintains the challenging behavior, therefore the learned appropriate behavior is more likely to be maintained and

generalized to other contexts (Conroy et al., 2002; Stichter, Shellady, Sealander, & Eigenberger, 2000). For example, if a 2 year-old child is engaging in tantrums to obtain his/her favorite toy because he/she lacks the skills to ask for it, the intervention might consist of teaching the child to use a card with his/her favorite toy's picture to request it. Thus, the appropriate replacement behavior is more likely to continue because it still satisfies the same function of the challenging behavior (obtaining a tangible item).

More attention has been given to FBIs since the Individuals with Disabilities Education Act (IDEA, 1997) mandated conducting FBAs and implementing FBIs to address the behavioral challenges of students with (or at-risk of) disabilities before resolving to suspension or expulsion (IDEA, 1997). Even though the policy focused on elementary and secondary students, a growing body of research has been published to support the use of FBA procedures within early childhood settings and early intervention programs (Conroy et al., 2002). The emphasis on using FBIs with younger population became clear when the Division of Early Childhood (DEC) of the Council for Exceptional Children (CEC) highlighted the importance of using FBIs in their position statement on interventions for challenging behavior (Dunlap & Fox, 2011).

FBIs are a problem-solving process that generally consists of six steps: (1) identifying and operationally defining the target behavior using clear and specific terms; (2) gathering information regarding the variables (e.g., factors, times, events) that increases the probability of the occurrence of challenging behavior; (3) determining the antecedents and the consequences that occurs immediately before and after the behavior and reliability predict the occurrence of the challenging behavior; (4) developing

hypotheses that explain the behavior; (5) validating these hypotheses; and (6) developing an intervention that matches the function of the challenging behavior (Umbreit et al., 2007).

Umbreit et al. (2007) developed a *Decision Model* to describe the process of conducting an FBA and implementing FBIs that consists of three steps. The first step consists of conducting FBA using indirect methods (e.g., interviews, surveys), direct methods (e.g., direct observation of target behavior, collecting ABC data), or experimental functional analysis. The FBA data helps in guiding the selection of the intervention. For example, if the data suggested that a skill deficit is responsible for the challenging behavior, the intervention would focus on teaching the missing skill (Wood, Ferro, Umbreit, & Liaupsin, 2010). The second step consists of selecting replacement behavior. The decision on the appropriate replacement behavior depends on the child's ability to perform the replacement behavior that is determined/guided by the previously collected FBA data. If the child is determined to lack the skills (skill deficient), the intervention will focus on teaching the replacement behavior and improve the environmental factors that might affect the occurrence of the behavior. On the other hand, if the FBA data suggests that the child already possesses the necessary skills to perform the replacement behavior, the intervention will consist on improving environmental factors that increases the likelihood of the appropriate behavior occurrence (Wood et al., 2010).

Previous Reviews

With regard to FBIs, several research syntheses exist. Seven previous reviews were located that were relevant for young children with challenging behavior. First, Gresham, McIntyre, Olson-Tinker, Dolstra, McLaughlin and Van (2004) examined the relevance of FBIs across school-based interventions in studies published in the *Journal of Applied Behavior Analysis* from 1991 to 1999. Results indicated that less than half (48%) of the interventions were function-based, and descriptive and experimental FBA procedures were used by almost the same proportion of studies (20% and 18%, respectively). Furthermore, fewer studies (10%) used a combination of descriptive and experimental analysis. In addition, interventions that used a combination of antecedent and consequence-based treatments were more commonly compared to studies that were either antecedent or consequence-based treatments.

Second, Conroy, Dunlap, Clarke, and Alter (2005) conducted a literature review on positive behavioral interventions for young children with challenging behavior. The review included 73 studies published from 1984 to 2003 and focused on young children between the ages birth to six year-old. Results showed an increasing trend in the publication of positive behavioral interventions' research including FBIs. Among the positive behavioral interventions used, only 40% of the interventions were linked to functional assessments outcomes. Primarily, most of the positive behavioral interventions were conducted with children 3 and 6 years old. Typical agents like classroom teachers and family members implemented more than 65% of the studies. In addition, the majority of the interventions were conducted in the least restrictive

environments like community schools, special education classrooms, and home settings compared to more restrictive environments.

Third, Wood, Blair, and Ferro (2009) examined the degree in which the current early childhood behavioral intervention research met the guidelines for effective intervention practices as outlined by Dunlap et al. (2006). The reviews included 35 studies using SCR designs published between 1990 and 2007 with 130 participants. Findings indicate that young children with challenging behavior benefited from FBIs. However, the researchers noted high variability in the FBA procedures used. For example, 26% of the studies did not include interviews, 46% of the studies did not include direct observations, and the behavioral hypothesis was not tested in 23% of the studies. Furthermore, typical agents, such as parents and teachers in naturalistic environments, implemented the majority of the interventions.

Forth, Harvey, Boer, Meyer, and Evans (2009) conducted a meta-analysis of 142 studies published between 1988 and 2006 with 305 participants to analyze intervention research to address challenging behavior. The results indicated that behavioral interventions were effective in reducing challenging behavior specifically when preceded by a functional analysis.

Fifth, Goh and Bambara (2010) conducted a meta-analysis of 83 single-case research design studies using the PND effect size to determine the effects of FBIs and analyze the interventions effects across different participant characteristics and intervention features. The review included 83 studies with 145 participants in grades K-12. Results indicated that FBIs were effective in enhancing students' behavior, with

moderate effect size (PND = 88%), and the results were maintained for a period of time that ranged from 1 week up to 2 years. The authors concluded, “Overall, FBA-based interventions were found to be equally effective across diverse student populations, and educational settings, including inclusive classrooms” (p. 271).

Sixth, Gage, Lewis, and Stichter (2012) investigated the effects of FBIs specifically on challenging behavior for students with or at-risk for emotional and behavioral disorders (EBD). The meta-analysis included 69 studies with 146 subjects and used hierarchical linear modeling (HLM) procedures. The authors found that FBIs were effective in reducing students’ challenging behavior by 70.5% and the procedures were effective across different students’ characteristics. Furthermore, FBIs that were preceded by functional analyses were more effective compared to interventions that relied on solely on descriptive assessment.

Finally, Wood, Drogan, and Janney (2014) analyzed early childhood practitioners’ involvement in FBIs and behavior intervention plans to address young children’s challenging behavior. The review included 30 studies published between 1990 and 2012 and included 71 children and 52 practitioners. Although those early childhood practitioners were the ones implementing the BIPs, they either participated in a limited role or were not included during the FBA process and the BIPs development.

Common findings across the previously reviewed studies suggested the effectiveness FBIs and the typical agents like classroom teachers regularly implemented the interventions. The findings of these research syntheses provide important contributions to the FBIs literature. Yet, in term of their applicability to young children at school

settings, they are not without limitations. First, many of these syntheses included older participants whose age ranged between birth up to 21 years olds (e.g., Gresham et al., 2004; Goh & Bambara, 2010; Gage et al., 2012; Harvey et al., 2009). Second, even though all of the previous reviews included studies conducted at different educational settings, only one review was exclusive to early childhood school settings (Wood et al., 2014). All of the other reviews included studies conducted at homes, hospitals, schools, inpatients/outpatient facilities, and other clinical settings. Third, some meta-analyses measured the effectiveness of FBIs exclusively on students with EBDs (e.g., Gage et al., 2012) and excluded any studies that included students without disabilities or students with other disabilities, such as autism spectrum disorder (ASD) or cognitive impairment. Finally, many of the previous research syntheses did not focus on the actual effectiveness of FBIs. For instance, even though Conroy et al. (2005) review provided valuable information regarding different types of positive behavioral interventions including FBA for young children, the review was descriptive in nature and did not analyze outcome measures for magnitude of effects. Likewise, while Wood et al. (2014) focused on early childhood practitioners' involvement in FBAs and BIPs development and did not analyze effects for the BIPs.

Purpose and Research Questions

This meta-analysis aims to expand the literature on FBIs by quantitatively synthesizing single subject research studies that focused on young children being served exclusively in early childhood education settings. In addition, it aims to determine the overall effectiveness of FBIs and to analyze the results across different participant

characteristics and interventions' features. Specifically, the current meta-analysis aims to answer the following research questions:

1. What are the descriptive characteristics of the FBIs designed to address young children's challenging behavior?
2. Overall, how effective are FBIs in addressing young children's challenging behavior in early childhood settings?
3. Is the intervention effectiveness related to the following participant characteristics: (a) intensity of challenging behavior and (b) disability status?
4. Is the effectiveness of FBIs related to FBA features, including: (a) FBA method, (b) function of the behavior, (c) type of FBI used, and (d) intervention agent?
5. Is the effectiveness of FBIs related to the quality of single-subject research designs using What Works Clearinghouse standards?

Method

Literature Search

Study identification procedures and inclusion criteria are described in details in the first study.

Descriptive Coding Procedures

The identified studies were summarized within categories: (a) study characteristics, (b) participants and setting characteristics, (c) FBA characteristics, and (d) FBIs characteristics. The descriptive coding for study, participants, and setting characteristics was obtained from the first study.

FBA characteristics. Coding for FBA characteristics involved five codes: (a) FBA method, (b) type of dependent variable, (c) intensity of challenging behavior, (d) assessment agent, and (e) function of the challenging behavior.

FBI characteristics. Coding for FBI characteristics involved three codes: (a) intervention agent, (b) intervention used, and (c) intervention category. A full coding menu for descriptive data is provided in Appendix A.

Effect Size Measure and Data Extraction

This meta-analysis includes only single-subject research (SCR) studies. These studies are characterized by a small sample size, small data sets, and often use data that violate the parametric assumptions (normality, constant variance, and internally scaled data). Tau-U was deemed an appropriate effect size for this meta-analysis for the following reasons Tau-U: (a) is a non-parametric measure that is not limited by parametric measures' requirements, (b) controls for undesirable baseline trend, (c) can be used along with visual analysis, (d) is a user-friendly index that can be calculated with pencil and ruler, (e) is distribution free index that can be used with small data sets, (f) has strong statistical power, (g) is a complete effect size index that considers all data points, and (h) is unlike parametric measures are highly influenced by extreme scores (outliers). (Parker, Vannest, Davis, & Sauber, 2011)

Tau-U can be described as the percentage of data that show improvements overtime after controlling for confounding baseline trend (Parker et al., 2011).

Specifically, the Tau-U index provides useful information regarding: (a) the improvement trend during the intervention phase (Phase B), (b) the improvement in non-

overlapping data between Phase A and B, and (c) the overall participant improvement after controlling for preexisting (baseline) improvement trend (Parker et al., 2011). Tau-U is calculated from all pair-wise comparisons between data points of two phases using the following *Equation 1*:

$$\text{Tau-U} = \frac{S}{\# \text{ of pairs}}$$

Where S= (pos-neg), S is calculated from a simple triangle “difference matrix” of all pairwise data comparisons made in a “time-forward” direction (Parker et al., 2011). Tau-U can control for undesirable positive Phase A trend by subtracting it (in the form of “S”) from the non-overlap formula. The calculation can be done using the following *Equation 2*:

$$\frac{(S \text{ nonoverlap} - S \text{ trend})}{\# \text{ Pairwise nonoverlap}}$$

In controlling for preexisting trends in Tau-U, the S is calculated across phases for non-overlap, but within Phase (A) only to control for Phase (A) trend. Baseline trend was corrected using an online Tau-U calculator (Vannest, Parker, & Gonon, 2011) only in cases where the last three data-points were moving in the opposite direction (therapeutic direction).

Isolation of Descriptive Information and Potential Moderators Coding

Data extraction was done using Excel. All variables were operationally defined with examples and non-examples to ensure accurate and consistent data extraction. In addition, the data extraction focused on (a) study information (e.g., author, year, journal, study design), (b) participant descriptions (e.g., number of participants, name, age,

gender, target behavior, and disability type if applicable), and (c) and independent variable information (e.g., type of intervention, implementer information, teaching/training method, and targeted behavioral outcome(s)). Moreover, to allow the calculation effect sizes, data were extracted from each study's graph(s) using GetData digitalizer program. The data were entered into an online Tau-U calculator (Vannest, Parker, & Gonon, 2011)

Potential Moderators

Studies were coded across two potential moderators related to participant characteristics and four potential moderators related to intervention characteristics. Potential moderators related to participant characteristics included: (a) intensity of challenging behavior and (b) disability status. Potential moderators related to intervention characteristics included: (a) FBA method, (b) function of the behavior, (c) type of FBI used, and (d) intervention agent.

Statistical significant testing for potential moderators. Each set of potential moderators was coded by levels (e.g., appropriate vs. challenging behavior). To confirm a potential moderator, the differences between the levels have to be statistically significant, indicating that the levels have differentially affected the students' outcomes. Statistical significance for moderator analysis between the Tau-U values was determined by calculating 84.3% confidence intervals and visually comparing the upper and lower limits of the confidence intervals for the effect sizes within each moderator levels. The $CI_{84.3}$ visual comparison method is similar to the $p = 0.05$ (Payton, Geenstone, & Schenker, 2008).

Intensity of challenging behavior. Intensity of challenging behavior was defined as the severity level of challenging behavior. Coding for this moderator was adapted from Scotti, Evans, Meyer, and Walker (1991) and involved three levels: (a) level one, (b) level two and, (c) level three. Level one includes chronic behaviors that interfere with daily activities. These challenging behaviors are stable and less likely to change over time. Examples include grabbing toys, non-compliance, talking to others, and stereotypic behaviors such as hand flapping and rocking. Level two includes more serious behaviors that pose a priority concern to caregivers and interfere with learning. These behaviors are more likely to increase in severity when left untreated but are milder than level three behaviors. Examples include aggression, disruptive behavior, tantrums that last for a long time, and elopement. Finally, Level three includes serious behaviors compared to level two and includes behaviors that require immediate attention because of dangers to self and others. Examples include self-injurious behaviors, mouthing objects that result in bleeding or chapping lips, and aggression that results to cuts or injuries to others.

Disability status. Disability status was defined as whether participants were diagnosed with a disability or typically developing. Codes for this moderator included: (a) typically developing, (b) at-risk for EBD, (c) intellectual disability, (d) ADHD or at-risk for ADHD, (e) developmental delays (e.g., ASD, pervasive developmental delay), (f) speech and language delays, (g) learning-disability, and (h) multiple disabilities.

FBA method. FBA method was defined as any type of assessment method used to identify the function of the challenging behavior. Codes for this moderator included:

(a) indirect\descriptive only (e.g., interviews, rating scales, record review), (b) direct descriptive only (e.g., direct observation, scatterplots), (c) experimental methods only (e.g., functional analysis, hypothesis testing, structural analysis), and (d) combination of two or more of these methods.

Function of the challenging behavior. Function of the challenging behavior was defined as the purpose of the challenging behavior. Codes for this moderator were based on Umbriet, Ferro, Liaupsin, and Lane (2007) and included: (a) to gain access to attention, (b) to gain access to a tangible item or an activity, (c) to gain access to sensory stimulation, (d) to escape attention, (e) to escape a demanding task/activity, (f) to escape sensory stimulation, and (g) multiple functions.

Intervention type. Intervention type was defined as FBIs developed using FBA data. Four codes for this moderator included: (a) antecedent-based intervention, (b) skill training, (c) consequence-based intervention, and (d) multicomponent intervention. Antecedent-based interventions were defined as proactive interventions that aim to prevent or decrease the occurrence of the challenging behavior by manipulating variables that might trigger the challenging behavior. Examples of antecedent-based interventions include: modifying a curriculum/activity (e.g., modify difficulty level, providing alternative tasks), rearranging the classroom environment to reduce the likelihood of challenging behavior (e.g., noise level, seating arrangements), providing non-contingent attention or reinforcement (NCR) or attention, and providing choices, pre-corrections, or reminders. Skill-training interventions were defined as any intervention designed to teach or enhance skills that the participant might have lacked.

Examples are functional communication training, self-management, social skills training, and social-story interventions. Consequence-based interventions are interventions that follow the occurrence of target behavior. Examples include positive reinforcement (e.g., praise, token-economy, teacher attention), differential reinforcement, extinction (e.g., ignoring incidents of challenging behavior), and redirection. Finally, multicomponent interventions were defined as any combination of two or more interventions.

Intervention agent. Intervention agent was defined as the individual responsible for implementing the FBI. Codes for this moderator included: (a) teacher/practitioner, (b) researcher or graduate student, (c) collaboration between classroom teacher and researcher, and (d) others (e.g., peers). In cases of classroom teacher and teacher-assistant implemented the interventions, only primary implementer data were coded.

Reliability for Descriptive Coding and Extraction of Data

Detailed information about reliability for study inclusion, reliability for What Works Clearinghouse (WWC) design standards coding, and how reliability was calculated are discussed in the first study.

Descriptive coding. One reviewer coded all studies for descriptive characteristics. One third of the studies ($n = 8$) were randomly selected and coded for reliability by a graduate student trained in descriptive coding procedures. The overall agreement between the reviewer and the graduate student was 86% (range 73% to 100%). Reliability for FBA characteristics was 87% (range 77% to 100%). Reliability for FBIs was 88% (range 82% to 86%).

Moderator analyses. A reviewer and graduate student conducted moderator analyses for all of the moderators. The overall agreement between the reviewer and the graduate student was 100%.

Results

Study, participant, and setting characteristics are presented in study 1. The first research question focused on describing the salient features of the FBIs. Table 3 provides detailed information on FBA characteristics and Table 4 provides a summary of the FBIs characteristics in each study.

Function-Based Assessment Characteristics

Function-based assessment method. Across the studies, a variety of assessment methods were used to identify the function for participants' challenging behavior. More than half of the studies used a combination between descriptive (i.e., direct and indirect) and experimental methods ($n = 15, 63\%$). One third of the studies used experimental methods only ($n = 8, 33\%$) and one study used direct descriptive methods only (4%). None of the included studies used indirect descriptive methods only.

Table 3. Summary of the FBA Characteristics

Study	N	SCR design	FBA method	Experimental	Function	Function-based intervention
Bellone et al. (2014)	4	Multi-elements	Combined (indirect + direct descriptive + experimental)	FA	Attention	DRA+ EXT
Blair et al. (2010)	3	MBD	Direct descriptive	--	Attention, tangible, escape	NCR, social-skills training, and antecedent manipulation
Bloom et al. (2013)	3	MBD, ABAB	Experimental	FA	Tangible, escape, sensory	DRA+ EXT, FCT, and NCR
Boyajian et al. (2001)	3	BAB	Combined (indirect descriptive + experimental)	FA	Attention, tangible, escape	Social-skills training, verbal instructions, and using a timer
Calloway & Simpson (1998)	3	ABA	Combined (indirect descriptive + experimental)	FA	Attention, Escape	Providing attention at the beginning of the day, praise, token economy, modified tasks, and frequent breaks
Duda et al. (2004)	2	ABAB	Combined (direct + indirect descriptive)	--	Attention, escape	Antecedents manipulation, choice, and behavior specific praise
Dufrene et al. (2007)	3	ABAB	Combined (direct descriptive + experimental)	FA	Attention, escape	CR and time-out from positive reinforcement
Durán et al. (2013)	1	AB	Combined (indirect + direct descriptive + experimental)	FA	Escape	FCT
Gibson et al. (2010)	1	ABAB	Combined (indirect descriptive + experimental)	FA	Tangible	FCT
Hines & Simonsen (2008)	1	AB	Combined (direct + indirect descriptive)	--	Tangible	FCT
Ingvarsson et al. (2009)	3	Alternating treatment, ABAB	Experimental	FA	Escape	Differing densities of reinforcement, NCR, CR, and EXT
Ishuin (2009)	1	ABAB	Combined (indirect descriptive + experimental)	FA	Attention	DRO
Lambert et al. (2012)	3	MBD	Experimental	Trail-based Functional Analysis	Escape, attention	FCT and DRA+EXT
Lang et al. (2010)	1	Alternating treatment	Experimental	FA	Attention, tangible	Tangible EXT
Marcus & Vollmer (1995)	1	ABAC	Experimental	FA	Escape	FCT+ DRN
Marcus & Vollmer (1996)	3	ABAB, ABCDAC	Experimental	FA	Tangible	NCR+ DRA, NCR, and DRO
May & Howe (2013)	1	AB	Combined (indirect descriptive + experimental)	FA	Escape, attention	DRA + engagement stimuli treatment package
Park & Scott (2009)	3	ABAB	Combined (indirect +direct descriptive + experimental)	Structural analysis	Escape, attention	Choice/preferred item, differential seating (proximity to teacher)
Payne et al. (2014)	3	AB, MBD, BAB	Experimental	FA	Escape, attention, & escape	DRA+EXT, CR, and token economy
Perrin et al. (2008)	2	Alternating treatment	Combined (direct descriptive + experimental)	FA	Attention, escape, & automatic reinforcer	NCR+EXT, FCT+EXT
Tiger et al. (2006)	1	MBD	Combined (direct descriptive + experimental)	FA	Automatic reinforcer	Response blocking

Table 3. Continued

Study	N	SCR design	FBA method	Experimental	Function	Function-based intervention
Umbreit & Blair (1997)	1	MBD	Combined (indirect, direct descriptive + experimental)	Structural analysis	Escape	Preferred activity
Wilder et al. (2007)	2	ABAB	Experimental	Structural Analysis	Escape	DRA
Wood et al. (2010)	3	MBD	Combined (indirect + direct descriptive)	--	Attention, Escape	Antecedent adjustment, DRA, and Ext

Note. MBD = Multiple-baseline design. DRA = Differential reinforcement of alternative behavior, EXT= Extinction, CR = Contingent reinforcement, NCR= Non-contingent reinforcement, DRN = Differential negative reinforcement, FCT = Functional-communication training, DRO = Differential reinforcement of other behavior

Table 4. Summary of Function-based Assessment and Intervention Characteristics

Category	Study level		Participant level	
	<i>n</i>	% of studies	<i>n</i>	% of Participants
FBA method				
Direct descriptive	1	4%	3	6%
Indirect descriptive	-	-	-	-
Experimental	8	33%	18	35%
Combined	15	63%	30	59%
Dependent variable				
Appropriate behavior	-	-	-	-
Challenging behavior	12	50%	23	45%
Both	12	50%	28	56%
Intensity of Challenging behavior				
Level 1	-	-	20	39%
Level 2	-	-	28	55%
Level 3	-	-	3	6%
Assessment agent				
Teacher/school staff	2	8%	6	11%
Researcher/graduate student	20	84%	38	75%
Collaboration	1	4%	4	8%
Not reported	1	4%	3	6%
Function				
Access to attention	-	-	14	27%
Access to tangible/activity	-	-	8	16%
Obtain sensory input	-	-	2	4%
Task avoidance	-	-	17	33%
Multiple functions	-	-	10	20%
Intervention agent				
Teacher/school staff	8	33%	20	39%
Researcher/graduate student	8	33%	18	35%
Collaboration	4	17%	7	14%
Not reported	2	8.5%	4	8%
Other	2	8.5%	2	4%
Intervention category				
Antecedent-based	6	21.5%	8	16%
Consequence-based	6	21.5%	12	23%
Skill-training	3	10%	3	6%
Combination	13	47%	28	55%

Type of dependent variables. Half of the studies examined the effects of FBIs to address challenging behaviors ($n = 12$), such as aggression, disruptive behavior, and leaving assigned area. The other half examined the effects of FBIs on both challenging and appropriate behavior ($n = 12$). At the participant level, FBIs were used to address challenging behavior for 23 of the participants (45%). For the remaining 28 participants (55%), FBIs were used to address both challenging and replacement behaviors.

Intensity of challenging behavior. FBIs were used to address three levels of intensity of challenging behaviors for participants. Twenty participants (39%) engaged in chronic, but stable, challenging behaviors (i.e., level 1 intensity) that interfere with daily activities. More than half of the participants ($n = 28$, 54%) engaged in serious challenging behaviors (i.e., level 2 intensity) that are more likely to increase in severity if left untreated. Only three of the participants (6%) engaged in dangerous, and more serious, challenging behaviors (i.e., level 3 intensity) that require immediate attention.

Assessment agent. Across the 24 studies, researchers or graduate assistants implemented the majority of the FBAs ($n = 20$, 84%). Early childhood practitioners assessed the function of the challenging behavior in only two studies (8%). The assessment agent was not reported in one study (4%) and both the classroom teacher and the researcher collaborated to assess the function of participants' challenging behavior in one study (4%).

Functions of challenging behavior. Participants' challenging behaviors were maintained by different functions. Seventeen participants (33%) engaged in challenging behavior maintained by task-avoidance. Fourteen participants (27%) engaged in

challenging behavior maintained by access to attention. Eight participants (16%) engaged in challenging behavior maintained by access to tangibles/activities. Only two participants (4%) engaged in challenging behavior maintained by sensory input (i.e., automatic reinforcement). Finally, 10 participants (20%) engaged in challenging behaviors maintained by multiple functions.

Function-Based Intervention Characteristics

Intervention agent. Across the studies, typical agents (i.e., classroom teachers and program staff) implemented one third of the interventions ($n = 8$) and researchers implemented another third of the interventions ($n = 8$). Classroom teachers and researchers collaborated to implement interventions in 17% of the studies ($n = 4$). The intervention agent was not reported in 8% of the studies ($n = 2$). Finally, other intervention agents implemented the interventions in 8% of the studies ($n = 2$). Specifically, a paraprofessional implemented the intervention in one study (Hines & Simonsen, 2008) and a grandparent was part of the implementation team in another study (Wood et al., 2011).

Intervention type. FBIs were categorized into four categories: (a) antecedent-based interventions, (b) consequences-based interventions, (c) skill-training interventions, and (d) multi-components interventions. Antecedent-based interventions were used with eight participants (16 %) and included non-contingent reinforcer (NCR), providing choice, and environment-manipulation. Consequence-based interventions, conversely, were used with 12 participants (23%) and included differential-reinforcement (DR), extinction, and positive reinforcement like praise and providing

attention. In addition, skill-training interventions were used with three participants (6%) and consisted of functional-communication training (FCT). Finally, multi-components interventions were used with 28 participants (55%). The most commonly used combination of interventions included, DRA with FCT and extinction, DRA with extinction, and NCR with antecedent/environment manipulation.

Overall Effects

The second research question focused on evaluating the overall effects of FBI to address young children's challenging behavior in preschool settings. The 24 studies yielded a total of 150 phase contrasts. Fifty-five phase contrasts (37%) examined the effects of FBIs on increasing appropriate replacement behavior and were not included in the overall effects analysis. Ninety-five phase contrasts (63%) examined the effects of FBIs to address young children's challenging behavior. With regard to the overall effectiveness of FBIs, the weighted mean effect size was 0.80 ($n = 95$, $SE = 0.03$, $CI_{84.3} [0.75-0.84]$). These findings show that FBIs had moderate to large effects on addressing challenging behavior exhibited by young children. Table 5 provides a summary of the effect sizes for the included studies. Figure 3 presents a forest plot of effect sizes aggregated by study and the overall effect size.

Findings for Potential Moderators Related to the Participant Characteristics

The fourth research question investigated of FBA interventions across two moderators: (a) intensity of challenging behavior and (b) disability status. Table 6 provides a summary of the effect sizes for moderator variables.

Table 5. Summary of Effect Sizes for Included Studies

Study	N	SCR design	Target behavior	Number of contrasts	Tau-U	CI 95%	
						LL	UL
Bellone et al. (2014)	4	Multi-elements	Overall	8	1.00	0.65	1.00
			Engagement	4	1.00	0.50	1.00
			Inappropriate vocalization	2	1.00	0.29	1.00
			Off-task	1	1.00	0.56	1.00
			Out-of area	1	1.00	0.43	1.00
Blair et al. (2010)	3	Multiple baseline	Overall	6	1.00	0.70	1.00
			Problem behavior	3	1.00	0.59	1.00
			Engagement	3	1.00	0.57	1.00
Bloom et al. (2013)	3	MBD, ABAB	Overall	10	0.78	0.60	0.96
			Problem behavior	4	0.77	0.50	1.00
			Independent communication	4	0.74	0.48	1.00
			Mouthing	2	1.00	0.45	1.00
Boyajian et al. (2001)	3	BAB	Overall	7	0.83	0.51	1.00
			Aggression	3	1.00	0.48	1.00
			Engagement	2	0.77	0.23	1.00
			Mand/ appropriate requests	2	0.68	0.08	1.00
Calloway & Simpson (1998)	3	ABA	Overall	3	0.94	0.59	1.00
			Aggression	1	1.00		1.00
			Non-compliance	1	0.87	0.81	1.00
			Leaving assigned area	1	0.96	0.68	1.00
Duda et al. (2004)	2	ABAB	Overall	16	0.87	0.66	1.00
			Engagement	8	0.88	0.60	1.00
			Problem behavior	8	0.84	0.56	1.00
Dufrene et al. (2007)	3	ABAB	Overall	6	1.00	0.59	1.00
			Aggression	4	1.00	0.52	1.00
			Non-compliance	2	1.00	0.25	1.00
Durán et al. (2013)	1	AB	Overall	2	0.58	0.06	1.00
			Aggression	1	0.75	0.53	1.00
			Independent requests/Mands	1	0.28	-0.09	1.00
Gibson et al. (2010)	1	ABAB	Elopement	2	1.00	0.30	1.00
Hines & Simonsen (2008)	1	AB	Overall	5	0.67	0.35	1.00
			Use of picture cards	1	0.75	0.45	1.00
			Problem behavior	2	0.73	0.25	1.00
			Engagement behavior	2	0.58	0.07	1.00
Ingvarsson et al. (2009)	3	Alternating treatment, ABAB	Overall	30	0.58	0.49	0.66
			Disruptive behavior	15	0.62	0.50	0.74
			Compliance	15	0.54	0.42	0.65
Ishuin (2009)	1	ABAB	Non-compliance	2	1	0.35	1.00
Lambert et al. (2012)	3	MBD	Overall	6	0.94	0.70	1.00
			Aggression	2	0.95	0.50	1.00
			Tantrums	1	0.97	0.41	1.00
			Alternative responses	3	0.93	0.59	1.00

Table 5. Continued

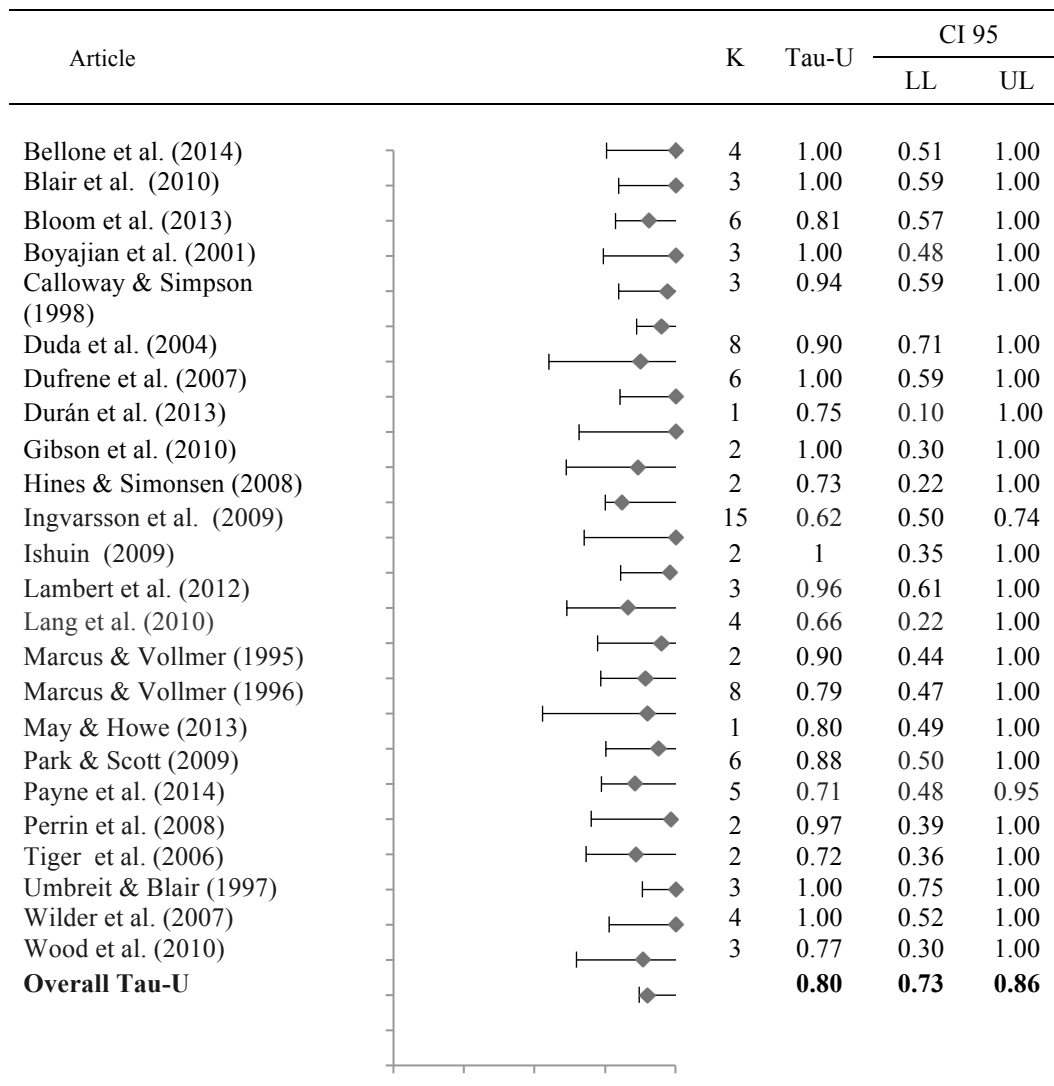
Study	N	SCR design	Target behavior	Number of contrasts	Tau-U	CI 95%	
						LL	UL
Lang et al. (2010)	1	Alternating treatment	Elopement	4	0.66	0.22	1.00
Marcus & Vollmer (1995)	1	ABAC	Overall	4	0.79	0.47	1.00
			Disruptive behavior	2	0.90	0.23	1.00
			Compliance	2	0.69	0.23	1.00
Marcus & Vollmer (1996)	3	ABAB, ABCDAC	Overall	10	0.54	0.28	0.80
			Self-injurious behavior	2	0.95	0.40	1.00
			Appropriate Mand	4	0.04	0.04	0.49
			Aggression	2	0.80	0.37	1.00
			Tantrums	2	0.20	-0.79	1.00
May & Howe (2013)	1	AB	Off-task behavior	1	0.80	0.49	1.00
Park & Scott (2009)	3	ABAB	Overall	6	0.88	0.50	1.00
			Disruptive behavior	4	0.83	0.37	1.00
			On-task behavior	2	1.00	0.31	1.00
Payne et al. (2014)	2	AB, MBD, BAB	Overall	9	0.69	0.50	0.87
			Aggression	5	0.71	0.48	0.95
			Compliance	3	0.64	0.27	0.97
			Mands	1	0.61	-0.56	1.00
Perrin et al. (2008)	2	Alternating treatment	Elopement	2	0.97	0.39	1.00
Tiger et al. (2006)	1	MBD	Hand mouthing	2	0.72	0.36	1.00
Umbreit & Blair (1997)	1	MBD	Problem behavior	3	1.00	0.75	1.00
Wilder et al. (2007)	2	ABAB	Non-compliance	4	1.00	0.52	1.00
Wood et al. (2010)	3	MBD	Disruptive behavior	3	0.77	0.30	1.00
Overall Tau-U					0.80	0.75	0.84

Table 6. Summary of the Effect Sizes for Moderator Variables

Moderator	Number of participants	Number of phase contrasts	ES	Standard Error	CI 84.3%	
					LL	UP
Related to participants' characteristics						
Intensity of challenging behavior						
Level 1	21	37	0.88	0.07	0.78	0.98
Level 2	27	51	0.74	0.04	0.68	0.80
Level 3	3	7	0.92	0.10	0.78	1.00
Disability status						
Typically developing	13	27	0.89*	0.06	0.81	0.97
Intellectual disability	4	10	0.92*	0.13	0.73	1.00
ADHD or at-risk for ADHD	4	4	1.00*	0.20	0.72	1.00
Developmental delay/autism	13	21	0.84*	0.08	0.72	0.95
Speech/language impairment	4	8	0.44*	0.09	0.33	0.56
Learning disability	1	4	0.67	0.13	0.49	0.85
Multiple disabilities	12	21	0.83*	0.08	0.72	0.93
Related to the function-based assessment intervention/characteristics						
FBA method						
Direct descriptive	3	3	1.00	0.21	0.71	1.00
Experimental	18	45	0.71*	0.04	0.65	0.77
Combined	30	47	0.90*	0.05	0.83	0.98
Function						
Gain access to teacher attention	14	21	0.90	0.09	0.77	1.00
Gain access to tangible/activity	8	16	0.75	0.09	0.63	0.87
Automatic reinforcer	2	4	0.80	0.15	0.59	1.00
Escape a demanding task/ activity	17	41	0.76	0.04	0.70	0.83
Multiple functions	10	13	0.85	0.11	0.70	1.00
Intervention agent						
Classroom teacher	15	28	0.88	0.08	0.77	1.00
Researcher/graduate student	16	34	0.72	0.05	0.65	0.78
Collaboration	13	22	0.86	0.07	0.77	0.95
Others	3	4	0.84	0.19	0.57	1.00
Not reported	4	7	0.79	0.15	0.59	1.00
Type of FBA intervention						
Antecedent-based	16	29	0.87*	0.07	0.77	0.96
Consequence-based	11	30	0.69*	0.05	0.62	0.76
Skill-training	3	5	0.80	0.18	0.56	1.00
Multicomponent	21	31	0.89*	0.06	0.80	0.98

Note. UP = upper limit; LL = lower limit; ES = effect size, * the asterisk indicates statistically significant difference between the moderator levels.

Figure 3. Forest plot of effect sizes aggregated by studies



Intensity of challenging behavior. Ninety-five phase contrasts focused on the effects of the function-based interventions in addressing three levels of intensities for challenging behaviors. Of those 95 phase contrasts, seven phase contrasts (7%) focused on serious behaviors that are considered dangerous to self and others (level 3) and require immediate attention. Those seven contrasts yielded the largest effect size ($ES = 0.92$, $SE = 0.10$, $CI_{84.3} = [0.78, 1.00]$). Thirty-seven phase contrasts (39%) focused on less serious behaviors (level 1), that can be described as chronic, interferes with daily activities, but less likely to change overtime. Those contrasts yielded the second largest effect size of 0.88 ($SE = 0.07$, $CI_{84.3} = [0.78, 0.98]$). Finally, 51 phase contrasts (54%) focused on behaviors that can be described as a priority concern to caregivers, interferes with learning, and likely to increase in severity if left untreated (level 2). Those contrasts yielded an effect size of 0.74 ($SE = 0.04$, $CI_{84.3} = [0.68, 0.80]$). However, the differences between the three intensity levels were not statistically significant.

Disability status. A total of 27 phase contrasts (28%) included typically developing participants and yielded an effect size of 0.89 ($SE = 0.06$, $CI_{84.3} = [0.81, 0.97]$). Ten phase contrasts (11%) included participants with intellectual disability and yielded an effect size of 0.92 ($SE = 0.13$, $CI_{84.3} = [0.73, 1.00]$). Eight phase contrasts (8%) included participants with speech/language impairments and yielded an effect size of 0.44 ($SE = 0.09$, $CI_{84.3} = [0.33, 0.56]$). Four phase contrasts (4%) included participants with ADHD or at-risk for ADHD and yielded an effect size of 1.00 ($SE = 0.20$, $CI_{84.3} = [0.72, 1.00]$). Twenty-one phase contrasts (22%) included participants with developmental delay or ASD and yielded an effect size of 0.84 ($SE = 0.08$, $CI_{84.3} =$

[0.72, 0.95]). Another four phase contrasts (4%) included a participant with learning disability and yielded an effect size of 0.67 ($SE = 0.13$, $CI_{84.3} = [0.49, 0.85]$). Finally, 21 phase contrasts (22%) included participants with multiple disabilities and yielded an effect size of 0.83 ($SE = 0.08$, $CI_{84.3} = [0.72, 0.93]$). A statistically significant difference was found between the effects of the FBIs on children with speech/language impairment and each of the following types of participants: (a) typically developing, (b) with intellectual disability, (c) with ADHD or at-risk of ADHD, (d) with developmental delays, and (e) with multiple disabilities. FBIs resulted in a statistically significant larger effect size when each type of disability status (except for learning disability) was compared to its effects on children with speech/language impairment.

Findings for Potential Moderators Related to the FBA Characteristics

The fourth research question is related to the effectiveness of function-based interventions across four moderators (a) FBA method, (b) function of the behavior, (c) type of FBIs used, and (d) intervention agent?

FBA method. Three phase contrasts (3%) used direct descriptive methods to assess the function of the participants' challenging behavior and yielded the largest effect size of 1.00 ($SE = 0.21$, $CI_{84.3} = [0.71, 1.00]$). Forty-seven phase contrasts (50%) used combined methods to assess the function of the participants' behavior and yielded an effect size of 0.90 ($SE = 0.05$, $CI_{84.3} = [0.83, 0.98]$). Finally, 45 phase contrasts (47%) used experimental methods to identify the function of the challenging behaviors and yielded an effect size of 0.71 ($SE = 0.04$, $CI_{84.3} = [0.65, 0.77]$). A statistically significant

difference was found between studies that used combined methods and those that used experimental methods.

Function of the challenging behavior. The majority of the phase contrasts included challenging behaviors maintained by task avoidance ($n = 41, 43\%$). Those phase contrasts yielded an effect size of 0.76 ($SE = 0.04, CI_{84.3} = [0.70, 0.83]$). Twenty-one phase contrasts (22%) included challenging behaviors maintained by access to teacher attention and yielded an effect size of 0.90 ($SE = 0.09, CI_{84.3} = [0.77, 1.00]$). Sixteen phase contrasts (17%) included challenging behaviors maintained by access to tangibles/activities and yielded an effect size of 0.75 ($SE = 0.09, CI_{84.3} = [0.63, 0.87]$). Thirteen phase contrasts (14%) included challenging behaviors maintained by access to multiple functions and yielded an effect size of 0.85 ($SE = 0.11, CI_{84.3} = [0.70, 1.00]$). Thirteen phase contrasts (14%) included challenging behaviors maintained by access to multiple functions and yielded an effect size of 0.85 ($SE = 0.11, CI_{84.3} = [0.70, 1.00]$). Finally, four phase contrasts (4%) included challenging behaviors maintained by access to automatic reinforcer and yielded an effect size of 0.80 ($SE = 0.15, CI_{84.3} = [0.59, 1.00]$). No statistically significant differences were found between any of the functions of the challenging behaviors.

Type of function-based interventions. Thirty-one phase contrasts (33%) included multi-component interventions and yielded an effect size of 0.89 ($SE = 0.06, CI_{84.3} = [0.80, 0.98]$). Thirty phase contrasts (31%) included consequence-based interventions and yielded an effect size of 0.69 ($SE = 0.05, CI_{84.3} = [0.62, 0.76]$). Twenty-nine phase contrasts (31%) included antecedent-based interventions and yielded

an effect size of 0.87 ($SE = 0.07$, $CI_{84.3} = [0.77, 0.96]$). Finally, only five phase contrasts included skill-training interventions and yielded an effect size of 0.80 ($SE = 0.18$, $CI_{84.3} = [0.56, 1.00]$).

Intervention agent. Researchers or graduate students implemented the FBIs in 34 phase contrasts (36%). Those phase contrasts yielded an effect size of 0.72 ($SE = 0.05$, $CI_{84.3} = [0.65, 0.78]$). Early childhood practitioners the FBIs in 28 phase contrasts (29%). Those phase contrasts yielded an effect size of 0.88 ($SE = 0.08$, $CI_{84.3} = [0.77, 1.00]$). Researchers and early childhood practitioners collaborated in implementing the interventions in 22 phase contrasts (23%). Those phase contrasts yielded an effect size of 0.86 ($SE = 0.07$, $CI_{84.3} = [0.77, 0.95]$). Fewer phase contrasts included other implementers or did not report the implementer. Other intervention agents (e.g., paraprofessional and a grandmother) implemented the intervention in four phase contrasts (4%) and yielded an effect size of 0.84 ($SE = 0.19$, $CI_{84.3} = [0.57, 1.00]$). The implementer was not reported in seven phase contrasts (7%). Those phase contrasts yielded an effect size of 0.79 ($SE = 0.15$, $CI_{84.3} = [0.59, 1.00]$). No statistically significant differences were found between any of the intervention agents.

Effectiveness of FBA Based on the Quality of SCR Designs

The final research question focused on evaluating differences in the effectiveness of FBI using WWC standards (Kratochwill et al., 2013). Studies that did not meet design standards yielded a larger effect size of 0.86 ($SE = 0.06$, $CI_{84.3} [0.77-0.95]$) compared to studies meeting design standards “with or without reservations,” with an effect size of 0.76 ($SE = 0.03$, $CI_{84.3} [0.71-0.82]$).

Discussion

The purpose of the current meta-analysis was to determine the overall effectiveness of FBIs and to analyze the results across different participants' characteristics and interventions' features. The following research questions were posed: (a) What are the descriptive characteristics for FBIs to address young children's challenging behavior?, (b) How effective are FBIs in addressing young children's challenging behavior in early childhood settings?, (c) Is the intervention effectiveness related to participants' characteristics?, (d) Is the effectiveness of interventions related to FBI features?, and (f) Is the effectiveness of FBIs related to the quality of SCR designs?

The first research question focused on identifying the descriptive characteristics for FBIs to address young children's challenging behavior. Five themes were noted. First, a combination of FBA methods (direct/indirect descriptive and experimental) was the most commonly used method to identify the function of challenging behavior. This finding is important because reliance on multiple sources to gather information about the function of the behavior would result in more accurate statements regarding the function of the behavior. This finding differs from Snell, Voorhees, and Chen (2005); who found that experimental functional analysis was the most commonly used assessment method. A possible explanation for this difference is that the 24 included studies used a combination of assessment methods already including experimental functional analysis (see Table 3).

Second, escaping demands (task avoidance) was the function that maintained one third of the participants' challenging behaviors, followed by obtaining early childhood

practitioners' attention, which was the function of more than one fourth of the participants' behaviors. This finding is surprising because early childhood education settings are not characterized by academically demanding tasks that might be perceived as aversive to young children. It is possible that some young children might perceive some of the commonly presented demands in early childhood setting as aversive (e.g., cleaning up, setting in circle time for a long period of time). However, using FBA models like Umbreit et al. (2007) *Decision Model* that investigate if skill deficit is responsible for the challenging behavior or not might help in addressing this issue. Children who lack the necessary skills are more likely to engage in challenging behaviors to escape difficult tasks (Wood et al., 2010).

Third, researchers or graduate students conducted the majority of the FBAs. This finding seems to be consistent with other researchers. For example, Wood, Blair, and Ferro (2009) found that teachers in childcare centers were included in less than 10% of the FBAs. In addition, Wood, Dragon, and Janney (2014) suggested that early childhood practitioners had either a limited role or were not included in the FBAs. A possible explanation to this finding is that the majority of early childhood practitioners lack the prerequisite skills to implement FBA, especially if the FBAs involved a combination of assessment methods or included experimental functional analysis methods.

Fourth, even though early childhood practitioners had limited role in conducting the FBAs, they either fully implemented the FBAs or collaborated with researchers to implement more than half of the interventions. This pattern was documented by Conroy

et al. (2005) and is encouraging. It seems that early childhood practitioners are increasingly taking an active role in addressing young children's challenging behaviors.

Finally, multi-component interventions were the most commonly used type of FBIs. This finding is in line with those of previous studies (Conroy et al., 2005; Gresham et al., 2004; Wood, Blair, & Ferro, 2009). It is possible, that multi-component interventions have higher chances of success in addressing challenging behaviors compared to single-component methods (e.g., antecedent-based only or consequence-based only). This finding is in agreement with Gresham et al. (2004), who found that a combination of antecedent and consequence-based treatments were more common compared to studies that were either antecedent or consequence-based treatments. The results of this meta-analysis support this possibility. Multi-component interventions resulted in the largest effect size (0.89) compared to single component interventions, such as consequence-based interventions (0.69) or skill-training interventions (0.80) and the difference was statistically significant.

The second research question focused on determining the overall effectiveness of FBIs in addressing young children's challenging behavior. The results of this meta-analysis showed that FBIs applied in early childhood settings can effectively be used to reduce challenging behaviors. Similar findings were obtained by Gage et al. (2012), who found that FBIs resulted in a 70% reduction of challenging behaviors by students with EBD. In addition, the findings match Goh and Bambara (2010), who found FBIs to be effective across diverse student populations and educational settings.

The third research question focused on determining if the intervention effectiveness related to participants' characteristics. Even though no statistically significance difference was found across the three challenging behavior intensity levels, practitioners might find FBIs more effective with serious and dangerous behaviors (i.e., Level 3 intensity), such as self-injurious behaviors. However, these interventions were also effective with chronic, but stable, challenging behaviors (i.e., Level 1 intensity), like grabbing toys and non-compliance and behaviors that are more likely to increase in severity if left untreated (i.e., Level 2 intensity) like, aggression, disruptive behavior, and elopement. However, FBIs resulted in large effect sizes across all of the three intensity levels. Finally, children with ADHD benefited the most from the FBIs. However, children with intellectual disabilities, along with those who were typically developing or with developmental disabilities, benefited from FBIs. Moderator analysis indicated a statistically significant difference in the effects of FBIs when children had disabilities. For example, students having all levels of disabilities, except for learning disabilities, benefited more compared to children with only speech or language impairments.

The fourth research question focused on determining if FBIs effectiveness is related to the intervention features. Contrary to expectations, a statistically significant difference was found between studies that used combined FBA methods and those that used only experimental methods. This finding is not supported by previous research (e.g., Gage et al., 2012), in which FBIs that used an experimental functional-analysis were found to be more effective in reducing challenging behaviors. As previously discussed, a possible explanation for this finding is that the majority of the included

studies used a combination of FBAs already including experimental functional analyses methods (see Table 3).

In addition, FBIs resulted in a large effect size when early childhood practitioners either fully implemented the intervention or collaborated with researchers, were compared to when the researchers implemented the interventions alone. This finding is encouraging because early childhood practitioners seem to be increasingly involved in the interventions and are expected to generate positive outcomes. Finally, a statistically significant difference was found between the types of FBIs used. Multi-component interventions were more effective ($\text{Tau-U} = 0.89$) as compared to consequence-based interventions ($\text{Tau-U} = 0.69$). In addition, antecedent-based interventions ($\text{Tau-U} = 0.87$) were more effective compared to consequence-based interventions ($\text{Tau-U} = 0.69$). These findings are encouraging because it provides an addition to evidence discussed in previous literature that proactive interventions (e.g., manipulating antecedents, adjusting environmental factors) show more positive effects compared to reactive interventions that consist of reacting to the challenging behavior alone.

The last research question focused on differential effects of FBIs on challenging behaviors based on the quality of SCR as evaluated by WWC standards. Previous research has highlighted the importance of investigating the relationship between methodological quality and quantitative treatment effects (Maggin, Johnson, Chafouleas, Ruberto, & Berggren, 2012). Contrary to expectations, the current meta-analysis did not find a statistically significant difference between studies meeting and not meeting WWC designs standards. Both type of studies, in fact, resulted in large effect sizes. However,

studies not meeting design standards resulted in even larger effect sizes. This finding might be consistent with Gage et al. (2012), who found no difference in the effects of FBIs for students with EBD based on study quality. However, this conclusion is difficult to support as the authors used the Horner et al. (2005) quality indicators and the majority of their studies were high quality.

Limitations

Conclusions based on this meta-analysis are limited by several factors. First, only published and peer-reviewed studies were included in this review. The inclusion of dissertations and conference papers could have increased the sample size and impacted the results. Second, because large number of potential moderators was analyzed in this review, which might increase the possibility of identifying moderators (e.g., Type I error or false positive results). Thus, the results for moderator analyses should be interpreted with cautious. Finally, Conclusions based on the effect sizes estimates should be viewed with caution given the absence of standards guidelines for selecting and interpreting effect sizes in meta-analyses of SCR.

Implications for Research

While this meta-analysis adds to the literature, there are still many implications for future research. Future research needs to report sufficient information regarding early childhood practitioners' qualifications and backgrounds (e.g., age, years of experience, degree). The current meta-analysis could not conduct moderator analysis between certified early-childhood and other practitioners due to a lack of reporting such information in many of the included studies. In addition, future research might include

generalization and maintenance data to determine if the intervention effects would be generalized to other contexts and maintained over a period of time. It was not possible to calculate effects sizes for maintenance and generalization phases due to the limited number of studies that collected these data. In addition, more research is needed on the nature of task-avoidance function in early childhood settings. It is important to know additional information regarding the nature and context of tasks that young children are likely to avoid. In addition, because early childhood practitioners had a limited role in conducting FBAs, more research is needed about simple and effective methods for training early childhood practitioners to identify behavioral functions with accuracy and with minimum reliance on experts.

Implications for Practice

The study provides six primary implications for practice. First, the overall effect size suggests FBIs in early childhood settings can be considered an effective strategy to address young children's challenging behaviors. Second, the results of this meta-analysis support early childhood practitioners' involvement in implementing FBIs in early childhood settings. Thus, support and in-service training are needed to ensure that practitioners have adequate skills and knowledge to conduct the assessment and implement the interventions. Third, since that one third of the functions of challenging behaviors were task-avoidance, early childhood practitioners might seek methods to make the tasks less aversive. Fourth, early childhood practitioners might consider using multi-component FBIs packages when addressing young children's challenging behaviors. Finally, FBIs were effective across different challenging behavior intensity

levels. Even though children with serious and dangerous behaviors (level 3) seemed to benefit the most from the FBIs followed by chronic but stable challenging behaviors (level1), all of the three intensity levels resulted in large effect sizes. Fifth, it is necessary to explore the feasibility of implementing newer models of functional analysis (e.g., trial-based functional analysis) in different natural early childhood settings. Finally, Because early childhood practitioners had an active role in the implementation of the FBIs and more than half of the implemented FBIs were multi-components, it is necessary to ensure that the teachers have the knowledge and skills to effectively be involved in FBIs teams.

CHAPTER IV

CONCLUSION

Unfortunately, large number of young children between the ages 2 and 6 years engage in challenging behaviors that interfere with their learning and social emotional development (Powell et al., 2007). Without effective interventions these behaviors tend to increase in rate and severity and predict many negative outcomes that affect those young children's quality of life (Campbell, 1991). FBIs are a collection of strategies to improve behaviors; the FBIs are linked to the functional assessment of the behavior which helps in (a) understanding the function (purpose) of the behavior, (b) identify events that reliably predict the occurrence of the behavior, and (c) identify events that reliably maintain the behavior overtime (O'Neill et al., 1997). Moreover, a large body of research indicates that FBIs can reduce challenging behaviors effectively. Several literature reviews and meta-analyses have examined the effects of FBIs to reduce challenging behavior in general. However, none of these meta-analyses examined the effects of the FBIs specifically to address young children's challenging behaviors in early childhood settings nor did the reviews applied the WWC criteria to evaluate the quality of evidence. The two studies within this dissertation address this gap in the literature.

The first study reported the descriptive characteristics of the 24 included studies and examined the strength of evidence for FBIs using the WWC quality indicators and the CEC standards. The 24 studies included a total of 51 participants, the majority of the participants were reported to be male and with a disability. Furthermore, the FBIs were

implemented at a variety of educational settings, researchers and graduate students conducted the majority of the assessments to identify the function of the behavior, and early childhood practitioners either implemented or were involved in the implementation of the interventions. Regarding the strength of evidence, the FBIs met the criteria for evidence-based practices based on the WWC quality indicators and met the criteria for potentially evidence-based practices based on the CEC standards. Furthermore, limited number of studies reported: (a) participants' ethnicity, (b) socioeconomic status, (c) social-validity data, (d) maintenance, and (e) generalization data.

The second study examined the overall effects of the FBIs to address young children's challenging behavior and analyze the results across the following six potential moderators: (a) intensity of challenging behavior, (b) disability status, (c) FBA method, (d) function of the behavior, (e) type of the FBI used, (f) and the intervention agent. The overall effect size indicated that FBIs can effectively be used to reduce challenging behaviors in early childhood settings $\tau_u = 0.80$ ($SE = 0.03$, $CI_{84.3} [0.75-0.84]$). The effectiveness of the intervention were not related to the intensity of the challenging behavior, disability status, function of the behavior, and the intervention agent. FBIs might be more effective when combinations of direct and experimental methods are used to identify the function of the behavior and when multicomponent interventions are implemented. However, the large effect sizes obtained during moderator analyses might suggest that the FBIs can be used effectively regardless of the intensity of the challenging behaviors, the participant's disability status, functions of the behavior, and the intervention agent. Taken together, the two studies demonstrate that sufficient

evidence exist to support the implementation of FBIs to address challenging behaviors in early childhood settings.

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