The Pennsylvania State University

The Graduate School

College of Education

DO FUNCTIONAL BEHAVIORAL ASSESSMENTS IMPROVE INTERVENTION EFFECTIVENSS FOR STUDENTS WITH ADHD? A SINGLE-SUBJECT META-ANALYSIS

A Dissertation in

School Psychology

by

Faith G. Miller

Submitted in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

August 2011

The dissertation of Faith G. Miller was reviewed and approved* by the following:

David L. Lee
Associate Professor of Special Education
Dissertation Adviser
Co-Chair of Committee

Robert L. Hale
Professor of Educational and School Psychology
Co-Chair of Committee

James C. DiPerna
Associate Professor of School Psychology
Professor-in-Charge of School Psychology Program

Scott D. Gest
Associate Professor of Human Development and Family Studies

*Signatures are on file in the Graduate School.

Abstract

The primary purpose of this quantitative synthesis of single-subject research was to investigate the relative effectiveness of function-based and non-function-based behavioral interventions for students diagnosed with attention-deficit/hyperactivity disorder. In addition, associations between various participant, assessment, and intervention characteristics were investigated. Seventy studies incorporating a total of 150 participants were included. Because no single effect size metric has garnered absolute support to date, three different effect size metrics were calculated: percentage of non-overlapping data, percent exceeding the median baseline phase, and the standard mean difference. Overall, function-based interventions were associated with significantly larger effects than non-function-based interventions. Interventions based on functional analysis manipulations were also associated with larger effects. Variables such as the intervention agent, the level of intervention restrictiveness, and the purpose of the intervention were also associated with larger treatment effects. Although each effect size metric measured differing aspects of treatment effectiveness, moderate to large correlations were found between metrics. Limitations, directions for future research, and implications for practice are discussed.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Acknowledgements

First, I would like to thank my dissertation advisor and committee chair, Dr. David Lee, for his consistent support and guidance over the past 3 years. He made this project possible. I would also like to thank my co-chair, Dr. Robert Hale for his support on this project and throughout my graduate career. I would also like to thank the members of my committee, Dr. James DiPerna, and Dr. Scott Gest, for their valuable contributions to this project.

Next, I would like to thank the Penn State School Psychology Alumni for the grant that supported this research. To my husband, Robert Miller: words cannot express the gratitude I feel for helping make this all possible and supporting me in so many ways along this journey. Your enthusiasm, sense of humor, unwavering support, and belief in me kept me going. Finally, I would like to thank my friends and family for their support and encouragement along the way.

Chapter 1

Introduction

The importance of utilizing effective behavior management techniques in schools has grown in recent years. Increased instructional demands, such as those created by the No Child Left Behind Act (NCLB; 2002), have heightened the importance of developing methods to effectively manage student behavior in order to maintain environments conducive to student learning. Disruptive student behavior often takes away from valuable instructional time in the classroom (Warren et al., 2006). This is problematic, considering research has demonstrated that the amount of instructional time provided in the classroom is highly correlated with student achievement (Brophy, 1988).

According to a recent nationwide survey of teachers, 77% of respondents felt that they could deliver more effective instruction if they did not have to devote as much time managing disruptive student behaviors (Public Agenda, 2004). In addition to allowing for increased instructional time for all students, effective behavior management techniques may promote individual student achievement and learning. Students who exhibit disruptive behaviors are typically less engaged in instruction than their peers (Walker, Colvin, & Ramsey, 1995). Although research suggests the relationship between academic and behavior problems is complex (e.g., Sutherland, Lewis-Palmer, Stichter, & Morgan, 2008), by remediating student problem behaviors, student engagement may increase, thereby improving student achievement. As such, developing effective behavioral interventions in order to reduce occurrences of problem behavior is critical.

The field of applied behavior analysis has been especially influential in utilizing systematic behavior modification techniques to develop effective individualized behavior intervention plans to manage problem behavior. Many of these interventions aim not only to reduce inappropriate behaviors, but also concurrently teach appropriate behaviors. One of the main tenets of applied behavior analysis is that behavior occurs in response to environmental stimuli. As such, the focus of interventions based on these principles lies in restructuring the environment. In order to collect information regarding environmental variables that contribute to occurrences of problem behavior, functional behavioral assessments (FBAs) are typically conducted. These assessments aim to identify the purpose or underlying cause of behavior. Once the function is identified, interventions are subsequently developed on the basis of that function. In this regard, FBA techniques have long been considered a best practice for developing effective interventions (Gresham, Watson, & Skinner, 2001).

Functional behavioral assessments are designed to provide information regarding the environmental conditions that maintain problem behavior (O'Neill et al., 1997). Broadly, FBA has been defined as a set of procedures used to determine the environmental events that reliably and predictably maintain occurrences of problem behavior (O'Neill et al., 1997). As discussed previously, information obtained from FBAs is often used in the development of behavior intervention plans. However, not all interventions are based upon the results of FBAs. Only recently were these methods mandated under certain circumstances by federal legislation.

Federal legislation such as the Individuals with Disabilities Education Act (IDEA; 1997) has emphasized the importance of developing positive, function-based interventions

for students with disabilities. The Individuals with Disabilities Education Act (1997) requires that an FBA be conducted when a disciplinary change in placement occurs for a child with a disability. In addition, FBAs are also advised for students who exhibit disruptive behavior that interferes with their own learning or the learning of others. With the advent of Response to Intervention (RtI) and School-wide Positive Behavior Support (SWPBS) initiatives, evidence-based intervention implementation has become increasingly important. Functional behavioral assessments may assist in the development of empirically supported interventions for students who exhibit problem behavior.

Students with behavioral disorders exhibit frequently challenging and often disruptive behaviors. These students may require interventions that are specialized and individualized. That is, a categorical diagnostic label may do little to inform treatment (Neef & Northup, 2007). As a result, FBA techniques have been recommended for students with various disabilities. One behavioral disorder, attention-deficit/hyperactivity disorder (ADHD) is particularly of issue. Attention-deficit/hyperactivity disorder is currently one of the most prevalent disorders of childhood. Prevalence estimates range from three to seven percent in school-age children (American Psychiatric Association [APA], 2000). According to Bloom and Cohen (2007), in the year 2006, 4.5 million school-age children had a history of an ADHD diagnosis. Further, ADHD is a disorder characterized by chronic symptoms that typically persist into adolescence and adulthood. These symptoms include inattention, hyperactivity, and/or impulsivity. Students diagnosed with ADHD often experience a variety of negative outcomes including poor peer relationships, underachievement, and low self-esteem (Goldman, Genel, Bezman, & Slanetz, 1998). Given the high prevalence of ADHD

and the negative outcomes associated with this disorder, it is essential to develop effective interventions to improve outcomes for this population.

There are two main evidence-based approaches for managing the symptoms of inattention, hyperactivity, and impulsivity associated with ADHD: pharmacological approaches and behavioral approaches (Toplak, Connors, Shuster, Knezevic, & Parks, 2008). Although stimulant medication is generally regarded as very effective in reducing ADHD symptoms (MTA Cooperative Group, 1999), several limitations have been noted with a strictly pharmacological approach such as unresponsiveness to medication, poor adherence to medication regimens, and potential long-term adverse effects (Chronis, Jones, & Raggi, 2006). Furthermore, school personnel are not in the position to advise parents regarding medication decisions. Instead, school-based practitioners are better suited to manage ADHD symptoms using behavioral approaches to intervention. As such, behavioral approaches are another common and important method to manage symptoms associated with ADHD.

Although increasing evidence supports the biological bases of ADHD (Barkley et al., 2002), both behavioral and pharmacological interventions have been found to be effective in the treatment of ADHD symptoms (e.g., MTA Cooperative Group, 1999; Pelham et al., 2005). The biological basis of ADHD does not preclude the importance of developing effective methods to manage occurrences of problem behavior. For example, numerous researchers (e.g., DuPaul, Eckert, & McGoey, 1997; Neef & Northup, 2007) conceptualized ADHD symptoms as arising from the interaction between biological factors and environmental stimuli. That is, behavior does not occur in a vacuum; environmental factors

inevitably influence behavior. As such, behavioral interventions are often considered an important component of treatment for students diagnosed with ADHD.

Functional behavioral assessment techniques may prove especially useful in developing behavioral interventions for students with ADHD. In an influential article by DuPaul, Eckert, and McGoey (1997), the authors concluded, "one size does not fit all" in developing interventions for students diagnosed with ADHD (p. 369). Instead, the authors recommend a function-based approach to intervention development (DuPaul, Eckert, & McGoey, 1997). Subsequently, other researchers have recommended the use of FBA techniques in developing effective function-based interventions for students with ADHD (e.g., DuPaul, 2007; Neef & Northup, 2007; Zachor, Hodgens, & Patterson, 2009). However, questions remain as to whether or not FBA-based behavioral interventions are actually more effective than non-FBA-based behavioral interventions for students with ADHD. Recently, DuPaul (2007) remarked on the state of function-based behavioral interventions for students with ADHD:

> Presumably, an intervention that includes consequences matched to the function of behavior will be more effective than one designed through a trial-and-error approach. Although, in general, research findings in support of this critical assumption have been equivocal, several single-subject design studies that included students exhibiting ADHD symptoms have indicated the value of an assessment-based approach to intervention design. (p. 186)

As suggested by DuPaul (2007), conflicting evidence is prevalent regarding the utility of FBAs in developing behavioral interventions for students who exhibit problem behaviors. Some have argued that FBA techniques provide little treatment utility in the

development of behavioral interventions. For example, Gresham et al. (2004) conducted a single-subject meta-analysis of function-based and non-function-based behavioral interventions and found no significant differences between the two in regard to intervention effectiveness. However, this study did not examine the relative effectiveness of function-based and non-function-based interventions within certain disability categories such as ADHD. Other researchers have found function-based behavioral interventions to be more effective than non-function based interventions in single-subject design studies (e.g., Ingram, Lewis-Palmer, & Sugai, 2005; Murphy, 2007).

Given the conflicting evidence presented regarding the utility of FBA techniques in developing effective function-based behavioral interventions, more research is needed in order to determine the merits of such procedures. Conducting an FBA can be very time consuming and requires the use of trained professionals (Watson & Skinner, 2004). If FBAs do not improve the effectiveness of behavioral interventions, they may be an unnecessary and time-consuming step in intervention planning. In addition to the time and resources required to conduct an FBA, there may also be costs associated with the delayed intervention to the student. The time-consuming process of conducting an FBA may delay intervention provision, potentially resulting in the loss of valuable instructional time for the student and the class. It is important to determine if these methods improve intervention effectiveness or if they are an unnecessary and costly burden.

Furthermore, little research has examined the use of FBA procedures for individuals within specific disability categories (e.g., Gresham et al., 2004). Although there is a greater research base in regard to FBA use for students who engage in self-injurious behaviors and for individuals with developmental disabilities, little is known regarding the utility of FBA

techniques for developing behavioral interventions for students diagnosed with ADHD. This is problematic considering (a) the prevalence of this disorder and (b) the fact that FBA techniques are frequently recommended for developing interventions within this population.

As an advocated best practice to effective intervention development, it is important to ascertain whether or not these methods improve intervention effectiveness. By identifying the root cause of problem behaviors, FBA-based interventions should presumably be more effective than non-function-based interventions. Although many researchers assume that function-based interventions are more effective than non-function-based interventions, research has not confirmed this assumption. Empirical studies directly comparing the effectiveness of FBA-based interventions to non-FBA-based interventions are sparse. This is unfortunate, considering the amount of time and resources that are required to conduct an FBA. If non-function-based behavioral interventions are just as effective, omitting this step to intervention planning could save valuable time and resources, in addition to reducing valuable time that a student must wait to receive intervention.

Examining the utility of function-based interventions for students with ADHD is especially important for a number of reasons. First, ADHD is the most common behavioral disorder among school-age children. Second, the negative outcomes associated with this disorder underscore the importance of developing effective interventions. If students with ADHD can better manage their behavior, they may experience fewer discipline referrals and undergo a better educational experience. Third, the symptoms associated with ADHD can be very challenging for teachers to manage. Effective behavioral management techniques are essential to maintain environments conducive to student learning. Thus, it is important to know if FBA-based interventions are effective in managing the behavior of these students.

Given the mixed findings regarding the utility of FBA-based interventions in general, and the lack of existing research regarding FBA use for students with ADHD, this research looks to expand upon the current knowledge base by examining the effectiveness of function-based and non-function-based behavioral interventions for students diagnosed with ADHD. A meta-analysis was conducted of single-subject research studies that both include and exclude FBA procedures for developing behavior interventions for students diagnosed with ADHD. It should be noted that relatively few meta-analyses have included single-subject research designs in the study of behavioral treatments for ADHD. As such, the exclusion of single-subject research in the meta-analysis of effective treatments for ADHD has been labeled "problematic" (Pelham & Fabiano, 2008).

To address this oversight, this study synthesized the findings of single-subject research investigations in order to address the primary research question:

1. On average, are function-based behavioral interventions more effective than non-function-based behavioral interventions for students diagnosed with ADHD?

In addition to answering this primary question, this meta-analysis assists in answering several other important questions regarding FBA use for students diagnosed with ADHD. By coding research studies based on important participant, assessment, and intervention characteristics, it can be better understood how these variables moderate intervention effectiveness within this population. Specifically, this investigation addressed the following secondary research questions:

2. What variables (e.g., FBA type, function of behavior, length of intervention, etc.) influence intervention effectiveness within these studies?

3. What are the characteristics of effective interventions for students diagnosed with ADHD?
4. To what extent are various single-subject effect size metrics in agreement with each other?

Chapter 2

Literature Review

Disruptive Classroom Behavior

Disruptive classroom behavior remains one of the most problematic issues facing educators (Liaupsin & Scott, 2008). Issues related to classroom management and school discipline continue to be cited as primary educational concerns by the public (Rose & Gallup, 2005). According to the U.S. Department of Education, problem behavior "interferes with the educational process and places a burden on teachers" (U.S. Department of Education 2002, p. III-17). The frequency and severity of problem behaviors in school-age children is evident in a number of recent investigations. For example, in a national survey conducted in 2003, 2.7 million children aged 4–17 were reported by a parent to have severe emotional or behavioral difficulties (Federal Interagency Forum on Child and Family Statistics, 2005). Furthermore, according to a recent national survey, over three million students were suspended from school at least once during the 2006 school year (Planty et al., 2009). This is troublesome considering students who experience disciplinary problems are at-risk for a variety of negative outcomes including: increased dropout rates, grade retention, school failure, and delinquency (Walker, Colvin, & Ramsey, 1995). Research suggests that the majority of discipline referrals in schools are not due to violence, instead these referrals are more frequently made for disruptive classroom behavior (Skiba, Peterson, & Williams, 1997).

Disruptive student behavior often takes away from valuable instructional time in the classroom and impedes student learning (Adelman & Taylor, 2006; Walker, Ramsey &

Gresham, 2003; Warren et al., 2006). This is problematic, considering research has demonstrated that the amount of instructional time provided in the classroom is highly correlated with student achievement (Brophy, 1988). In an era that demands accountability for student learning and achievement (See NCLB, 2002), it is essential to promote environments conducive to student learning.

Effective behavior management techniques may be used to decrease occurrences of disruptive behavior and allow for increased instructional time in the classroom. For example, according to a recent nationwide survey of teachers, 77% of respondents felt that they could deliver more effective instruction if they did not have to devote as much time managing disruptive student behaviors (Public Agenda, 2004). Interestingly, the majority of disruptions are typically caused by only a few students in the classroom (Walker, Ramsey & Gresham, 2003). These students, who display frequently disruptive behaviors, may be diagnosed with emotional or behavioral disorders. Behavior disorders refer broadly to a group of disorders that are characterized by significant behavioral excesses or deficits (Gresham, 1991). Students with behavioral disorders exhibit frequently challenging and often disruptive behaviors. Although prevalence estimates vary considerably depending on the definition and methodology used, an estimated 5-16% of children in the United States have severe behavior problems (Bowen, Jensen, & Clark, 2004).

Attention-Deficit/Hyperactivity Disorder

Among those children with behavior problems, attention-deficit/hyperactivity disorder (ADHD) is the most prevalent disorder among school-age children (National Institute of Mental Health [NIMH], 2008). Prevalence estimates of ADHD range from 3-7%

in school-age children (APA, 2000). According to Bloom and Cohen (2007), in the year 2006, 4.5 million school-age children had a history of an ADHD diagnosis. Attention-deficit/hyperactivity disorder is diagnosed more often in males than females; with male-to-female prevalence ratios ranging from 2:1-9:1 depending on the subtype and setting examined (APA, 2000). Attention-deficit/hyperactivity disorder has also been found across various ethnic, racial, and socioeconomic groups (Barkley, 2003). As such, ADHD is not unique to certain subsections of the American population. It is a highly prevalent disorder across many demographics.

Attention-deficit/hyperactivity disorder is a neurobehavioral disorder characterized by persistent problems with inattention and/or hyperactivity-impulsivity (APA, 2000). According to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR; APA, 2000), ADHD is classified into three different subtypes, each with their own diagnostic criteria. These subtypes include: ADHD-primarily inattentive type, ADHD-primarily hyperactive-impulsive type, and ADHD-combined type. Examples of symptoms associated with ADHD are outlined in the DSM-IV-TR and include the following: (a) often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities, (b) often has difficulty sustaining attention in tasks or play activities, (c) often fidgets with hands or feet and squirms in seat, (d) often leaves seat in classroom or in other situations in which remaining in seat is expected, (e) often blurts out answers before questions have been completed, and (f) often has difficulty awaiting turn (APA, 2000). According to the diagnostic criteria outlined in the DSM-IV-TR, symptoms must also be present before age seven in order to substantiate a diagnosis of ADHD and the

magnitude of these symptoms must result in clinically significant impairment in social, academic, or occupational functioning.

Attention-deficit/hyperactivity disorder is a disorder characterized by chronic symptoms that typically persist into adolescence and adulthood (NIMH, 2008). In addition to the chronic nature of ADHD, individuals diagnosed with ADHD also frequently exhibit a number of comorbid psychiatric conditions such as tic disorders, conduct problems, and mood and anxiety disorders. The most frequently occurring comorbid diagnosis with ADHD is oppositional defiant disorder, followed by conduct disorder (Barkley, 2003). As a result, students with ADHD generally experience a variety of negative outcomes including poor peer relationships, higher rates of delinquency and substance abuse, low self-esteem, lower educational attainment, and educational underachievement (Goldman, Genel, Bezman, & Slanetz, 1998; Mannuzza & Klein, 2000).

In addition to these general negative outcomes, students with ADHD also experience a number of difficulties related to school functioning specifically. As suggested above, individuals diagnosed with ADHD differ from their peers in terms of cognitive and attentional processes. Because of these deficits in attentional processes, students with ADHD exhibit behavioral symptoms associated with the disorder. Several studies have examined differences in attention processes associated with ADHD. Specifically, research has examined the role of selective and sustained attention in children with ADHD. Selective attention is the ability to focus on relevant stimuli while ignoring irrelevant stimuli, whereas sustained attention is the ability to attend to a stimulus over time (Barry, Klinger, Lyman, Bush, & Hawkins, 2001). Some research suggests that children with ADHD differ from their peers only in regard to deficits in sustained attention (Barry et al., 2001; Chee, Logan,

Schachar, Lindsay, & Wachsmuth, 1989). Given the structure of schooling and the demands placed on sustained attention, it is likely that these deficits may contribute to difficulties in school functioning associated with ADHD. For example, deficits in sustained attention have been linked to grade retention (Gordon, Mettelman, & Irwin, 1994).

Difficulties related to school functioning are common issues for students with ADHD (see Loe & Feldman, 2007). The lack of attentional focus previously described may result in the decline of academic performance for students diagnosed with ADHD. Students with ADHD frequently exhibit poor academic performance in terms of failing grades, grade retentions, and lower scores on standardized achievement tests (Barbaresi, Katusic, Colligan, Weaver, & Jacobsen, 2007; Barkley, Fischer, Edelbrock, & Smallish, 1990; Biederman et al., 1996; Fergusson, Lynskey, & Horwood, 1997). In a recent meta-analysis, Frazier, Youngstrom, Glutting, and Watkins (2007) found moderate to large discrepancies in academic achievement between individuals diagnosed with ADHD and their peers.

Not only are children with ADHD at risk for a number of poor academic outcomes, but students with ADHD are also at greater risk for behavior and disciplinary problems as well. Substantial research suggests that children with ADHD frequently exhibit disruptive classroom behaviors and are at greater risk for school suspensions and expulsions (see Barkley, 2003). Elevated levels of hyperactivity and impulsivity associated with two subtypes of ADHD have the potential to disrupt the learning environment. These symptoms associated with ADHD typically interfere not only with the learning of the student diagnosed with ADHD but also the learning of other students in the classroom. Disruptive behaviors typically exhibited by students diagnosed with ADHD such as not following

directions, talking out of turn, fidgeting, and leaving the assigned area may disrupt student learning and detract from valuable instructional time in the classroom.

Given the academic and disciplinary problems typically associated with ADHD, the school environment may become aversive to these students. As a result, behavioral problems may become exacerbated. This can develop into a cyclical downward spiral in which ADHD symptoms lead to an aversive environment, which triggers behavior problems, which in turn leads to an aversive environment, and so on. Interventions, when implemented effectively, have the potential to break this cycle for students with ADHD and improve both short and long term outcomes. The number of negative outcomes associated with ADHD underscores the importance of developing effective interventions within this population.

Etiology of ADHD

Although the cause of ADHD is currently unknown, several prominent theories have been put forth. Although a comprehensive review of all available theories lies beyond the scope of this paper, it is important to understand how different theoretical approaches influence treatment approaches for this disorder. Johnson, Wiersema, and Kuntsi (2009) recently reviewed four major psychological theories of ADHD: executive dysfunction theory, state regulation theory, delay aversion theory, and dynamic developmental theory. A brief synopsis of their review is provided below.

According to executive dysfunction theory, symptoms associated with ADHD arise from deficits in executive control within the frontal cortex of the brain (Johnson et al., 2009). Within this framework, behavioral inhibition -or impulsivity, is thought to lead to deficits in executive functions such as working memory, internalization of speech, self-

regulation, and goal directed behavior (Barkley, 1997). Executive dysfunction theory helps explain many of the core deficits associated with ADHD. Unfortunately this theory is not well applied to individuals diagnosed with ADHD-primarily inattentive type. Furthermore, this theory has been criticized because it is (a) difficult to falsify and (b) it is difficult to define and test specific executive functions (Johnson et al., 2009).

State regulation theory posits that children with ADHD experience difficulty regulating an optimal state of activation (Johnson et al., 2009). That is, children with ADHD typically experience under-activation, resulting in increased symptoms. Contextual factors may influence activation levels and as such, this theory explains the variability sometimes associated with ADHD symptoms. Similarly, optimal stimulation theory holds that children with ADHD require higher amounts of stimulation and novelty in order to maintain a sufficient level of arousal or homeostasis (Zentall & Zentall, 1983). Thus, when under-stimulated, organisms seek out stimulation. Such is thought to be the case with ADHD. Theoretically, children with ADHD should behave similarly to their peers when an optimal state of activation has been researched, however according to Johnson et al. (2009), this has not been well-established by the literature.

Delay aversion theory accounts for motivational differences in individuals with ADHD. Within this framework, "children with ADHD are not impulsive in the sense of always opting for an immediate reward at the expense of overall rewards, but they do so only in circumstances where this leads to a shorter overall delay" (Johnson et al., 2009, "The Delay Aversion and Dual Pathway Theories" para. 1). Research suggests that children with ADHD tend to select smaller, immediate rewards more often than larger, delayed rewards (Sonuga-Barke, Taylor, Sembi, & Smith, 1992). As such, hyperactivity and impulsivity arise

from an attempt to avert delay. More recently, delay aversion theory has been reconceptualized as a dual pathway theory, reflecting both delay aversion and behavioral inhibition (Johnson et al., 2009). However, as suggested above, the focus of this theory is on impulsivity and is not well applied to ADHD-primarily inattentive type (Johnson et al., 2009).

Lastly, dynamic developmental theory holds that the primary problems in ADHD arise from variations in reinforcement and extinction processes (Johnson et al., 2009). Developed by Sagvolden, Johansen, Aase, and Russell (2004), this comprehensive theory has garnered support through both neuropsychological findings as well as behavioral observations. For example, research suggests that children with ADHD respond to reinforcement differently than typical children (e.g., Luman, Oosterlaan, & Sergeant, 2005; Johansen et al., 2009). Haenlein and Caul (1987) posit that children diagnosed with ADHD have an elevated reward threshold and subsequently require higher rates of reinforcement. Dynamic developmental theory offers a promising approach to understanding all three subtypes of ADHD (Johnson et al., 2009).

Each theoretical perspective offers different insight into the nature of ADHD. Because no one theory has garnered absolute support to date, each one provides plausible explanations regarding the causal factors and developmental course of ADHD. From these different perspectives and theories arise multiple approaches to intervention. That is, the theoretical approach espoused inevitably influences treatment selection. For example, theorists that emphasize contextual factors (such as those outlined in state regulation, delay aversion, and dynamic developmental theories) will similarly target contextual factors in treatment. Conversely, it is likely that theorists who emphasize biological factors (such as

executive dysfunction theory) will likely take a pharmacological approach to treatment. For example, stimulant medication is thought to improve executive functions (Swanson, 2003). Each theory has contributed to the development of different treatments for ADHD. A more detailed discussion of evidence-based approaches to intervention for students with ADHD will follow.

Evidence-Based Interventions for Students with ADHD

Given the high prevalence of ADHD and the negative outcomes associated with this disorder, it is essential to develop effective interventions to improve outcomes for this population. Attention-deficit/hyperactivity disorder is currently one of the most widely studied disorders of childhood. A substantial number of research studies and resulting meta-analyses have shed light on effective treatments for children diagnosed with ADHD.

Approaches to treating symptoms associated with ADHD can be dichotomized into two broad categories: pharmacological and behavioral. Both approaches have garnered a great deal of empirical support over the years. In one of the largest ADHD treatment studies conducted, the Multimodal Treatment Study of Children with ADHD (MTA Cooperative Group, 1999) examined the effectiveness of pharmacological and behavioral approaches to treatment. Results indicated that, over 14 months of treatment, a pharmacological approach was generally more effective than a behavioral approach to treatment. A discussion of the relative merits of each approach will follow.

Pharmacological interventions.

A pharmacological approach to treating ADHD involves the use of stimulant or non-stimulant medication in order to manage symptoms and improve functioning. The use of

medication in treating ADHD has been studied extensively and has found to be a highly effective means of increasing on-task behavior and reducing classroom disruptions (Chronis, Jones, & Raggi, 2006). In fact, stimulant medication is the most common method for treating problem behaviors associated with ADHD (DuPaul & Stoner, 2003).

Although stimulant medication is generally regarded as very effective in reducing ADHD symptoms, there are several important limitations associated with this approach to treatment. First, medication use may result in the development of undesirable side effects such as insomnia, loss of appetite, and the development of tics (NIMH, 2008). Second, although stimulant medication improves attention, behavior, and academic productivity on a short-term basis, long-term effects are not well supported (DuPaul & Stoner, 2003). For example, stimulant medication has not been found to lead to positive gains in academic achievement (Swanson et al., 1993). Third, research has shown poor adherence to medication regimens for children with ADHD. For example, Perwien, Hall, Swensen, and Swindle (2004) found that 84% of children were not compliant with their medication regiment after 2 months. Lastly, research suggests that there may be potential long-term adverse effects associated with a pharmacological approach to treatment, such as decreased weight and growth rates (e.g., Faraone, Biederman, Morley, & Spencer, 2008; Swanson et al., 2007).

In addition to the above limitations, there is one additional caveat regarding the use of medication in the treatment of ADHD in school-age children. That is, school personnel are not in the position to advise parents regarding medication decisions. Advising parents in this manner extends beyond the scope of competence for most school personnel and is ill-advised as this may constitute practicing medicine without a license (Shaw, Clayton, Dodd,

& Rigby, 2004). Instead, school-based practitioners are better suited to manage ADHD symptoms using behavioral approaches to intervention. Behavioral interventions are also a better fit for classrooms as they aim to explicitly teach students appropriate behavior. As such, behavioral approaches are another common and important method to manage symptoms associated with ADHD.

Behavioral interventions.

According to recently published meta-analyses, behavioral interventions are highly effective in the treatment of students diagnosed with ADHD (Fabiano et al., 2009; Pelham & Fabiano, 2008). These findings are not new; in 1997 DuPaul and Eckert performed a seminal meta-analysis of school-based interventions for students diagnosed with ADHD. The authors found moderate to high effects of behavioral interventions. Although ADHD is thought to be a neurobiological disorder, ADHD symptoms are thought to arise from a complex interaction between biological and environmental factors (DuPaul, Eckert, & McGoey, 1997). As such, behavioral interventions aim to modify environmental conditions in order to improve the functioning of students with ADHD.

Behavioral interventions are typically rooted in the principles of applied behavior analysis (ABA). Cooper, Heron, and Heward (2007) define ABA as "the science in which procedures derived from the principles of behavior are systematically applied to improve socially significant behavior to a meaningful degree and to demonstrate experimentally that the procedures employed were responsible for the improvement in behavior" (p. 14). Based upon the work of B.F. Skinner in the 1950s, ABA involves the scientific study of behavior. Specifically, ABA is primarily concerned with the relationship between environmental

events and occurrences of behavior. Within this framework, behavior arises in response to environmental stimuli. As such, the focus of intervention lies within the environment, as opposed to within the child. The basic principles of ABA include reinforcement, punishment, extinction, and stimulus control among others.

Using the principles of ABA, environmental conditions are changed in order to modify student behavior in a desirable way. These interventions may focus on manipulating environmental antecedents that trigger behavior and/or consequences that follow behavior. Consequence-based interventions, known as contingency management techniques, are thought to be most influential in changing the behavior of students with ADHD (Zachor, Hodgens, & Patterson, 2008). In fact, Pelham, Wheeler, and Chronis (1998) found that classroom contingency management techniques for children with ADHD have a strong evidence-base and concluded that these techniques are well-established treatments.

Several specific intervention approaches fall under the category of contingency management; these include (but are not limited to) token economies, response cost, and time out from reinforcement. Token economies are motivational systems that provide immediate reinforcement, such as tokens or points, contingent upon occurrences of desirable behaviors, which can later be exchanged for rewards (Ayllon, 1999). Token economies have been found to be an effective technique to manage student behaviors associated with ADHD (DuPaul, 2007). Response cost involves the removal of tokens or privileges contingent upon occurrences of negative behaviors. DuPaul, Guevremont, and Barkley (1992) found that, when used in conjunction with positive approaches, response cost was an effective means for managing the behavior of students diagnosed with ADHD. As the name implies, time out from reinforcement involves removing the student from reinforcing situations (i.e., either

moving by them to another place in the classroom or making them ineligible for reinforcement) for a set period of time. Time-out procedures have also been found to effectively reduce problem behaviors for students with ADHD (Kapalka & Bryk, 2007). Research suggests that students diagnosed with ADHD may require more powerful contingencies in order to promote behavior change (Barkley, 1998), and the interventions outlined above may be an important means for doing so.

In addition to these specific behavioral interventions, other behavioral strategies may be used to decrease occurrences of problem behavior. Abramowitz and O'Leary (1991) reviewed several additional effective contingency management techniques for students diagnosed with ADHD including contingent teacher attention (both positive and negative), group contingencies, and differential reinforcement procedures. However, as previously noted, contingency management approaches are not the only methods developed to reduce problem behaviors. Antecedent approaches may also be an effective means for reducing problem behavior associated with ADHD. Antecedent approaches to intervention typically involve manipulating the task or environmental events that precede problem behaviors (Abramowitz & O'Leary, 1991). For example, Zentall and colleagues found that increased task stimulation may "normalize" the behavior of hyperactive children (Zentall, 1986; Zentall & Dwyer, 1989; Zentall & Zentall, 1983). Other antecedent approaches, such as classroom seating, have also been investigated for students with ADHD (Schilling, Washington, Billingsley, & Deitz, 2003). Although antecedent approaches have been studied less frequently than consequence approaches, they may also be an effective means for reducing problem behaviors associated with ADHD.

As suggested by the preceding discussion, there are many different behavioral interventions that may be effective in managing the behavior of students diagnosed with ADHD. Techniques have been developed in order to assist in the selection of a particular intervention. Sometimes referred to as functional assessments or functional behavioral assessments (these terms are often used interchangeably), these methods may be used in order to inform intervention selection and planning.

Designing Behavioral Interventions: Functional Behavioral Assessments

Including FBAs in intervention development has long been considered a best practice (Gresham, Watson, & Skinner, 2001). The purpose of conducting an FBA is to better understand the environmental conditions that maintain problem behavior. As the term suggests, the underlying premise of FBA is that all behavior, both appropriate and inappropriate, serves some function to an organism. According to Carr (1994), there are four primary functions of behavior: (a) attention seeking, (b) escape or avoidance, (c) sensory reinforcement, and (d) access to tangible events. Other authors have further condensed these functions into two primary functions: (a) to gain something or (b) to avoid or escape something (O'Neill et al., 1997). Gain functions include teacher/peer attention, tangible reinforcement, and stimulation. Conversely, avoid/escape functions include teacher/peer attention and aversive tasks or demands.

The goal of conducting an FBA is to understand the function – or purpose – of problem behavior. In addition, conducting an FBA provides information regarding environmental events such as antecedents and consequences that contribute to occurrences

of problem behavior. It is within this framework that FBA is used in individualized intervention development and planning.

Before providing a discussion of the particulars involved in conducting an FBA, it is important to first clarify the key terms involved. There has been some confusion in the use of terms such as "functional assessment," "functional behavioral assessment," and "functional analysis," and the elements included in each (Ervin, Ehrardt, & Poling, 2001). As discussed previously, the terms "functional assessment" and "functional behavioral assessment" are often used interchangeably. Broadly, functional behavioral assessment (FBA) is defined as "a process for gathering information that can be used to maximize the effectiveness and efficiency of behavioral support" (O'Neill et al., 1997, p. 3). More detailed and specific definitions have been developed that elaborate further on this process. For example, Ervin, Ehrhardt, and Poling (2001) describe FBA as "relating external conditions to specific behaviors so as to allow that behaviors to be predicted and controlled…[it] reveals antecedent variables and consequences that control the behavior of interest, and this information is used to develop interventions that change behavior in a desired way" (p. 173). Northup and Gulley (2001) put forth a slightly different definition of FBA: "a range of general assessment methods (e.g., questionnaires, rating scales) used to describe and formulate hypotheses regarding variables that may control behavior" (p. 228). Although each definition offers a slightly different perspective, they all reflect the primary goal of FBA: to understand why behavior occurs. Within this framework problem behavior may serve different purposes across different individuals and settings. Functional behavioral assessments allow for the development of individualized interventions that address the function of an individual's behavior.

Various methods may be used in conducting an FBA as there is no agreed upon procedure (or set of procedures) for doing so (Scott, Meers, & Nelson, 2000). Typically, the process involved in conducting an FBA utilizes some combination of descriptive analysis techniques and/or experimental techniques (Quinn et al., 2001). A descriptive analysis may include direct and/or indirect methods. Direct methods include data obtained through observations, while indirect methods include interviews and/or rating forms. Functional analysis (FA) involves the experimental manipulation of environmental conditions so as to evoke problem behaviors and thus identify the function of the behavior. While both FBA and FA seek to identify the function of behavior, the term FBA is typically used to describe descriptive analyses while FA is specifically used to describe experimental manipulations (Northup & Gulley, 2001). As such, an FBA may or may not include a FA, as typically FAs are performed when the function of the behavior is unclear based on results of an FBA (O'Neill et al., 1997). There are strengths and weakness associated with both FBA and FA. That is, descriptive analysis methods are typically less time consuming than FA methods, but are also less accurate at identifying the function of behavior (O'Neill et al., 1997).

O'Neill et al. (1997) identified five primary outcomes of FBA: (a) development of a clear description of the problem behaviors, (b) identification of environmental events or characteristics that predict both occurrences and non-occurrences of problem behavior (c) identification of the function of behavior (d) development of hypotheses about the events and conditions surrounding the problem behavior, and (f) collection of observational data that support the hypotheses. Information obtained from FBAs is then used to develop individualized interventions based on the presumed function of the behavior. That is, once the function is identified, using either experimental or non-experimental means, an

intervention is developed on the basis of that function. These interventions are designed to make the problem behavior ineffective, inefficient, or irrelevant (O'Neill et al., 1997). The perceived value of utilizing FBA techniques in intervention planning is evidenced by its inclusion in the Individuals with Disabilities Education Act (IDEA; 1997). Under IDEA (1997), an FBA must be conducted when a long-term disciplinary change in placement occurs for a child with a disability (i.e., a suspension of 10 days or more) in order to build a behavior intervention plan. However, there are other circumstances for which FBAs are recommended, such as for students who exhibit disruptive behavior that interferes with their own learning or the learning of others (IDEA, 1997). Yet, IDEA (1997) does not specify procedures for how to conduct school-based FBAs, and some contend their inclusion in public policy was premature (Nelson, Mathur, & Rutherford, 1999). Because IDEA (1997) does not articulate how FBAs should be performed, there is often great variability in the methods used in conducting FBAs (Nusz, 2009).

It should also be noted that not all behavioral interventions utilize FBA techniques in intervention planning – many do not. FBA techniques are often time consuming and typically require specialized personnel to complete. O'Neill et al. (1997) recommend that FBAs should be conducted for a *minimum* of 2-5 days, until clear functional patterns emerge in the data. Quinn and colleagues (2001) estimated the time needed to complete an FBA ranged from a week to 30 days. Furthermore, there are several major gaps in the literature pertaining to the use of FBAs in schools related to students with high incidence disabilities (Quinn et al., 2001). Conversely, non-function-based interventions have been criticized because (a) they may inadvertently reinforce the problem behavior, (b) they may be

irrelevant to the function, and (c) the intervention may not reinforce alternative appropriate behaviors (Neef & Northup, 2007).

According to Newcomer and Lewis (2004), "the value of functional assessment has rested on the *assumption* that treatment effectiveness increases if the treatment matches the function of the target behavior" (p. 168). A growing body of research has examined the utility of FBAs in improving intervention effectiveness, based on the differing perspectives presented above. These studies consist predominately of single-subject designs and meta-analyses. A review and critique of this research will follow.

Prior Research on FBAs

Some controversy exists as to whether or not FBA techniques improve the effectiveness of interventions. A growing body of research has investigated the effectiveness of function-based and non-function-based behavioral interventions. Conflicting evidence can be found in the literature that both supports and opposes the utility of FBAs in promoting intervention effectiveness.

Support for function-based interventions primarily comes from single-subject research studies. That is, findings from single-subject investigations seem to support the use of FBAs in developing effective interventions. Early investigations of FBAs demonstrated their utility in intervention planning primarily for individuals with severe disabilities and for individuals exhibiting self-injurious behaviors (e.g., Carr, 1977; Carr, Newsome, & Binkoff, 1980; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). However, an emerging body of literature supports the utility of FBAs in intervention planning for individuals with high incidence disabilities as well (e.g., Blair, Umbreit, & Bos, 1999; Dunlap, White, Vera,

Wilson, & Panacek, 1996; Kern, Delaney, Clarke, Dunlap, & Childs, 2001; Smith & Sugai, 2000; Wright-Gallo, Higbee, Reagon, & Davey, 2006). However, relatively few studies have directly compared the effectiveness of function-based and non-function-based behavioral interventions.

An increasing number of small *N* and single-subject design studies have compared the effectiveness of function-based and non-function-based behavioral interventions and found function-based interventions to be superior to non-function-based interventions (e.g., Ellingson, Miltenberger, Stricker, Galensky, & Garlinghouse, 2000; Filter & Horner, 2009; Ingram, Palmer, & Sugai, 2005; Meyer, 1999; Murphy, 2007; Newcomer & Lewis, 2004; Repp, Felce, & Barton, 1988; Taylor & Miller, 1997; Schill, Kratochwill, & Elliott, 1998). However, several meta-analyses have yielded conflicting findings. Stage and Quiroz (1997) performed a meta-analysis of interventions designed to reduce disruptive classroom behavior. Their meta-analysis included 99 studies that included both group designs and single-subject designs. Results from the meta-analysis indicated that interventions based on functional assessments were less effective than non-function-based group contingency management interventions. Interestingly, these results were derived from only 11 effect sizes from four functional assessment single-subject design studies, while group contingency interventions consisted of 25 effect sizes. Thus, these differences could be due, in part, to differences in sample sizes between groups.

Similarly, Gresham et al. (2004) conducted a meta-analysis of 150 school-based, single-subject behavioral intervention studies in order to determine the effectiveness of interventions based on FBAs compared to those that did not incorporate FBAs in intervention planning. The researchers found that function-based interventions were no more

effective than non-function based interventions. Findings from these meta-analyses call into question the utility of FBAs in intervention development. However, it is important to note that neither of these investigations examined the relative effectiveness of function-based interventions among various disability categories.

A small number of single-subject meta-analyses have examined the effectiveness of function-based interventions for students diagnosed with various disabilities. Campbell (2003) found that, for individuals with autism, interventions that included FBAs were more effective than those that did not. Furthermore, he found that experimental functional analyses resulted in more effective interventions than descriptive assessments. Similarly, Didden, Korzilius, van Ooorsouw, and Sturmey (2006) found that, for individuals with mild mental retardation, FBA-based interventions were more effective than non-FBA-based interventions. In line with the findings of Campbell (2003), the researchers also found that experimental functional analyses resulted in more effective interventions than descriptive assessments.

Vegas (2005) performed a meta-analysis of single-subject design studies and investigated the effectiveness of FBA-based behavioral interventions for various disability categories. However, this investigation did not compare the relative effectiveness of function-based interventions to non-function based interventions. Instead, it investigated the magnitude of effects of FBA-based interventions among various disability categories. Results of this analysis suggested that function-based interventions were effective in reducing problem behavior among individuals with various disabilities, including ADHD. For individuals diagnosed with ADHD, moderate to large effects were found for function-based behavioral interventions (depending on the effect size metric used).

Together, these studies provide compelling evidence that function-based behavioral interventions are effective. However, while there is evidence to suggest that FBAs improve intervention effectiveness for individuals diagnosed with autism and mild mental retardation, it is unclear whether these findings will hold true for students diagnosed with ADHD. Vegas (2005) found FBA-based interventions to be effective for students diagnosed with ADHD. Yet, it remains unclear whether FBA-based interventions are more effective than non-FBA-based interventions within this population. To date, no single-subject meta-analysis has been performed examining the relative effectiveness of FBA-based interventions to non-FBA-based interventions for students diagnosed with ADHD. Still, a growing number of single-subject studies have been performed that seem to support their use.

Functional Behavioral Assessments for Students with ADHD

A function-based approach to intervention development is frequently advocated for students with ADHD (e.g., DuPaul, 2007; DuPaul & Ervin, 1996; DuPaul & Stoner, 2003; Neef & Northup, 2007; Northup & Gulley, 2001; Pelham & Fabiano, 2008; Reid & Maag, 1998; Zachor, Hodgens, & Patterson, 2009). Although increasing evidence supports the neurobiological bases of ADHD, it should be noted this does not preclude the importance of developing effective methods to manage occurrences of problem behavior. As noted by Neef and Northup (2007):

> A functional approach to ADHD is not necessarily inconsistent with this assumption, as a functional approach makes no assumptions concerning etiology. Rather, the model suggests that many problem behaviors associated with ADHD may not be due

> to biological factors alone, but rather may be due to an interaction between a child's biological characteristics and specific environmental events. (pp. 89-90)

In fact, FBAs have been recommended as a best practice in developing interventions for students with ADHD (Hoff, Doepke, & Landau, 2002). In line with these recommendations, a number of single-subject investigations have examined the effectiveness of function-based interventions within this population.

A growing body of research supports the effectiveness of interventions based on the results of FBAs for students diagnosed with ADHD (e.g., Boyajian, DuPaul, Handler, Eckert, & McGoey, 2001; Edwards, Magee, & Ellis, 2002; Ervin, DuPaul, Kern, & Friman, 1998; Ervin, Kern, Clarke, DuPaul, Dunlap, & Friman, 2000; Flood & Wilder, 2002; Northup et al., 1995; Reitman & Passeri, 2008; Stahr, Cushing, Lane, & Fox 2006; Umbreit, 1995). However, no attempt has been made to synthesize this research in order to examine the effectiveness of function-based interventions relative to non-function-based interventions for students diagnosed with ADHD. This is problematic considering the amount of time and resources required to conduct an FBA. The time taken to complete an FBA may take away from valuable intervention time and increase the amount of time a student must wait to receive intervention. Nelson, Mathur, and Rutherford (1999) contend that, if non-function-based interventions are of comparable effectiveness, FBAs will have been "an unfortunate detour in special education" (p.173). Given the prevalence of ADHD in schools and the poor outcomes associated with this disorder, it is important to know if FBA-based interventions are more effective in managing the behavior of these students.

As previously noted, using FBAs in intervention development is an advocated best practice. As such, it is important to ascertain whether or not these methods improve

intervention effectiveness. Although a number of single-subject studies support the effectiveness of function-based interventions for students with ADHD, no comparison has been made to the effectiveness of non-function-based interventions within this population. It is through the accumulation of research that evidence-based practices can be established. One method for making this determination is to synthesize existing studies utilizing function-based and non-function-based interventions for students diagnosed with ADHD. Meta-analytic techniques provide a useful means for doing so.

The Importance of Meta-Analytic Research

The term meta-analysis was coined by Glass (1976) to describe "an analysis of analyses…the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings" (p. 3). Meta-analyses are conceptualized and conducted in a method parallel to typical research studies. That is, a research question is developed, data are collected and analyzed, and those data are interpreted and conclusions are drawn- only the unit of measurement is typically at the study level, as opposed to the participant level. Meta-analytic research is essential in determining evidence-based practices- "rarely do single experiments or studies provide sufficiently definitive answers upon which to base policy" (Hedges & Olkin, 1982, as cited by Wolf, 1986, p. 9). As a result, the popularity of meta-analytic research has gown with each passing year (Cooper & Hedges, 2009).

Meta-analyses are useful in a number of ways. Rosenthal and DiMatteo (2001) delineated several advantages to conducting meta-analyses, including: assessing the "landscape" of relevant research, preventing over-reliance on statistical significance testing,

maximizing the use of data, developing "intimacy" with the data, developing precise and focused hypotheses, and identifying moderator variables. In their review, the authors also cited several criticisms of meta-analyses, including: biased sampling, "garbage in, garbage out" issues, potential non-independence of effects, over-emphasis on individual effects, and perceived issues in combining results from diverse studies (i.e., the "apples and oranges" argument). Despite these criticisms, meta-analysis remains an important method toward developing a cumulative knowledge base. As articulated by Schmidt (1992):

> Today, many discoveries and advances in cumulative knowledge are being made not by those who do primary research studies, but by those who use meta-analysis to discover the latent meaning of existing literatures. It is possible…to make major original discoveries and contributions without conducting primary research studies simply by mining the information in accumulated research literatures. (p. 1179)

Although there are many different procedures for conducting meta-analyses, the general process is the same. Rosenthal and DiMatteo (2001) identified six basic steps in conducting a meta-analysis. These include:

1. Defining dependent and independent variables.
2. Conducting a systematic search of relevant literature and calculating effect sizes from each study.
3. Assessing the variability among the obtained effect sizes, keeping moderating variables in mind.
4. Combining the effect sizes using measures of central tendency.
5. Examining the significance levels of the obtained measures of central tendency.
6. Utilizing graphs and other tools to examine the distribution of effect sizes.

These steps provide a basic framework for understanding the general process of meta-analytic research. Because the goal is to quantify the results of numerous studies, a common outcome metric, called an effect size (ES), is a necessary component in the quantitative synthesis of studies. A traditional ES metric developed by Glass (1976), the standardized mean difference (*d*), is often used for this purpose. The standardized mean difference can be expressed as:

$$d = \frac{M_t - M_c}{S_c}$$

Where the mean of the treatment group is subtracted by the mean of the control group and divided by the standard deviation of the control group. However depending on the nature of the data, a variety of different effect size metrics may be employed (Hedges & Olkin, 1985).

In addition to the steps provided above, three main guiding principles have also been put forth in conducting meta-analyses: accuracy, simplicity, and clarity (Hall & Rosenthal, 1995). Although the amount of data collected from studies may be somewhat cumbersome to manage, meta-analyses should remain as simple and straightforward as possible in order to avoid becoming overly convoluted (Rosenthal & DiMatteo, 2001). That is, the goal of any statistical analysis is parsimony, and meta-analyses are no exception to this rule.

Meta-Analysis of Single-Subject Research

Historically, the majority of meta-analyses have been performed using group studies. However, the notion of conducting meta-analyses of single-subject research is not all that new. Discussions emerged in the 1970s regarding the synthesis of data from single-subject research methodologies (e.g., Shine & Bower, 1971). Interestingly, the practice of single-subject meta-analysis is relatively new to the fields of psychology and education. In fact,

Shadish and Rindskopf (2007) found only 24 published single-subject meta-analyses in the past three decades, compared to thousands of traditional meta-analyses. Although it is likely that more single-subject meta-analyses have been conducted in a field such as medicine, these investigations remain relatively sparse in the fields of psychology and education.

The fact that single-subject meta-analyses have been relatively few in number is unfortunate, considering (a) the strength of single-subject designs, (b) the dramatic increase in studies employing single-case designs, and (c) the need to establish evidence-based practices (Schlosser & Sigafoos, 2008; Scruggs & Mastropieri, 1998; Shadish, Rindskopf, & Hedges, 2008). However, interest in single-subject meta-analytic techniques is quickly escalating in psychological research (e.g., Beretvas & Chung, 2008; Jenson, Clark, Kircher, & Kristjansson, 2007; Ma, 2006; Parker, Hagen-Burke, & Vannest, 2007; Shadish & Rindskopf, 2007; Van den Noortgate & Onghena, 2003). An increasing number of researchers are performing single-subject meta-analyses or investigating techniques for doing so. In a descriptive review of recent single-subject meta-analyses, topics of investigation were diverse, ranging from writing interventions (Rogers & Graham, 2008) to studies of aphasia (Beeson & Robey, 2006). The size of single-subject meta-analyses also varies considerably. One included as few as nine studies (i.e., Beto, & Bansal, 1992) while another included over 400 (i.e., Scotti, Evans, Meyer, & Walker, 1991). The size of the meta-analysis conducted clearly varies as a function of the literature-base on a certain topic.

As with most novel concepts, the idea of single-subject meta-analysis was initially met with both praise and skepticism. Over the years, as a more solid research base has been established, growing numbers of researchers now advocate the use of single-subject meta-analysis in determining evidence-based practices. According to Schlosser (2005), “while

there is still some debate about what ‘effect size’ is most appropriate, the question of whether or not to synthesize single-subject experimental designs using meta-analytic techniques is no longer in question.” (p. 376).

As suggested by Schlosser (2005), there is little agreement among researchers regarding how to best synthesize information via single-subject meta-analyses. Some contention has arisen among researchers regarding the various methods employed in single-subject meta-analyses (e.g., Allison & Gorman, 1994; Scruggs & Mastropieri, 1994). The lack of agreement in this area is still echoed by other researchers. Recently, Beretvas and Chung (2008) wrote, "There is still no consensus concerning how best to summarize results from single-subject experimental design studies" (p. 129).

Part of the reason why there is so much disagreement in regard to single-subject meta-analyses is because single-subject data are not typically subjected to statistical analyses. The traditional method of data analysis for single-subject research has been visual analysis of graphed data (Parsonson & Baer, 1992). That is, researchers typically graph the data and visually examine differences between baseline and treatment phases in terms of level and trend. Kazdin (1982) remarked that visual inspection “would seem to permit, if not actively encourage, subjectivity and inconsistency in the evaluation of intervention effects” (p. 239). Furthermore, this approach does not allow for the quantitative synthesis of data across research studies. As a result, statistical methods have been advocated as an alternative to visual inspection, although there is little consensus on which method is preferable (Kazdin, 1982).

The nature of time-series data makes them difficult to analyze using traditional statistical methods. Single-subject research is typically conducted using time-series methods,

recording occurrences of behavior over short periods of time (e.g., off-task behavior). These designs may take several forms, the most basic of which is an AB design where the A phase represents the baseline (or no treatment) phase and B represents the intervention phase. Other variations of this design include ABA, ABAB, alternating treatments, multiple treatments, and multiple baseline designs. Data obtained from time-series designs: (a) are not independent of one another and are often autocorrelated, (b) typically have a relatively small number of data points within phases, (c) often have trend present in the data, and (d) are unlikely to form a normal distribution (Shadish & Rindskopf, 2007). Because of these complexities, statistical analysis of time-series data can be difficult. Kazdin (1982) outlined several different methods to statistically analyze data obtained from single-subject designs, including: conventional *t* and *F* tests, time-series analyses, an R_n ranking test, randomization tests, and the split-middle technique. However, none of these methods fully resolve all of the issues presented above, and no one method has garnered absolute support.

Because single-subject, time-series data are difficult to analyze statistically, they is also difficult to synthesize. As discussed previously, ESs must be calculated in order to synthesize information across studies. The majority of ESs that have been developed for meta-analyses are designed for use with group design studies. In order to calculate these ESs, data must be obtained from a control group and a treatment group; these are lacking in single-subject research. As a result, different ES metrics are required in conducting single-subject meta-analyses. A number of different methods and ES metrics have been proposed in synthesizing data from single-subject designs.

Approaches to Single-Subject Meta-Analyses

Various methods have been proposed in performing single-subject meta-analyses (for a review, see Shadish & Rindskopf, 2007). Presently, there is no consensus regarding how to best conduct single-subject meta-analyses (Beretvas & Chung, 2008). As such, a perusal of previously conducted single-subject meta-analyses reveals a wide array of diverse methods. Broadly, these approaches can be dichotomized into two groups: parametric approaches and non-parametric approaches. Parametric approaches (such as regression analyses) are difficult to perform with time-series data because many of the necessary assumptions cannot be met (Ma, 2006). As discussed previously, assumptions such as normality, homogeneity of variance, and independence of observations are typically not met using time-series data. Additionally, the small number of data points per phase can make regression estimates unreliable. For example, Huitema (1985) found that the modal number of data points within each phase was 3-4 in his review of experiments published in the *Journal of Applied Behavior Analysis.* Conducting regression-based analysis in the presence of so few data points is problematic. Interestingly, Campbell (2004) recently determined that regression-based methods were not superior to non-regression methods in conducting single-subject meta-analyses.

An emerging area of interest has been in the use of multi-level models in performing single-subject meta-analyses. Multi-level models are advantageous above traditional regression approaches because they do not require the same number of observations over time (Shadish & Rindskopf, 2007). However, these methods are still in their infancy and little research has been conducted in utilizing these techniques to synthesize research across studies. According to Shadish, Rindskopf, and Hedges (2008), "…we have only taken a few

steps on the long journey of developing these models and understanding their strengths and weaknesses" (p. 191). These promising methods to single-subject meta-analyses require further development and still need to be refined. Because much remains unknown regarding the use of multi-level models for this purpose, alternative methods to single-subject meta-analyses should continue to be explored. As a result, many researchers have turned to non-parametric approaches.

One of the most popular methods of conducting single-subject meta-analyses is to use the percentage of non-overlapping data (PND). Developed by Scruggs, Mastropieri, and Casto (1987), PND is calculated by determining the percentage of treatment data points that do not overlap with the lowest (in cases of maladaptive behavior) or highest (in cases of adaptive behavior) baseline data point (see Figure 1).

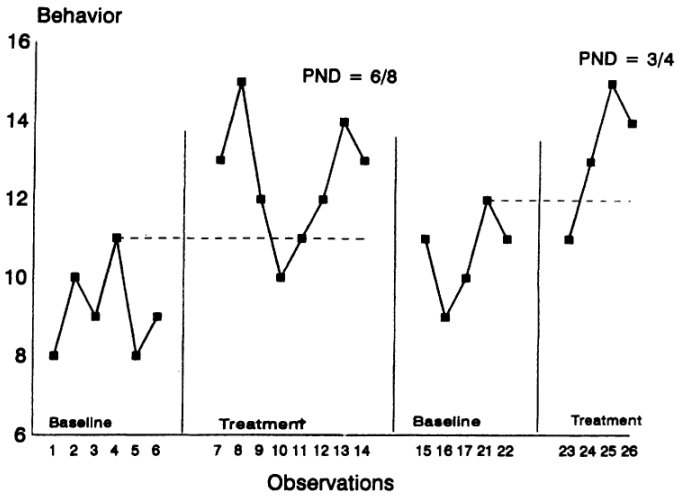

Figure 1. Reprinted from "Summarizing Single-Subject Research: Issues and Applications," by T. E. Scruggs and M. A. Mastropieri, 1998, *Behavior Modification, 22,* p. 224. Copyright 1998 by Sage Publications, Inc. Reprinted with permission.

There are several advantages to using PND as an effect size metric for single-subject meta-analyses: it does not require the assumptions of parametric effect size estimates and it is easy to calculate and interpret (Ma, 2006). However, PND has also been criticized because it can be greatly affected by outliers in the data and it tends to provide a conservative estimate of effect (Ma, 2006). As a result, several authors have proposed variants of PND, including the percentage of zero data (PZD; Scotti et al., 1991) and the percentage of all non-overlapping data (PAND; Parker, Hagen-Burke, & Vannest, 2007). However, these alternatives to PND have not been studied as extensively and have not been used as widely. Although PAND has recently received increased interest due to the development of a formula that allows PAND to be converted to a phi coefficient, Shadish et al. (2008) found the algorithm proposed yields inconsistent results. As a result, at this time PAND requires further refinement. Furthermore, Parker et al. (2007) recommend PAND for data sets containing a minimum of 20 data points. As discussed previously, many single-subject design studies have only a few data points per phase. As a result, this metric would not be appropriate to use with studies containing fewer than 20 data points.

One promising alternative to PND is the percentage exceeding the median baseline phase (PEM; Ma, 2006). This metric is calculated in the same way as PND, only the median baseline data point is used instead of the highest or lowest baseline data point. The percent exceeding the median offers advantages over PND; it is not as sensitive to outliers in the data and is less affected by autocorrelation (Ma, 2006; Manolov, Solanas, & Leiva, 2010). However, PEM still does not address the issue of the metrics' insensitivity to the magnitude of effects. As Ma (2006) explained, "Scores of 100% could be obtained whether all treatment scores were just slightly or substantially higher than the median of the preceding

baseline" (p. 611). This problem also exists with PND. As a result, another alternative effect size metric has been advocated.

A third popular approach to single-subject meta-analysis is the method proposed by Busk and Serlin (1992). Their approach to single-subject meta-analysis is derived from the work of Glass (1976), using a parallel method to the standardized mean difference statistic. However, instead of determining the difference between treatment and control groups, the treatment and baseline phases are used instead. Dubbed "the assumption models," Busk and Serlin developed three alternative effect size indices for conducting single-subject meta-analyses. Model One (the no-assumption model) makes no assumptions regarding the data. Model Two assumes equality of variances across both baseline and treatment phases. Model Three assumes both a normal distribution and homogeneity of variances. A particular model is selected based on the assumptions met by the data. However, as previously noted, these assumptions can be difficult to meet with time-series data. As a result, Model One becomes the default, and this model typically produces large effect sizes when compared to other techniques (Jenson, Clark, Kircher, & Kristjansson, 2007). Model One is calculated by subtracting the mean of the baseline phase from the mean of the treatment phase, and then dividing by the standard deviation of the baseline phase. Due to its similarity to Glass's (1976) *d* metric, this effect size metric is referred to as the standardized mean difference (SMD) metric.

Clearly, there is no simple answer in terms of how to best perform single-subject meta-analyses. As a result, a "triangulation of metrics" has been advised (Beretvas & Chung, 2008). To this end, the present investigation utilized three different effect size metrics: PND, PEM, and Busk and Serlin's (1992) no-assumption model (SMD).

Purpose of the Present Investigation

This investigation contributes to the literature base in several ways. First, this study is the first to examine the relative effectiveness of function-based behavioral interventions compared to non-function-based behavioral interventions for students diagnosed with ADHD. Second, this study provides insight into potential moderating variables influencing the effectiveness of these interventions. Third, this study utilizes three different approaches to single-subject meta-analysis, permitting the examination of the extent to which these three metrics are in agreement.

Research Questions and Hypotheses

1. On average, are function-based behavioral interventions more effective than non-function-based behavioral interventions for students diagnosed with ADHD?
    a. It is hypothesized that function-based behavioral interventions will be more effective than non-function-based behavioral interventions for students diagnosed with ADHD.
2. What variables influence intervention effectiveness?
    a. Although this question in somewhat exploratory, it is hypothesized that a small number of variables will influence treatment effectiveness:
        i. It is hypothesized that experimental FBAs will result in the development of more effective interventions than descriptive FBAs.
        ii. It is hypothesized that the duration of the intervention will influence treatment effectiveness- specifically, that longer interventions will lead to more effective outcomes.

iii. It is hypothesized that interventions utilizing a combined approach (i.e., antecedents and consequences) will result in more effective interventions than interventions utilizing a single approach.

3. What are the characteristics of effective interventions?
    a. This question is exploratory in nature and thus no a priori hypotheses are put forth.
4. To what extent are PND, PEM, and SMD effect size metrics in agreement with each other?
    a. This question is exploratory in nature and thus no a priori hypotheses are put forth.

Chapter 3

Method

Literature Search Procedures

Potential studies were identified using two different methods in order to perform a comprehensive search of all relevant literature. First, electronic searches were performed using the following databases: PsychINFO, Educational Resources Information Center (ERIC), and ProQuest Databases (Education, Psychology, and Dissertation and Theses Modules). Descriptors included in the electronic search included terms such as "functional assessment," "functional behavioral assessment," "functional analysis," "attention deficit hyperactivity disorder," "attention deficit disorder," "single-subject," and "behavior intervention". Second, a method called "footnote chasing" was used; in which studies were identified through other author's references (White, 2009). For example, several meta-analyses have been conducted examining the effectiveness of behavioral interventions for students with ADHD (e.g., DuPaul & Eckert, 1997; Fabiano et al., 2009; Vegas, 2005). These references were examined to determine if they met criteria for inclusion.

There is some contention regarding the inclusion of unpublished literature in meta-analyses. Specifically, some have argued that the inclusion of only published, peer-reviewed studies maintains a higher level of quality assurance (e.g., Frazier et al., 2007). However, problems are well documented with including only published studies in meta-analyses (e.g., publication bias; see Sutton, 2009). In order to mediate these different perspectives,

unpublished doctoral dissertations were included as they are, in a sense, peer-reviewed literature and thus should presumably be of acceptable quality.

Criteria for Inclusion

Studies written in English between the years of 1980 and May 2010 were selected for inclusion if they: (a) were single-subject or small *N* design studies, (b) contained school-aged participants diagnosed with ADHD between the ages of 4-21, (c) contained a graph displaying time-series baseline and treatment data in order to permit the calculation of effect sizes, (d) utilized a direct observation of behavior, and (e) utilized a direct behavioral intervention. For the purpose of this meta-analysis, an intervention was considered behavioral if the intervention utilized antecedent or consequence-based strategies. The start-date of 1980 was selected because it corresponds with the publication of the *Diagnostic and Statistical Manual of Mental Disorders, Third Edition* (APA, 1980), in which the term "attention deficit disorder" first appeared. Additionally, in order to compare non-function-based interventions to function-based interventions, the studies that met the above criteria and included an FBA procedure (consisting of direct or indirect procedures, and/or FA manipulations) were included in the function-based-intervention group.

Although a number of single-subject design studies have utilized interventions targeting peer or interpersonal relationships for students diagnosed with ADHD, these studies were excluded from the present investigation. Because the primary purpose of this study was to examine the relative effectiveness of FBA-based interventions to non-FBA-based interventions, it was deemed important to establish a degree of homogeneity in the interventions utilized and behaviors targeted between groups. As such, it was decided to

exclude interventions targeting peer relationships or social skills as this aspect of treatment was not targeted in FBA-based interventions.

Graphs were required to have a direct comparison of baseline to treatment. In cases where medication was used as part of a treatment, only the conditions that allowed a comparison of treatment to baseline were included. For example, if the participant was not on medication during baseline, the treatment condition that contained behavioral treatment without medication was used. Conversely, if the participant was on medication during baseline, the treatment condition that utilized medication and behavioral treatment was used. This was necessary to avoid confounding the effects pharmacological treatment with behavioral treatment. In cases where the effects of medication could not be separated from the effects of behavioral treatment, those cases were excluded from the present investigation.

Graphs were also required to display behavioral data. Graphs that included academic data (e.g., percent of problems answered correctly) were not included in the present investigation. The primary purpose of this study was to determine non-academic behavioral change (e.g., reductions in disruptive behavior), and academic variables were considered outside of the scope of that purpose.

Coding Procedures

Each study was coded based on a number of study, participant, assessment, and intervention characteristics (see Appendix A). This permitted the examination of potential moderating variables. In order to maximize the amount of descriptive information obtained,

studies were initially coded on a large number of variables. These variable categories were condensed prior to examining moderating variables in order to maximize power.

Study characteristics.

Each study was coded for publication status (published article or unpublished dissertation), year of publication, and number of participants included. Published articles were also coded for the journal in which they were published. Additionally, each study was coded on a number of quality indicators for single-subject designs. Horner, Carr, Halle, Mcgee, Odom, and Wolery (2005) developed criteria in order to assess the quality of single-subject research. These criteria were developed into a checklist in order to determine the number of quality indicators met by each study (see Appendix B). Specific aspects of quality assessed were: (a) adequate description of participants and setting, (b) operationalization of the dependent variable with quantifiable, precise, and repeated measurement, along with adequate inter-observer agreement, (c) operationalization of the independent variable, active manipulation of the independent variable, and assessment of treatment integrity, (d) baseline with five or more data points, (e) replication across participants/settings/materials, and (f) dependent variable is socially important, and magnitude of change is important.

Participant characteristics.

A variety of participant variables were coded. These included age, grade, gender, ethnicity, ADHD subtype, comorbid DSM diagnoses, medication status, and education placement status. Additionally, diagnostic characteristics were coded for each participant,

including (a) the individual who made the diagnoses and (b) the method used to arrive at a diagnosis.

Assessment characteristics.

Each study was coded for the following assessment characteristics: Whether or not an FBA was performed, type of FBA, individual who conducted FBA, the function of behavior, design used in FA, and FBA setting. The majority of these variables applied only to the FBA-based group, as the non-FBA-based group did not utilize these techniques. In order to verify the inclusion of essential characteristics of FBAs, a panel of three experts in applied behavior analysis reviewed the coding procedures developed for FBA characteristics. This panel determined the coding procedures captured the essential features of FBAs and confirmed the adequacy of the coding mechanism.

It should be noted that some FBA studies compared the relative effectiveness of function-based interventions to non-function based interventions. In such cases, only the function-based intervention was coded in order to preserve the assumption of independence that must be met for statistical analyses.

Intervention characteristics.

Intervention characteristics were coded for the following variables: Purpose of intervention, setting of intervention, type of intervention, level of intervention, individual implementing the intervention, target behavior, severity of behavior, design used, and length of intervention. Intervention levels were coded utilizing the hierarchy of behavior reduction techniques articulated by Lee and Axelrod (2005). Interventions were classified as Level 1 if

they utilized reinforcement strategies. Level 2 interventions utilized extinction procedures. Level 3 interventions utilized negative punishment procedures, while Level 4 interventions utilized positive punishment techniques. Behavior severity was coded utilizing the framework utilized by Harvey et al. (2009). Level 1 behaviors were chronic behaviors likely to interfere with community acceptance. Level 2 behaviors were more serious behaviors likely to increase in severity if left untreated, and Level 3 behaviors were dangerous behaviors requiring immediate attention. It should be noted that, when coding for behavior severity, if multiple behaviors were targeting during the intervention, the participant was coded for the most severe behavior. Studies were also coded for data regarding reliability, social validity, treatment integrity, maintenance, and generalization (if applicable).

Reliability of Coding Procedures

The reliability of coding procedures was assessed via inter-rater agreement for 10 randomly selected studies (7%). The percentage agreement was calculated as follows for each category:

$$AR = \frac{Number\ of\ observations\ agreed\ upon}{Total\ number\ of\ observations}$$

A graduate student with advanced coursework in applied behavior analysis served as an independent coder. He was trained by the researcher and provided a coding guide that operationalized each variable. One study (not included in the reliability analysis) was coded together as a practice exercise. Subsequently, the reliability of coding for each category was calculated and the percentage of agreement can be found in Table 1. All agreement rates exceeded 95%.

Table 1

Inter-rater Agreement of Coded Variables

Category	Percent Agreement	Range
Study characteristics	100.0	100
Participant characteristics	99.5	95-100
Assessment characteristics	96.4	90-100
Intervention characteristics	96.5	85-100

The reliability of the quality indicators was assessed separately. Assessing the quality of studies is an inherently subjective process. According to Petitti (2000), "The development of reliable and valid measures of the quality of studies…remains an illusive goal" (p. 93). As such, one quality indicator had to be excluded due to insufficient reliability. The indicator, "Three or more demonstrations of experimental control" was excluded. Determination of experimental control involves the visual assessment and integration of three factors: level, trend, and variability (Horner et al., 2005). The tendency for clinical judgments based on multivariate information to be flawed and imperfect is well documented (see Dawes, Faust, & Meehl, 1989). Due to the low reliability of this indicator and ambiguity in determining experimental control, this indicator was excluded. The remaining six indicators were used to assess study quality and the reliability of these ratings was 80%.

Data Analysis

Baseline and treatment data points were extracted from graphs using the computer software UnGraph (BioSoft, 2004). The UnGraph software allowed for precise extraction of data presented on electronic graphs and the reliability and validity of data obtained using this software has been supported by prior research (Shadish et al., 2009). In order to assess the reliability of data extraction, six graphs were randomly selected and an independent coder utilized the Ungraph software to extract data from a total of 160 data points. Agreement rates of the sample of extracted data were 96%. All disagreements in data extraction arose due to differences of only 1 point. Extracted data were then imported into a data file in SPSS 18.0. The data file also contained the coded participant, assessment, and intervention characteristics outlined above.

Effect sizes were calculated using the individual (rather than study) as the primary unit of analysis. Because FBAs result in the development of individualized interventions, it was important to calculate effect sizes at the participant level. Effect sizes were computed using three different methods: percent non-overlapping data (PND) proposed by Scruggs, Mastropieri, and Casto (1987), percent exceeding the median baseline phase (PEM) proposed by Ma (2006), and the no-assumption model (Model One) proposed by Busk and Serlin (1992). The PND metric was calculated by determining the percentage of treatment data points that did not overlap with the highest (in cases of adaptive behavior) or lowest (in cases of maladaptive behavior) baseline data point(s). The PEM metric was calculated by determining the percentage of treatment data points that do not overlap with the median

baseline data point. Effect sizes using Busk and Serlin's Model One Standard Mean Difference (SMD) were calculated as follows:

$$SMD = \frac{M_t - M_b}{S_b}$$

Where the mean of the treatment phase is subtracted by the mean of the baseline phase, and divided by the standard deviation of the baseline phase. Effect sizes were calculated so that one effect size of each type (PND, PEM, and SMD) was calculated for each participant.

Because a variety of single-subject designs were represented in this meta-analysis, strategies were identified in order to calculate effect size metrics from various study designs. Effect sizes for various single-subject designs were calculated following the conventions reported by Schlosser and Lee (2000):

1. $A_1B_1A_2$ designs: Effect sizes were calculated by combining the two baseline phases.
2. $A_1B_1A_2B_2$ designs: Two effect sizes were calculated: A_1B_1 and A_2B_2 and a mean effect size was calculated.
3. $B_1A_1B_2$ designs: Effect sizes were calculated by combining the two treatment phases.
4. Multiple baseline designs (within participants): Effect sizes were calculated within each tier, added, and then divided by the number of tiers.
5. Multiple baseline designs (across participants): Separate effect sizes were calculated for each individual.
6. Alternating treatments or multiple treatment designs: Effect sizes were calculated by comparing the most effective behavioral treatment with its corresponding baseline phase.

As discussed previously, effect sizes were calculated utilizing only behavioral data. That is, academic variables, such as the percent of problems correct on a worksheet, were excluded from the present investigation. It was determined that these academic variables extended beyond the scope of this study, as the primary purpose was to determine the extent of behavioral change in regard to disruptive classroom behaviors.

The results from this investigation are presented in the following manner. First, a descriptive review of these study, participant, assessment, and intervention characteristics is presented across FBA-based groups and non-FBA-based groups, as well as the entire sample as a whole. Second, the results of inferential statistical analyses are presented. A number of planned statistical comparisons were conducted in order to answer the primary and secondary research questions. In addition, a number of post-hoc exploratory comparisons were performed in order to better understand the influence of secondary variables on treatment effectiveness. One caveat should be noted; the comparisons that were exploratory in nature were not adjusted for multiple comparisons. As such, these results should be interpreted with caution. However, the goal was to provide an extensive examination of the variables that influence treatment effectiveness within this sample and to provide a foundation for future research.

Chapter 4

Results

Descriptive Analyses

Characteristics of studies.

Utilizing the search terms described previously, an initial examination of study abstracts yielded a total of 157 potential single-subject studies that were considered for potential inclusion in this meta-analysis. Of that total, 32 studies were excluded because they did not meet the criteria for a direct behavioral intervention (i.e., were academic, cognitive behavioral, or utilized parent training programs). Twenty-four studies were excluded because they did not include a time-series graph. Twenty-one studies were eliminated because the participant did not have a formal diagnosis of ADHD. Six studies were excluded because they did not utilize a direct and observable measure of behavior, and four studies did not contain sufficient information. Thus, a total of 70 studies met criteria for inclusion, 41 utilized an FBA in intervention planning while 29 did not. Of the total, 11 were unpublished dissertations while 59 were published in peer-reviewed journals. Published studies that were included in the present analysis were retrieved from a total of 18 peer-reviewed journals. The majority of published articles (20%) were pulled from the *Journal of Applied Behavior Analysis*. A complete list of study characteristics is displayed in Table 2.

As depicted in Figure 2, studies conducted within the last 10 years were more likely to include an FBA than exclude an FBA in intervention planning. On average, FBA-based intervention studies tended to include fewer participants than non-FBA-based studies (*M* =

1.63, *SD* = 1.02 and *M* = 2.86, *SD* = 1.55 respectively). As discussed previously, each study was rated on a 6-point scale in terms of the number of quality indicators met. On average, FBA-based studies and non-FBA-based studies were rated similarly in terms of quality indicators, with non-FBA-based studies rated slightly higher (*M* = 4.49, *SD* = .10 and *M* = 4.13, *SD* = .09 respectively). The most common indicator not met was "Adequate description of participants and setting".

Table 2

Study Characteristics

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
Publication status						
Published	33	80	26	90	59	84
Unpublished	8	20	3	10	11	16
Journal title						
American Journal of Occupational Therapy	0	0	1	4	1	2
Behavior Modification	1	3	5	19	6	10
Behavior Therapy	0	0	1	4	1	2
Behavioral and Residential Treatment	0	0	1	4	1	2
Behavioral Disorders	5	15	0	0	5	8
Behavioral Interventions	1	3	0	0	1	2
Child and Family Behavior Therapy	0	0	4	15	4	7

Characteristic	FBA-based		Non-FBA-based		Total	
	n	%	*n*	%	*N*	%
Education and Treatment of Children	4	12	2	8	6	10
Journal of Applied Behavior Analysis	9	27	3	12	12	20
Journal of Behavior Therapy and Experimental Psychiatry	2	6	1	4	3	5
Journal of Emotional and Behavioral Disorders	2	6	1	4	3	5
Journal of Positive Behavior Interventions	3	9	0	0	3	5
Journal of School Psychology	0	0	1	4	1	2
Journal of the Association for Persons with Severe Handicaps	1	3	0	0	1	2
Psychology in the Schools	0	0	2	8	2	3
Remedial and Special Education	0	0	1	4	1	2
School Psychology Quarterly	2	6	2	8	4	7
School Psychology Review	3	9	1	4	4	7
Year published						
1980-1989	0	0	3	10	3	4
1990-1999	15	37	15	52	30	43

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
2000-2009	26	63	11	38	37	53
Total number of studies	41	59	29	41	70	100
Total number of participants	67	45	83	55	150	100

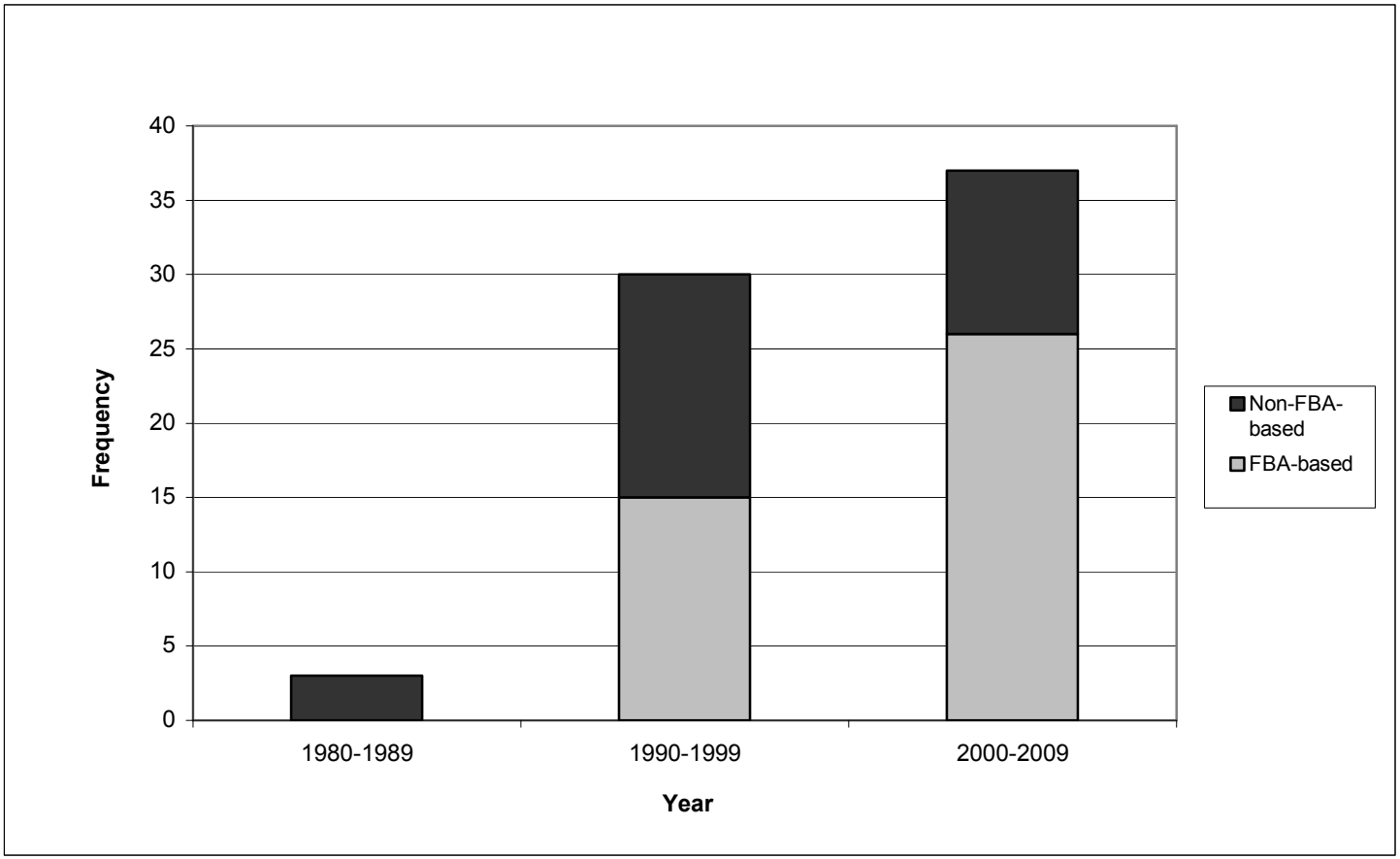

Figure 2. Study distributions by publication year.

Characteristics of participants.

Across both groups, participants were similar in regard to age, gender, and ethnicity. The mean age of participants in the FBA-group was 9 years and 0 months, while the mean age of participants in the non-FBA group was 8 years and 10 months. A slightly larger percentage of participants in the FBA group were taking medication when compared to the non-FBA group (49% and 39% respectively). Additionally, a larger percentage of participants in the FBA group were described as having a comorbid diagnosis (45%) when compared to the non-FBA group (16%). Specifically, the most commonly reported comorbid diagnosis was oppositional defiant disorder. Most participants were described as being diagnosed with ADHD by a physician, and the DSM used in combination with rating scales was the most commonly used method of diagnosis. However, a substantial number of studies did not specify who provided the diagnosis (55%) or the method that was used to arrive at the diagnosis (52%). Participant characteristics and diagnostic characteristics of the sample are displayed in Tables 3 and 4 respectively.

Table 3

Participant Characteristics

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
Gender						
Male	56	84	66	80	122	81
Female	11	16	17	20	28	19
Ethnicity						
Caucasian	19	28	22	27	41	27
African American	8	12	8	10	16	11
Hispanic	2	3	0	0	2	1
Not specified	38	57	53	64	91	61
Grade						
Pre-kindergarten-kindergarten	5	7	6	7	11	7
1^{st}-5^{th}	28	42	36	43	64	43

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
6th-8th	8	12	17	20	25	17
9th-12th	1	1	1	1	2	1
Not specified	25	37	23	28	48	32
Subtype						
Primarily inattentive	1	2	2	2	3	2
Primarily hyperactive/impulsive	3	5	0	0	3	2
Combined	6	9	11	13	17	11
ADD	6	9	0	0	6	4
Not specified	51	76	70	84	121	81
Medication status						
Taking medication	33	49	32	39	65	43
Not taking medication	17	25	40	48	57	38
Not specified	17	25	11	13	28	19

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
Education status						
Receiving special education services	29	43	13	16	42	28
Regular education	22	33	24	29	46	31
Not specified	16	24	46	55	62	41
Comorbid diagnosis						
ODD	9	13	2	2	11	7
CD	2	3	2	2	4	3
LD	3	5	4	5	7	5
Other(s)	16	24	5	6	21	14
None/not specified	37	55	70	84	107	71

Note. ADD = Attention deficit disorder; ODD = Oppositional defiant disorder; CD = Conduct disorder; LD = Learning disability

Table 4

Diagnostic Characteristics

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*N*	%	*N*	%
Individual who provided diagnosis						
Physician	12	18	15	18	27	18
Psychologist	3	5	22	27	25	17
Psychiatrist	2	3	5	6	7	5
Physician and psychologist	0	0	3	4	3	2
Physician or psychologist	5	8	0	0	5	3
Not specified	45	67	38	46	83	55
Method of diagnosis						
DSM	11	16	13	16	24	16
Rating scales only	2	3	0	0	2	2
DSM and rating scales	5	8	32	39	37	25
Interview and rating scales	0	0	9	11	9	6
Not specified	49	73	29	55	78	52

Characteristics of assessments.

The assessment characteristics of FBA-based studies are presented in Table 5. The most common descriptive methods employed were a combination of a structured interview or rating scale and a direct observation of behavior (58%). Sixty-four percent of the sample utilized experimental manipulations (functional analyses) in intervention planning. Of those studies that utilized functional analyses (FAs), only 19% used brief FAs while the remainder used typical FAs. Studies that included FA manipulations were most often conducted in a naturalistic, non-analog setting (40%). Studies that utilized functional analyses used a variety of conditions. Only 3% of studies utilized the typical FA conditions of attention, play, demand, and alone as described by Iwata et al., (1982). Studies that included a FA most often used an alternating treatment or multi-element design (45%). The majority of FBAs were conducted in school settings (76%) and were most often conducted by a researcher or researcher assistant (46%). Problem behaviors were equally distributed in terms of serving either a gain (37%) or escape (37%) function.

Table 5

FBA Assessment Characteristics

Characteristic	*n*	%
Descriptive methods		
Direct observation only	3	5
Informal interview	1	2
Structured interview/rating scale	2	3
Informal interview and direct observation	11	16
Structured interview/rating scale and direct observation	39	58
No descriptive methods, FA only	11	16
FA included		
FA conducted	43	64
No FA conducted	24	36
FA length		
Brief	13	32
Typical	28	68
Not specified	2	5
FA setting		
Analog	14	33
Naturalistic	27	63
Not specified	2	5

Characteristic	*n*	%
FA conditions		
Typical (attention, demand, play, alone)	2	3
Other	41	61
None	24	36
FA type		
Manipulated antecedents	6	14
Manipulated consequences	3	7
Manipulated both antecedents and consequences	32	74
Not specified	2	5
FA design		
Reversal	10	23
Alternating treatment/multi-element	30	70
Other	1	2
Not specified	2	5
FBA agent		
Teacher/teaching assistant	7	11
Researcher/research assistant	31	46
Multiple	6	9
Other	8	12
Not specified	15	22

Characteristic	*n*	%
FBA setting		
School	51	76
Home	4	6
Clinic	6	9
Other	6	9
Function		
Gain	25	37
Escape/avoid	25	37
Multiple	9	13
Not conclusive/not specified	8	12

Note. FA = functional analysis.

Characteristics of interventions.

Intervention characteristics for the sample are provided in Table 6. Across groups, most interventions (75%) were implemented in the school setting. The majority of interventions were implemented in regular education settings (39%) by a teacher or teaching assistant (33%). The most commonly reported purpose of these behavioral interventions was to decrease inappropriate behavior (39%), while increasing appropriate behavior was targeted in 35% of studies. Twenty-six percent of studies intended to both increase appropriate behavior while concomitantly decreasing inappropriate behavior. Behaviors targeted for intervention were most often chronic behaviors (Level 1), although FBA-based studies tended to target more severe behaviors than non-FBA studies. That is, FBA-based studies targeted a larger percentage of Level 2 and Level 3 behaviors compared to non-FBA studies (see Table 6).

Across groups, the majority of interventions targeted both antecedents and consequences of behavior (59%). Least-restrictive, reinforcement-based or structural interventions (Level 1) were the type of interventions used most often (67%). Reversal designs were most commonly employed (39%), however a large percentage also used multiple baseline designs (35%). Intervention length, which was measured by the number of intervention data points, was relatively short in the majority of studies. Forty-seven percent of the total sample included only 1-11 intervention data points.

Interobserver agreement (IOA) data were collected in 91% of the sample's total studies. The overall mean IOA for the sample was 94%. For the FBA-based group, the mean IOA was 94% while the mean IOA for the non-FBA-based group was 93%.

Overall, 35% of the interventions promoted maintenance, while only 14% of the interventions promoted generalization. Of the FBA studies, only 25% included data regarding maintenance while 42% of the non-FBA sample included data on maintenance. Similarly, only 13% of the FBA sample included information on generalization, while 19% of the non-FBA sample included information on generalization.

Social validity was investigated for 59% of the total sample and of that number, 57% of the feedback was positive. Between groups, social validity ratings were similar; 58% of the FBA group and 55% of the non-FBA group were rated positively. Treatment integrity data were also investigated between groups: 58% of the FBA group compared to 49% of the non-FBA group investigated treatment integrity. The mean treatment integrity percentage was 94% for the FBA group compared to 99% for the non-FBA group.

Correlations between effect size metrics.

Of interest in the present investigation was also the degree of association between effect size metrics. Pearson correlations were calculated in order to assess the extent to which the PND, PEM and SMD metrics were related. Correlations between metrics are presented in Table 7. According to the guidelines provided by Cohen (1988), moderate to large correlations were found between the three effect size metrics. All correlations were statistically significant at the .001 level.

Table 6

Intervention Characteristics

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
Intervention setting						
School	47	70	66	80	113	75
Non-school	15	22	17	21	32	21
Residential treatment	5	8	0	0	5	3
Intervention location						
Regular education class	26	39	33	40	59	39
Special education class	10	15	12	15	22	15
Integrated classroom(s)	7	10	3	4	10	7
Hospital	4	6	4	5	8	5
Summer program	2	3	14	17	16	11
Home	4	6	1	1	5	3

Characteristic	FBA-based		Non-FBA-based		Total	
	n	%	*n*	%	*N*	%
School (not specified)	4	6	9	11	13	9
Other	10	15	6	7	16	11
Intervention agent						
Teacher/teaching assistant	24	36	26	31	50	33
Researcher/research assistant	17	25	16	19	33	22
Parent	4	6	1	1	5	3
Multiple	13	18	19	23	32	21
Other	6	9	14	17	20	13
Not specified	3	5	7	8	10	7
Intervention purpose						
Decrease inappropriate behavior	31	46	28	34	59	39
Increase appropriate behavior	12	18	40	48	52	35
Both	24	36	15	18	39	26

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
Behavior severity						
Level 1	42	63	74	89	116	77
Level 2	8	12	1	1	9	6
Level 3	17	25	8	10	25	17
Intervention type						
Antecedent	8	12	8	10	16	11
Consequence	22	33	23	28	45	30
Combined	37	55	52	63	89	59
Intervention level						
Level 1	52	78	49	59	101	67
Level 2	2	3	0	0	2	1
Level 3	2	3	4	5	6	4
Combined 1 & 2	10	15	1	1	11	7

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
Combined 1 & 3	1	2	29	35	30	20
Intervention design						
AB	8	12	4	5	12	8
Reversal	26	39	36	43	62	41
Alternating treatment/multi-element	8	12	3	4	11	7
Multiple baseline	25	37	28	34	53	35
Other	0	0	12	14	12	8
Intervention length						
1-11 data points	36	54	35	42	71	47
12-22 data points	24	36	39	47	63	42
22+ data points	7	10	9	11	16	11
IOA data included						
Yes	60	90	76	92	136	91
No	7	10	7	8	14	9

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
Maintenance promoted						
Yes	17	25	35	42	52	35
No	0	0	0	0	0	0
Not included	50	75	48	58	98	65
Generalization promoted						
Yes	7	10	14	17	21	14
No	2	3	2	2	4	3
Not included	58	87	67	81	125	83
Social validity investigated						
Yes	40	59	48	58	88	59
No	27	40	35	42	62	41
Social validity results						
Positive	39	58	46	55	85	57

	FBA-based		Non-FBA-based		Total	
Characteristic	*n*	%	*n*	%	*N*	%
Negative	1	2	0	0	1	1
Not reported	27	40	35	42	62	41
Treatment integrity data included						
Yes	39	58	41	49	80	53
No	28	42	42	51	70	47

Table 7

Correlations Between ES Metrics

Metric	PND	PEM	SMD
PND	-	.612*	.444*
PEM	.612*	-	.316*
SMD	.444*	.316*	-

Note. * = $p < .05$

Inferential Analyses

Data were first examined in order to determine whether parametric or non-parametric analyses were more appropriate given the characteristics of the data. These data did not meet the assumptions required by parametric statistics. As indicated by statistically significant ($p < .05$) values on Kolmogorov-Smirnov and Shapiro-Wilk tests of normality, these data violated the assumption of normality. In order to verify these results, skewness and kurtosis were also examined. The values were divided by their relative standard errors and compared against the values known for a normal distribution. All values far exceeded the known value of 1.96 for a normal distribution. Additionally, results from Levene's test suggested the homogeneity of variance assumption was not tenable for the PND effect size metric ($p < .05$). Given these results, and the relatively small size of the sample, nonparametric analyses were chosen.

First, participant demographics were investigated in order to determine the degree of similarity between the FBA and non-FBA groups. Because comparisons were made between these groups, ideally they would be relatively similar in terms of demographic characteristics. To this end, a series of chi square analyses were conducted. It should be noted however, that some cells had frequencies less than five, which is generally considered the minimum sample for chi square analyses. As such, the validity of these results may be questionable for cells that contained frequencies fewer than five. The following variables had cell frequencies less than five: ethnicity, grade, ADHD subtype, and comorbid diagnosis, and should subsequently be interpreted with caution. No statistically significant differences were found between samples in regard to gender, ethnicity, or grade. However,

statistically significant ($p < .05$) differences were found in regard to ADHD subtype, medication status, education status, and comorbid diagnosis. Thus, the samples differed in some respects based on demographic characteristics.

Planned comparisons.

In order to answer the primary research question and determine whether including FBAs in intervention planning leads to more effective interventions, two separate Mann-Whitney *U* analyses were performed. First, a significance test was performed in order to determine if there were statistically significant differences between the mean ranks of the effect sizes (PND, PEM, SMD) of the FBA sample when compared to the non-FBA sample. No significant differences were found across all effect sizes, $p > .05$. However, the FBA sample included several cases for which no function was identified or specified. The total sample was subsequently recoded into two groups: those that identified a function of behavior ($n = 59$) and those that did not ($n = 91$). Statistically significant differences were found between groups across all three effect sizes (PND, $U = 2184.00$, $p = .024$; PEM, $U = 2171.00$, $p = .013$; SMD, $U = 2087.00$, $p = .011$). That is, studies that identified a function of behavior had significantly larger effects than ones that did not. The mean effect sizes for the FBA sample were as follows: PND = 81.96, PEM = 95.30, and SMD = 3.88. Mean effect sizes and mean ranks for each group are also displayed in Table 7.

In order to answer the secondary research questions, several Mann-Whitney *U* and Kruskall-Wallis analyses were performed. Because multiple comparisons were performed, a Bonferonni correction was used to reduce the family-wise error rate and adjust the alpha to .016. Each hypothesis will be discussed in turn.

First, it was hypothesized that experimental manipulations (or FAs) would result in the development of more effective interventions than descriptive methods alone. A Mann-Whitney U test revealed statistically significant differences between groups across all three effect sizes (PND, $U = 333.50$, $p = .007$; PEM, $U = 334.00$, $p = .003$; SMD, $U = 344.00$, $p = .012$). The FA manipulations were associated with larger effects than descriptive methods alone. The mean effect sizes for interventions that included FA manipulations were as follows: PND = 83.75, PEM = 94.78, and SMD = 3.99. Mean effect sizes and mean ranks for each group are also displayed in Table 8.

Second, it was hypothesized that the duration of interventions would influence treatment effectiveness. Specifically, it was hypothesized that longer interventions would lead to more effective outcomes. A Kruskal-Wallis test was performed in order to determine if there were statistically significant differences between short, medium, and longer duration interventions. No significant differences were found in regard to treatment effectiveness based on intervention length, $p > .05$.

Third, it was hypothesized that interventions utilizing combined antecedent and consequence strategies would be more effective than interventions using only one of these strategies in isolation. A Kruskal-Wallis test was performed in order to determine if there were statistically significant differences between groups. Significant differences were found for SMD, $p = .017$, but not for the other two effect size metrics, $p > .05$. For antecedent-based interventions, the SMD metric was significantly higher than for consequence or combined strategies.

Exploratory analyses.

Next, a series of exploratory analyses were performed in order to investigate the influence of other variables on treatment effectiveness. Because these analyses were exploratory in nature, no adjustments were made for multiple comparisons, thus inflating the Type I error rate. However, the use of a Bonferroni correction in this case would have resulted in the substantial loss of statistical power (see Nakagawa, 2004 for a discussion of this issue). Because these analyses were not corrected for multiple comparisons, these findings should be interpreted with caution. However, it was anticipated that these exploratory analyses would provide a foundation for future research.

First, several study and participant characteristics were examined to determine their influence on treatment effectiveness. Again, these variables were tested using non-parametric analyses (either Mann-Whitney *U* or Kruskal-Wallis tests, depending on the nature of the data). No significant differences were found on intervention effectiveness in regard to publication status, gender, medication status, or grade level across groups, $p > .05$.

Next, assessment characteristics were examined to determine their influence on treatment effectiveness. These analyses pertained only to the FBA group, as the non-FBA group did not utilize any assessment data. The first analysis that was conducted was a Mann-Whitney *U* test in order to determine whether there were statistically significant differences between descriptive methods in FBA processes. These methods were dichotomized into two groups: a single method group (comprised of only single descriptive procedures used in isolation) and a combined methods group (comprised of assessments utilizing multiple descriptive procedures). Across all three effect size measures, no significant differences

were found between groups, $p > .05$. Similarly, no significant differences were found (via Kruskal-Wallis tests) for treatment effectiveness as a function of the individual who completed the FBA, or for the function of the behavior, $p > .05$. In terms of FBA setting, no significant differences were found across school, home, clinic or other settings for SMD and PND metrics, $p > .05$. However, significant differences were found for PEM, $H = 10.70$, $p = .008$. That is, for the PEM metric, FBAs conducted in a clinic setting were associated with significantly larger effects than FBAs conducted in other settings.

Several analyses were also conducted in order to investigate variables related to functional analyses (FAs) and their influence on treatment effectiveness. Across all three effect sizes, a Mann-Whitney *U* test revealed no statistically significant differences between FAs conducted in naturalistic versus analog settings, $p > .05$. Similarly, no significant differences were found in treatment outcomes between FAs that either: a) manipulated consequences, b) manipulated antecedents, or c) manipulated antecedents and consequences, $p > .05$. In terms of FA length, treatment outcomes did not differ between typical and brief FAs for PND and SMD, $p > .05$. However, statistically significant differences were found in regard to PEM for FA length, with typical length FAs being more effective than brief FAs, PEM, $U = 118.00$, $p = .021$.

Lastly, several exploratory analyses were conducted in regard to intervention characteristics and their influence on treatment effectiveness. A series of Kruskal-Wallis tests were conducted in order to investigate the extent to which intervention variables influenced treatment effectiveness. First, intervention setting was investigated. No significant differences were found across school, non-school, and residential treatment settings, $p > .05$. However, significant differences were found as a function of the individual

who implemented the intervention for PND, $H = 11.23$, $p = .011$ and PEM, $H = 13.61$, $p = .004$, but not for SMD, $p > .05$. Specifically, for PEM, intervention implementation by the researcher or research assistant was associated with better outcomes, while PND values were greatest when the intervention was implemented by multiple individuals (see Table 9). No significant differences were found in regard to behavior severity and treatment effectiveness, $p > .05$. However, according to a chi-square analysis, the FBA-based sample targeted significantly more severe behaviors than the non-FBA sample, $x^2 (2) = 20.18$, $p < .001$.

The purpose of intervention was also investigated in regard to treatment effectiveness. The intervention purposes were coded into three categories: a) decrease inappropriate behavior, b) increase appropriate behavior, or c) both. Statistically significant differences were found between these groups across all three effect sizes (PND, $H = 15.01$, $p = .001$; PEM, $H = 11.57$, $p = .003$; SMD, $H = 17.19$, $p < .001$). Interventions that targeted increasing appropriate behavior were significantly more effective. The mean effect sizes were as follows for interventions that targeted increasing appropriate behavior: PND = 86.17, PEM = 97.33, and SMD = 3.82. Mean effect sizes and mean ranks are also presented for each group in Table 10.

The level of intervention implemented (based on the least restrictive alternative) was statistically significant for SMD, $H = 16.81$, $p = .001$, and PND, $H = 12.68$, $p = .009$, but not for PEM, $p > .05$. That is, Level 1 interventions (those based on structural changes or positive reinforcement strategies) were significantly more effective than other, more restrictive intervention levels (mean PND = 76.13 and SMD = 3.77). Means and mean ranks for each group are also displayed in Table 11.

Lastly, the influence of treatment integrity on treatment effectiveness was explored via a Mann-Whitney *U* test. No significant differences were found between studies that investigated treatment integrity and studies that did not, $p > .05$.

Table 7

Mean Effects and Mean Ranks: Function

		PND		PEM		SMD	
Function identified	*n*	*M*	*MR*	*M*	*MR*	*M*	*MR*
Yes	59	81.96	83.98*	95.30	84.20*	3.88	85.63*
No	91	67.69	70.00	90.40	69.86	2.87	68.93

Note. MR = mean rank, * $p < .05$

Table 8

Mean Effects and Mean Ranks: Functional Analysis

		PND		PEM		SMD	
FA included	*n*	*M*	*MR*	*M*	*MR*	*M*	*MR*
Yes	43	83.75	38.24*	94.78	38.23*	3.99	38.00*
No	24	65.07	26.40	91.87	26.42	2.92	26.83

Note. MR = mean rank, * $p < .05$

Table 9

Mean Effects and Mean Ranks: Intervention Agent

		PND		PEM		SMD	
Intervention agent	*n*	*M*	*MR*	*M*	*MR*	*M*	*MR*
Teacher/TA	50	73.70	69.35	94.07	73.25	2.80	65.43
Researcher/RA	33	81.07	79.38	96.07	78.65*	3.65	82.24
Multiple	32	79.97	80.23*	95.66	76.23	3.24	76.98
Other	25	58.25	48.62	80.95	46.90	2.90	56.84

Note. MR = mean rank, * $p < .05$

Table 10

Mean Effects and Mean Ranks: Intervention Purpose

		PND		PEM		SMD	
Purpose	*n*	*M*	*MR*	*M*	*MR*	*M*	*MR*
Decrease inappropriate	59	63.44	63.55	89.47	70.37	2.45	60.27
Increase appropriate	52	86.17	93.70*	97.33	89.84*	3.82	94.40*
Both	39	71.07	69.31	89.99	64.14	3.78	73.33

Note. MR = mean rank, * $p < .05$

Table 11

Mean Effects and Mean Ranks: Intervention Level

		PND		PEM		SMD	
Intervention level	*n*	*M*	*MR*	*M*	*MR*	*M*	*MR*
Level 1	101	76.13	80.84*	92.45	77.31	3.77	83.34*
Level 2	2	6.77	6.25	53.46	15.50	.69	12.75
Level 3	6	47.50	36.92	95.14	81.83	1.39	36.50
Levels 1 & 2	11	81.74	78.77	95.22	80.77	2.99	81.23
Levels 1 & 3	30	70.28	68.65	92.90	70.22	2.25	59.00

Note. MR = mean rank, * $p < .05$

Summary of Findings

A total of 70 studies were selected for inclusion in the present meta-analysis; 41 studies that included FBAs in intervention planning and 29 that did not. Thus, the entire sample consisted of 150 individual participants; 67 of which comprised the FBA group and 83 of which comprised the non-FBA group. These groups were relatively similar in terms of demographic variables; they were predominately male students in the primary grades. More participants in the FBA group were described as: (a) taking medication, (b) receiving special education services, and (c) having a comorbid diagnosis than the non-FBA group.

Within the FBA group, assessment characteristics remained diverse. Most studies utilized a combination of descriptive methods; typically combining structured interviews/rating scales with a direct observation of behavior. More than half the studies included functional analysis (FA) manipulations, most of which were typical in length. A variety of FA conditions were employed across studies, but most involved manipulating both antecedents and consequences and most used multi-element/alternating treatment designs. Most FBAs were conducted in school settings by a researcher/researcher assistant and the identified function was equally likely to be "gain" or "escape/avoid" within this sample.

Across samples, interventions were most often conducted in school settings in regular education classrooms. The intervention agent was most often the classroom teacher and the target behaviors were usually relatively mild, chronic behaviors. For the FBA group, the purpose of the intervention was most often to decrease inappropriate behavior, while it was most often to increase appropriate behavior for the non-FBA group. Across groups,

combined antecedent and consequence-based interventions were most common and they were most often Level 1, minimally restrictive interventions. Reversal designs were typically used, and interventions were typically shorter for the FBA group. Interobserver agreement data were collected on the large majority of studies, while treatment integrity data were collected only about half the time. The non-FBA group collected relatively more data in regard to maintenance and generalization of interventions. However, the groups were similar in terms of social validity data; they collected data for slightly more than half the studies and the majority of those findings were positive. Treatment integrity data were also fairly similar between groups, approximately half of the studies in each group included treatment integrity data, however the FBA group collected a larger percentage of treatment integrity data. Of those studies that included this data, the mean percentage of treatment integrity differed slightly between groups, with the non-FBA group reporting slightly higher integrity rates on average.

A series of correlations were calculated in order to determine the degree of association between effect size metrics. Overall, moderate to large correlations were found between effect size metrics. The strongest association was found between PND and PEM while the association between SMD and PEM was weakest.

A series of nonparametric analyses were conducted and the findings were as follows. Initially, no statistically significant differences were found between the FBA and non-FBA group. However, once the groups were re-coded in terms of function identified versus no function identified, statistically significant differences were found between groups across all three effect size metrics. Statistically significant differences were also found within the FBA group in regard to functional analysis (FA) manipulations. That is, when an FA was

conducted, significantly larger effects were evident than when only descriptive methods were used. Across groups, statistically significant differences were found in regard to the individual who implemented the intervention: for PND, the implementation by multiple individuals resulted in the largest effects, while for PEM, implementation by the researcher/researcher assistant was associated with greater effectiveness. Across groups, interventions that targeted increasing appropriate behavior were significantly more effective than ones that targeted behavior reduction or both. Lastly, across groups, interventions that were minimally restrictive (Level 1) were associated with greater PND and SMD effects.

Chapter 5

Discussion

The purpose of the present investigation was threefold: to understand how the inclusion or exclusion of FBAs in intervention planning influenced intervention effectiveness, to understand how different variables (such as intervention length and agent) influenced intervention effectiveness, and to perform a quantitative synthesis on extant studies utilizing behavioral interventions for students diagnosed with ADHD in order to better understand best practices for this population. In addition to these primary goals, of interest was also the practice of single-subject meta-analyses and the extent to which various effect size metrics were associated with one another. A discussion of the findings in relation to these goals, as well as a discussion relating these findings to previous research, will follow. Additionally, a discussion regarding the limitations of this research, implications, and directions for future research will be provided.

Hypotheses and Findings

As discussed previously, the primary purpose of this quantitative synthesis was to determine the extent to which including FBAs in intervention planning influenced treatment effectiveness. It was hypothesized that including an FBA in intervention planning would result in the development of more effective interventions. To that end, this study yielded several interesting findings. When the groups were split on the basis of FBA inclusion, no statistically significant findings were evident. However, when the groups were split on the basis of function identified versus not identified, statistically significant differences were found in favor of identifying a function of behavior. These findings suggest that the FBA

process in and of itself does not necessarily lead to optimally effective interventions, however specifying the function of behavior may. Within this sample, significantly larger effects were evident when a function of behavior was specified and when the intervention was tailored to that function. These findings suggest that descriptive methods used only to identify the antecedents and consequences of behavior may not maximize outcomes, and that it is important to use that information to determine the function of behavior. Interestingly, despite the fact that FBA-based interventions tended to be shorter in length and target more severe behaviors, these interventions remained significantly more effective when a function was identified than non-function-based interventions. These findings provide compelling evidence regarding the potency of function-based interventions.

Another important goal of this research was to determine how various study, participant, assessment, and intervention characteristics influenced intervention effectiveness. Consistent with prior hypotheses, results from the planned statistical comparisons suggest that including functional analysis (FA) manipulations in intervention planning may contribute to the development of more effective interventions. These findings attest to the utility of FAs in effective intervention development. Because FAs directly manipulate environmental conditions that bring about problem behavior, they may be a more effective means of identifying the function of behavior than descriptive methods alone.

Contrary to prior hypotheses, across groups, effect sizes did not significantly differ based upon intervention duration or intervention type (antecedent, consequence, or combined). Fabiano et al. (2009) also did not detect associations between intervention length and treatment effectiveness in their meta-analysis of behavioral treatments for ADHD. However, it should be noted that some of these groups had very limited sample sizes (with

some as few as only seven participants) and thus there was reduced power to detect significant differences. This was a salient issue in a number of statistical analyses that were conducted. Although a number of the variables that were explored did not reach statistical significance, this does not mean that these variables may not be influential and impact intervention effectiveness. The studies included in the present investigation differed on many levels: in total approximately 50 participant, assessment, and intervention variables were coded. There was vast variability across all variables. Given the relatively small sample size and the large variability of these data, these factors reduced the statistical power of the analyses, thus making it difficult to obtain statistically significant findings. As a result, only a few of the exploratory analyses yielded significant findings, and even these findings must be interpreted with caution as they were not adjusted for multiple comparisons. For example, based on PND effect size data, intervention implementation by multiple individuals was associated with the largest effects. However, based on PEM effect size data, the largest effects were associated with implementation by a researcher or research assistant. Given these discrepant findings, it is difficult to ascertain any conclusive findings regarding intervention agents. However, according to both effect size metrics, implementation by researchers was associated with larger effects than implementation by teachers. These findings could be due to a number of factors. For example, researchers often receive more training than teachers and are likely more personally invested in the project.

Interestingly, across all three effect size measures, when the goal of the intervention was to increase appropriate behavior, larger effects were found. These studies targeted behaviors such as on-task behavior, time spent in seat, and hand raising. While there are a number of potential explanations for this finding, it may be related to behavior inhibition

difficulties associated with ADHD. That is, a core deficit for individuals diagnosed with ADHD is believed to be behavior inhibition (Barkley, 2003). As such, targeting behavioral inhibition in interventions may not be the most effective means for initiating behavior change for this demographic. In his review of prior research, Barkley (2003) noted that children with ADHD tend to have "considerable difficulty stopping an ongoing behavior" (p. 79). In line with current perspectives regarding school-wide positive behavior support, it may be more beneficial to strengthen alternative behaviors than focus solely on behavior reduction or inhibition. Teaching replacement behaviors seems to be more effective than simply reducing the problem behavior. Of course, the benefit in targeting positive behaviors is that generally negative behaviors will also decrease as a result.

Lastly, it was found that the level of intervention restrictiveness was associated with significant differences across PND and SMD effect size metrics. Level 1 interventions utilized minimally restrictive, structural or reinforcement-based strategies. Level 2 interventions utilized extinction techniques. Level 3 interventions utilized negative punishment techniques such as response cost. Level 4 interventions utilized positive punishment strategies such as reprimands. Across both PND and SMD metrics, Level 1 intervention strategies were associated with the largest effects. Although slightly less effective than Level 1 strategies, a combined approach utilizing Level 1 and Level 2 intervention strategies was the second most effective treatment. These findings suggest that minimally restrictive, structural or positive reinforcement-based interventions are an effective means for behavior change within this sample. It is important to note, however, that limited sample sizes in other groups (i.e., Level 2 and Level 3) may have contributed to these findings.

Framework for Interpretation

General guidelines have been developed in order to provide a framework for interpreting the magnitude of effects for single-subject research. Table 12 provides an outline of the interpretation guidelines provided for PND, PEM, and SMD effect size metrics.

Table 12

Effect Size Interpretation Guidelines

	Framework for interpretation			
Metric	Ineffective	Questionable	Moderate	Highly Effective
PND[a]	< 50%	50% – < 70%	70% - 90%	> 90%
PEM[b]	< 50%	50% – < 70%	70% - 90%	> 90%
SMD[c]	< .20	.20 - .50	.50 - .80	> .80

Note: [a] provided by Scruggs et al. (1996), [b] provided by Ma (2009), [c] provided by Cohen (1988).

This interpretative framework was compared to the mean effect size metrics reported in Tables 7 – 11. Function-based interventions fell within the moderate to highly effective range while non-function-based interventions fell within the questionable to highly effective range. Interventions based on functional analyses manipulations also fell within the moderate to highly effective range. For intervention agents, the mean PND value fell within the moderate range for multiple intervention agents, while the mean PEM value fell within

the moderate range for the researcher/assistant as the intervention agent. Across all three effect size metrics, interventions that targeted increasing appropriate behavior fell within the highly effective range. Lastly, across PND and SMD metrics, Level 1 interventions fell within the moderately to highly effective range.

For meta-analytic research, it seems as though the utility of single-subject effect size metrics lies primarily in their ability to be used as a comparative tool. For example, within this study nearly all mean SMD values from Tables 7 - 11 fell within what would be considered the highly effective range. Likewise, the majority of PEM values fell within the highly effective range. As a more conservative measure, PND values showed less of a restricted range and more differentiation. The tendency for PEM and SMD effect size metrics to be positively skewed provides a limited view of differing aspects of treatment effectiveness. However, each effect size metric provided a practical means for quantifying and comparing relative effects.

Connections to Prior Research

Functional behavioral assessment strategies.

Many of the findings from this quantitative synthesis are consistent with previous research. For example, a number of single-subject investigations have found function-based interventions superior to non-function-based interventions for students diagnosed with ADHD (e.g., Filter & Horner, 2009; Hawkins & Axelrod, 2008; Murphy, 2006). Based on the findings from the present investigation, the key to maximizing intervention effectiveness is identifying a *function* of the behavior. Descriptive ABC observations may not be optimal if the function is not clearly identified. Olympia and Larsen (2005) contended that, “The

ABC format…may also generate ambiguous or unclear information" (p. 4). If steps are not taken to identify the function of behavior, interventions may be less effective. These findings also speak to the ambiguity and variation within the FBA process. Ervin et al. (2001) spoke to this issue, stating that, "The widespread variations in methods and procedures across and within studies make it difficult to uncover the critical features or essential components of FBA" (p. 205). The question is: Is identifying environmental variables sufficient? Based on the findings from the present investigation, the answer appears to be no. A function must be specified and the intervention must be matched to that function in order to maximize treatment effectiveness.

These findings are also consistent with other single-subject meta-analyses. Campbell (2003) found including an FBA in intervention planning lead to more effective outcomes for individuals diagnosed with autism. Didden et al. (2006) also found FBAs to lead to more effective interventions for individuals with mild mental retardation. Lastly, Harvey and colleagues (2009) found including FBAs in intervention planning lead to more effective interventions for challenging behavior. The present investigation extended this prior research to include students diagnosed with ADHD.

In line with Campbell (2003) and Didden et al. (2006), the results from the present investigation also revealed that experimental functional analyses (FAs) were associated with larger effects than descriptive methods alone. O'Neill et al. (1997) described FAs as, " the most precise, rigorous, and controlled method of conducting a functional (behavioral) assessment" (p. 6). As such, it was expected that FAs would result in the development of more effective interventions. These findings add to the existing literature that attests to the utility of conducting FAs when time and resources permit.

Intervention strategies.

The findings from the present investigation are also consistent with recommendations made regarding best practices for developing interventions for students diagnosed with ADHD. For example, DuPaul and Stoner (2010) contend that multiple intervention agents should be used when implementing interventions for students diagnosed with ADHD. That is, they posit that interventions will be more effective when multiple agents are used. This contention was partially supported in the present investigation. Significantly larger PND effects were found when multiple intervention agents were used. However, the largest PEM effects were found when a researcher or research assistant implemented the intervention. Despite these contradictory findings, in the school setting researchers may not be present or available to implement interventions. Thus, in line with the assertion by DuPaul and Stoner (2010), it may be advisable to incorporate multiple intervention agents when designing and implementing interventions for students diagnosed with ADHD within the school setting.

According to Scott, Anderson, Mancil, and Alter (2009), "Problem behaviors are best reduced by replacing them with other similarly functional but more appropriate alternatives" (p. 426). Based on the findings from the present investigation, this statement holds some validity for students diagnosed with ADHD. When interventions targeted increasing appropriate behavior, effect sizes were significantly larger. These findings are consistent with what we know about ADHD and behavioral inhibition, which is thought to be a core deficit in individuals diagnosed with ADHD (Barkley, 2003). Given the body of evidence that demonstrates behavioral inhibition difficulties in individuals diagnosed with

ADHD (see Oosterlaan, Logan, & Sergeant, 1998), targeting behavioral inhibition may not be a highly effective practice within this demographic. Instead, it may be better advised to teach appropriate replacement skills.

With any intervention, it is always important to utilize the least restrictive alternative; treating ADHD is no exception. According to the findings of the present investigation, minimally restrictive interventions (structural changes or positive reinforcement-based interventions) are an effective means of initiating behavior change in students diagnosed with ADHD. DuPaul and Stoner (2003) contend that the core component of any behavioral intervention for students with ADHD should be positive reinforcement. This assertion is supported by these data, which demonstrate larger effects for these interventions than for more restrictive ones. However, given the limited number of interventions that utilized Level 2 (extinction) or Level 3 (negative punishment) approaches, these findings must be interpreted with caution. In line with the findings of Vegas (2005), Level 1 interventions are the type most commonly implemented.

Study characteristics.

It is encouraging to see increasing numbers of studies investigating important issues such as treatment integrity and social validity relative to prior research. For example, in the meta-analysis performed by DuPaul and Eckert (1997), only 14.5% of studies included information regarding treatment integrity and social validity. Comparatively, 57% of the current sample included social validity data while 53% included data regarding treatment integrity. However, there remains room for improvement and all studies should investigate these important and influential variables.

Due to their complexity, concerns have been raised regarding treatment integrity for FBA-based interventions (Lane, Smither, Huseman, Guffey, & Fox, 2007). Findings from the present investigation suggest that function-based interventions may have lower rates of treatment integrity on average than non-function based interventions, but within this sample these rates were still high and on average were above 90%. Thus, this investigation did not detect issues with treatment integrity for function-based interventions.

Furthermore, the number of studies that included a reliability assessment has increased relative to prior research: DuPaul and Eckert (1997) found 78% of their sample included this information while 91% of the present sample included reliability data. However, data from the present investigation also suggest that maintenance and generalization remain under-investigated, especially within the FBA sample. These findings are consistent with the findings of others, and suggest that FBA and intervention studies are lacking in addressing these issues (e.g., Fabiano et al., 2009; Wood, Blair, & Ferro, 2009).

Limitations

A number of limitations need to be addressed within the framework of this quantitative synthesis of single-subject research. First, nonparametric analyses did not permit the examination of mediating or moderating variables. That is, each variable could only be examined in isolation. This is problematic considering variables seldom operate in isolation within our natural environment. However, because the assumptions for parametric analyses could not be met, this investigation was an important first-step in understanding the influence of these variables on treatment effectiveness.

Relatedly, this study tested associations between effect sizes and variables. Hence, causal relationships could not be established. As such, these findings provide a framework for which to view associations between variables and effect sizes, but the non-experimental design did not permit the examination of causal effects. Therefore, it is important to remember that these findings do not suggest causal relationships, but rather associations between variables and treatment effectiveness.

Second, the meta-analytic process requires fitting variables into categories. While some categories were based on prior research (e.g., levels of intervention restrictiveness) others were not and had to be developed (e.g., intervention length). This procedure truncated the variability among studies but was a necessary step in the meta-analytic process. Thus, the vast variability among studies was not entirely captured. This is the trade-off that is made in meta-analytic research; in an effort to understand the broad body of literature, we cannot see the array of individual differences that exist between studies.

Third, it is important to consider the possibility that the studies that were included in the non-FBA group may have utilized FBA procedures but not reported them. Gresham et al. (2004) also noted this as a potential issue in their review. The length restrictions put on published studies may be a barrier in reporting information comprehensively. For example, the most common quality indicator not met by studies was "Adequate description of participants and settings". Given the length restrictions put forth by peer-reviewed journals, authors may be forced to omit these pertinent descriptions.

Additionally, the studies included in this quantitative synthesis are reflective of the literature base. That is, the majority of study participants were Caucasian, male, primary grade students. Although ADHD is diagnosed more often in males than females, further

research is needed to assess the efficacy of these interventions among various demographics. This issue is compounded by the fact that the majority of studies did not provide adequate descriptions of student demographic characteristics. For example, 61% of studies did not include information regarding participant ethnicity. It is essential that future research include adequate descriptions of participant demographic characteristics.

Fourth, there were limitations in the development of quality indicators in assessing single-subject research. Although Horner and colleagues (2005) did an excellent job delineating general indicators of quality in single-subject research, operationalizing these indicators into clear, meaningful, and non-subjective criteria proved to be a challenge. Challenges in developing reliable and valid methods to assess the quality of studies are well documented and are not unique to this investigation (see Greenland & O'Rourke, 2001). The term quality is subjective in and of itself and will likely vary based on the individual assessing quality. Therefore, the development and use of quality indicators within this investigation is considered necessary but insufficient. That is, they are flawed and should be interpreted with some caution, rather than taken as absolute values. For example, the quality indicator "Baseline has five or more data points" may not be highly indicative of study quality. Are studies containing four baseline data points really of less quality than those containing five? Not necessarily, however there needed to be some clear operationalization of a sufficient number of baseline data points. Furthermore, one quality indicator was dropped due to insufficient reliability. Unfortunately, this indicator is an essential component of single-subject research. Being able to demonstrate experimental control is crucial in establishing the internal validity of a study. However, given the complexity in analyzing level, trend, and variability simultaneously, it was difficult to reach agreement

regarding experimental control. These issues represent substantial limitations of the present investigation.

Finally, the lack of consensus regarding best practices in conducting single-subject meta-analyses made drawing conclusions difficult at times. The use of three different metrics was helpful in order to capture differing aspects of treatment effectiveness. For the most part, the effect sizes were in agreement, but there were times when all three were not (e.g., when examining intervention agents). Furthermore, no guidelines have been developed for the interpretation of the SMD metric for single-subject research. Because this metric often arrived at values greater than one, it could not be meaningfully interpreted within the same framework provided by Cohen (1988). That is, nearly all values fell within the highly effective range. As this area of study continues to grow, it is hoped that a greater consensus can be reached regarding how to best conduct single-subject meta-analyses to guide future research.

Directions for Future Research

This investigation provided further evidence that function-based interventions for students with ADHD are highly effective, more so than non-function based interventions. While it was hoped that this investigation would shed some light regarding best practices in conducting an FBA, this goal was only partially achieved. The results of this investigation suggest that identifying the function of behavior is important, and that experimental methods were associated with the largest effects. However, little is known regarding best practices for descriptive methods, as no significant differences were found among various methods. Future research should continue to investigate various descriptive methods and determine

which ones are associated with the development of more effective treatments. For example, which rating scales or interviews are associated with the greatest outcomes? Answers to these types of questions would help guide practitioners regarding best practices in conducting FBAs.

Likewise, although the findings from this investigation suggest that functional analysis (FA) manipulations are associated with better outcomes, little is known regarding the training and knowledge required to run these effectively. In this investigation, researchers were most often responsible for conducting FAs. Therefore, it remains unclear whether teachers or other school personnel could conduct FA manipulations of the same caliber. Additional research is needed to determine the skills and training necessary to conduct effective FA manipulations. Furthermore, these findings highlight the need for training these specialized skills to school professionals.

Relatedly, due to the non-experimental design of this meta-analysis, experimental single-subject research investigations should continue to explore the findings of this quantitative synthesis. These investigations could address and investigate causal relationships in a way not permitted by non-experimental research. These studies would provide further evidence either supporting or refuting the findings of this study, and help establish best practices in developing effective interventions for students diagnosed with ADHD.

As single subject research continues to grow, it is important to continue to refine methods for conducting single-subject meta-analytic research. Currently, hierarchical linear modeling (HLM) methods are being developed and offer a promising approach to conducting single-subject meta-analyses. While these methods continue to be refined, they

permit the examination of subjects as nested within studies, something not accounted for in the present investigation. At present, these methods have yet to be refined for single-subject meta-analyses, and consensus has yet to be reached regarding how to best model these types of data. It is hoped that HLM techniques will continue to be developed and provide an innovative way to synthesize single-subject research.

Another important area for future research involves the development of a reliable and validated method for determining the quality of single-subject research. Horner et al. (2005) initiated an important step in that direction by identifying aspects of quality in single subject designs. More recently, Kratochwill et al. (2010) developed technical standards for evaluating single-case design studies. However, the development of a validated instrument to assess study quality would also be of great value. Methods to operationalize experimental control and the development of actuarial methods to assess experimental control would be greatly beneficial for both single-subject research and the quantitative synthesis of single-subject research. Kratochwill et al. have made an important contribution in this respect; they conceptualize experimental control as existing on a continuum (i.e., strong evidence, moderate evidence, and no evidence) rather than as a dichotomous decision. Future research should utilize these standards to assess the quality of single-subject designs.

Lastly, this study investigated behavioral interventions for students diagnosed with ADHD, and the term “behavioral intervention” was fairly narrowly defined. Studies that investigated peer relationships and social skills were excluded from the present investigation in order to create continuity between groups. Likewise, academic variables were not investigated. However, these areas of research remain important in the development of

comprehensive interventions for students with ADHD. Future research should continue to investigate the effectiveness of these interventions within this demographic.

Implications for Practice

Although the nature of this investigation did not permit the analysis of causal pathways, some general recommendations can be made to guide practice based on the associations found within this study. First, behavioral interventions for students diagnosed with ADHD should be developed based on the identified function of the behavior. Second, functional analysis manipulations should be conducted in order to gain clear insight into the function of the behavior. Third, Level 1 reinforcement-based or structural interventions appear to be an effective way of initiating behavior change for these students. As such, these interventions should be utilized before other more restrictive alternatives. These interventions should focus on targeting and increasing appropriate behavior, rather than targeting disruptive behavior. Lastly, it may be beneficial for these interventions to be implemented by multiple intervention agents when possible.

Conclusion

The primary purpose of the present investigation was to determine if function-based interventions were more effective than non-function-based interventions for students diagnosed with ADHD. Clearly the results from one study or meta-analysis seldom constitute evidence-based practice, so it is important to consider the findings from the present investigation in the context of other research. The findings from this investigation, combined with findings from other single-subject studies and meta-analyses, provide compelling evidence for the importance of developing function-based interventions. As

Ervin et al. (2001) stated, "…very little is known regarding the effectiveness of interventions based on FBA relative to interventions derived in other ways" (p. 205). Others have also echoed this sentiment in recent years (e.g., DuPaul, 2007; Gresham et al., 2004). However, a body of evidence is growing in support of function-based interventions, and this investigation contributes to that growing evidence.

Furthermore, growing evidence points to the utility of including functional analysis (FA) manipulations in intervention planning. As suggested by the present analysis, these methods were vastly diverse and need not be conceptualized in the traditional manner originally put forth by Iwata et al. (1982). Although questions have arisen regarding the feasibility of FA manipulations in applied settings (e.g., Ervin et al., 2001), the advent of brief FA procedures and simple AB designs in testing environmental manipulations have expedited this process. However, based on findings from the present investigation, researchers are still the primary individuals responsible for conducting FAs. Thus, while including FA manipulations appears to be a best practice in developing effective, function-based interventions, the feasibility of individuals other than researchers conducting effective FAs remains unknown.

Aside from investigating characteristics associated with FBAs, this study also provided additional evidence in support of teaching appropriate replacement behaviors to students with ADHD and utilizing proactive, Level 1 interventions. These intervention strategies appear to be an effective means for initiating behavior change within this sample. Behavioral interventions are an important and effective way of addressing problem behavior for students with ADHD. The findings from the present investigation provide further support

for behavioral treatments for ADHD, and for the use of function-based interventions in addressing problem behavior.

References

References marked with an asterisk indicate studies included in the meta-analysis.

Abramowitz, A. J., & O'Leary, S. G. (1991). Behavioral interventions for the classroom: Implications for students with ADHD. *School Psychology Review, 20*, 220-234.

Adelman, H. S., & Taylor, L. (2006). *The implementation guide to student learning supports in the classroom and schoolwide: New directions for addressing barriers to learning* (pp. 49-77). Thousand Oaks, CA: Corwin Press.

American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, DC: Author.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: American Psychiatric Association.

* Ashcroft, R. (1990). *A nonaversive intervention into the disruptive classroom behaviors of young boys labeled seriously emotionally disturbed* (Unpublished doctoral dissertation). University of San Francisco, San Francisco, CA.

Ayllon, T. (1999). *How to use token economy and point systems* (2nd ed.). Austin, TX: Pro-Ed.

Barbaresi, W. J., Katusic, S. K., Colligan, R. C., Weaver, A. L., & Jacobsen, S. J. (2007). Long-term school outcomes for children with attention-deficit/hyperactivity disorder: A population-based perspective. *Journal of Developmental and Behavioral Pediatrics, 28*, 265-273. doi:10.1097/DBP.0b013e31811ff87d

Barkley, R. A. (1997). Attention-deficit/hyperactivity disorder, self-regulation, and time: Toward a more comprehensive theory. *Journal of Developmental & Behavioral Pediatrics, 18*, 271-279. Retrieved from www.csa.com

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

Barkley, R. A. (2003). Attention-deficit/hyperactivity disorder. In E. J. Mash, & R. A. Barkley (Eds.), *Child psychopathology* (2nd ed., pp. 75-143). New York, NY: Guilford Press.

Barkley, R. A., Cook, E. H., Dulcan, M., Campbell, S., Prior, M., Atkins, M., … Lewandowski, L. (2002). Consensus statement on ADHD. *European Child & Adolescent Psychiatry, 11*, 96-98. doi:10.1007/s007870200017

Barkley, R. A., Fischer, M., Edelbrock, C. S., & Smallish, L. (1990). The adolescent outcome of hyperactive children diagnosed by research criteria: I. An 8-year prospective follow-up study. *Journal of the American Academy of Child & Adolescent Psychiatry, 29*, 546-557. doi:10.1097/00004583-199007000-00007

Barry, T. D., Klinger, L. G., Lyman, R. D., Bush, D., & Hawkins, L. (2001). Visual selective attention versus sustained attention in boys with attention-deficit/hyperactivity disorder. *Journal of Attention Disorders, 4*, 193-202. doi:10.1177/108705470100400401

Beeson, P. M., & Robey, R. R. (2006). Evaluating single-subject treatment research: Lessons learned from the aphasia literature. *Neuropsychology Review, 16,* 161-169.

Biederman, J., Faraone, S., Milberger, S., Guite, T., Mick, E. & Chen, L. (1996). A prospective 4-year follow-up study of attention-deficit hyperactivity and related disorders. *Archives of General Psychiatry,* 53, 437-446.

Beretvas, S. N., & Chung, H. (2008). A review of meta-analyses of single-subject experimental designs: Methodological issues and practice. *Evidence-Based Communication Assessment and Intervention, 2*(3), 129-141.

Beto, J. A., & Bansal, V. K. (1992). Quality of life in treatment of hypertension. *American Journal of Hypertension*. 5, 125-133.

BioSoft (2004). Ungraph for Windows (Version 5.0). Cambridge, U.K.: Author.

* Blair, K.C., Umbreit, J., & Bos, C.S. (1999). Using functional assessment and children's preferences to improve the behavior of young children with behavioral disorders. *Behavioral Disorders*, *24*, 151-166.

Bloom, B., & Cohen, R. A. (2007). Summary health statistics for U.S. children: National Health Interview Survey, 2006. *Vital and Health Statistics*, Series 10(234). Hyattsville, MD: National Center for Health Statistics. Retrieved from http://www.cdc.gov/nchs/data/series/sr_10/sr10_234.pdf

Bowen, J. M., Jenson, W. R., & Clark, E. (2004). *School-based interventions for students with behavior problems* (pp. 27-43). New York, NY: Kluwer Academic/Plenum.

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

* Bradley-Klug, K. L. (1997). The effects of a self-management intervention on the classroom behavior of young adolescents with attention deficit hyperactivity disorder. Unpublished doctoral dissertation, Lehigh University.

Brophy, J. (1988). Research linking teacher behavior to student achievement: Potential implications for instruction of chapter 1 students. *Educational Psychologist, 23*, 235-286. doi:10.1207/s15326985ep2303_3

* Broussard, C. D., & Northup, J. (1995). An approach to functional assessment and analysis of disruptive behavior in regular education classrooms. *School Psychology Quarterly, 10*, 151-164. doi:10.1037/h0088301

* Broussard, C., & Northup, J. (1997). The use of functional analysis to develop peer interventions for disruptive classroom behavior. *School Psychology Quarterly*, 12, 65-76. doi:10.1037/h0088948

Busk, P. L., & Serlin, R. C. (1992). Meta-analysis for single-case research. In T. R. Kratochwill & J. R. Levin (Eds.), *Single-case research design and analysis: New directions for psychology and education* (pp. 187-212). Hillsdale, NJ: Erlbaum.

Campbell, J. M. (2003). Efficacy of behavioral interventions for reducing problem behavior in persons with autism: A quantitative synthesis of single-subject research. *Research in Developmental Disabilities*. 24, 120-138.

Campbell, J. M. (2004). Statistical comparison of four effect sizes for single-subject designs. *Behavior Modification, 28*, 234-246. doi:10.1177/0145445503259264

Carr, E. G. (1977). The motivation of self-injurious behavior: A review of some hypotheses. *Psychological Bulletin, 84*, 800-816. doi:10.1037/0033-2909.84.4.800

Carr, E. G. (1994). Emerging themes in the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 27*, 393-399. doi:10.1901/jaba.1994.27-393

Carr, E. G., Newsom, C. D., & Binkoff, J. A. (1980). Escape as a factor in the aggressive behavior of two retarded children. *Journal of Applied Behavior Analysis, 13*, 101-117. doi:10.1901/jaba.1980.13-101

Chee, P., Logan, G., Schachar, R. J., & Lindsay, P. (1989). Effects of event rate and display time on sustained attention in hyperactive, normal, and control children. *Journal of Abnormal Child Psychology, 17*, 371-391. doi:10.1007/BF00915033

* Chiang, C. L. (1995). *Effects of self-monitoring on children with attention-deficit hyperactivity disorder* (Unpublished doctoral dissertation). University of Northern Colorado, Greeley, CO.

Chronis, A. M., Jones, H. A., & Raggi, V. L. (2006). Evidence-based psychosocial treatments for children and adolescents with attention-deficit/hyperactivity disorder. *Clinical Psychology Review, 26*, 486-502. doi:10.1016/j.cpr.2006.01.002

* Clarke, S., Dunlap, G., Foster-Johnson, L., Childs, K. E., Wilson, D., White, R., & Vera, A. (1995). Improving the conduct of students with behavioral disorders by incorporating student interests into curricular activities. *Behavioral Disorders, 20*, 221-237.

Cohen, J. (1988). *Statistical power for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

* Coles, E. K., Pelham, W. E., Gnagy, E. M., Burrows-MacLean, L., Fabiano, G. A., Chacko, A., . . . Robb, J. A. (2005). A controlled evaluation of behavioral treatment with children with ADHD attending a summer treatment program. *Journal of*

Emotional and Behavioral Disorders, 13(2), 99-112. doi:10.1177/10634266050130020301

Cooper, H., & Hedges, L. V. (2009). Research synthesis as a scientific process. In H. Cooper, L. V. Hedges & J. C. Valentine (Eds.), *The handbook of research synthesis and meta-analysis* (2nd ed., pp. 3-16). New York, NY: Russell Sage Foundation.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed, pp. 2-14). Upper Saddle River, NJ: Pearson Prentice Hall.

* Cormier, E. (2004*). Effects of in-home parent training for parents of children with attention deficit hyperactivity disorder (ADHD) based on results of a brief functional analysis.* (Unpublished doctoral dissertation). University of Florida, Gainesville, FL.

* Cowick, B. S. (1996). *Functional assessment: Development and evaluation of a comprehensive treatment program for youth with mild disabilities* (Unpublished doctoral dissertation). University of California, Berkeley, CA.

* Davies, S., & Witte, R. (2000). Self-management and peer-monitoring within a group contingency to decrease uncontrolled verbalizations of children with attention-deficit/hyperactivity disorder. *Psychology in the Schools, 37*, 135-147. doi:10.1002/(SICI)1520-6807(200003)37:2<135::AID-PITS5>3.0.CO;2-U

Dawes, R. M., Faust, D., & Meehl, P. E. (1989). Clinical versus actuarial judgment. *Science, 243,* 1668–1674.

* Didden, R., Curfs, L. M. G., Sikkema, S. P. E., & de Moor, J. (1998). Functional assessment and treatment of sleeping problems with developmentally disabled children: Six case studies. *Journal of Behavior Therapy and Experimental Psychiatry, 29*(1), 85-97. doi:10.1016/S0005-7916(97)00038-4

Didden, R., Korzilius, H., van Oorsouw, W., & Sturmey, P. (2006). Behavioral treatment of challenging behaviors in individuals with mild mental retardation: Meta-analysis of single-subject research. *American Journal on Mental Retardation, 111*, 290-298.

* Ducharme, J. M., & Harris, K. E. (2005). Errorless embedding for children with on-task and conduct difficulties: Rapport-based, success-focused intervention in the classroom. *Behavior Therapy, 36*, 213-222. doi:10.1016/S0005-7894(05)80070-X

* Dunlap, G., dePerczel, M., Clarke, S., Wilson, D., Wright, S., White, R., & Gomez, A. (1994). Choice making to promote adaptive behavior for students with emotional and behavioral challenges. *Journal of Applied Behavior Analysis, 27*, 505-518. doi:10.1901/jaba.1994.27-505

* Dunlap, G., Foster-Johnson, L., Clarke, S., Kern, L., & Childs, K. E. (1995). Modifying activities to produce functional outcomes: Effects on the problem behaviors of students with disabilities. *Journal of the Association for Persons with Severe Handicaps, 20*, 248-258

* Dunlap, G., Kern-Dunlap, L., Clarke, S., & Robbins, F. R. (1991). Functional assessment, curricular revision, and severe behavior problems. *Journal of Applied Behavior Analysis, 24*, 387-397. doi:10.1901/jaba.1991.24-387

Dunlap, G., White, R., Vera, A., Wilson, D., & Panacek, L. (1996). The effects of multi-component, assessment-based curricular modifications on the classroom behavior of children with emotional and behavioral disorders. *Journal of Behavioral Education, 6*, 481-500. doi:10.1007/BF02110518

DuPaul, G. J. (2007). School-based interventions for students with attention deficit hyperactivity disorder: Current status and future directions. *School Psychology Review, 36*, 183-194.

DuPaul, G. J., & Eckert, T. L. (1997). The effects of school-based interventions for attention deficit hyperactivity disorder: A meta-analysis. *School Psychology Review, 26*, 5-27.

DuPaul, G. J., Eckert, T. L., & McGoey, K. E. (1997). Interventions for students with attention-deficit/hyperactivity disorder: One size does not fit all. *School Psychology Review, 26*, 369-381.

DuPaul, G. J., & Ervin, R. A. (1996). Functional assessment of behaviors related to attention-deficit/hyperactivity disorder: Linking assessment to intervention design. *Behavior Therapy, 27*, 601-622. Retrieved from www.csa.com

* DuPaul, G. J., Guevremont, D. C., & Barkley, R. A. (1992). Behavioral treatment of attention-deficit hyperactivity disorder in the classroom: The use of the attention training system. *Behavior Modification, 16*, 204-225. doi:10.1177/01454455920162004

DuPaul, G. J., & Stoner, G. (2003). *ADHD in the schools: Assessment and intervention strategies* (2nd ed.). New York, NY: Guilford Press.

DuPaul, G. J., & Stoner, G. (2010). Interventions for attention deficit hyperactivity disorder. In M. R. Shinn & H. M. Walker (Eds.), *Interventions for achievement and behavior problems in a three-tier model including RTI* (pp. 825-848). Bethesda, MD: NASP Publications.

* Durand, V. M., & Carr, E. G. (1992). An analysis of maintenance following functional communication training. *Journal of Applied Behavior Analysis, 25*, 777-794. doi:10.1901/jaba.1992.25-777

* Edwards, W. H., Magee, S. K., & Ellis, J. (2002). Identifying the effects of idiosyncratic variables on functional analysis outcomes: A case study. *Education and Treatment of Children, 25*, 317-330. Retrieved from www.csa.com

Ellingson, S. A., Miltenberger, R. G., Stricker, J., Galensky, T. L., & Garlinghouse, M. (2000). Functional assessment and intervention for challenging behaviors in the classroom by general classroom teachers. *Journal of Positive Behavior Interventions, 2*(2), 85-97. doi:10.1177/109830070000200202

* Ervin, R. A., DuPaul, G. J., Kern, L., & Friman, P. C. (1998). Classroom-based functional and adjunctive assessments: Proactive approaches to intervention selection for adolescents with attention deficit hyperactivity disorder. *Journal of Applied Behavior Analysis, 31*, 65-78. doi:10.1901/jaba.1998.31-65

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

Ervin, R. A., Kern, L., Clarke, S., DuPaul, G. J., Dunlap, G., & Friman, P. C. (2000). Evaluating assessment-based intervention strategies for students with ADHD and comorbid disorders within the natural classroom context. *Behavioral Disorders, 25*, 344-358.

Ervin, R. A., Radford, P. M., Bertsch, K., Piper, A. L., Ehrhardt, K. E., & Poling, A. (2001). A descriptive analysis and critique of the empirical literature on school-based functional assessment. *School Psychology Review, 30*, 193-210.

* Evans, J. H., Ferre, L., Ford, L. A., & Green, J. L. (1995). Decreasing attention deficit hyperactivity disorder symptoms utilizing an automated classroom reinforcement device. *Psychology in the Schools, 32*, 210-219. doi:10.1002/1520-6807(199507)32:3<210::AID-PITS2310320308>3.0.CO;2-8

* Fabiano, G. A., & Pelham, W. E., Jr. (2003). Improving the effectiveness of behavioral classroom interventions for attention-deficit/hyperactivity disorder: A case study. *Journal of Emotional and Behavioral Disorders, 11*, 124-130. doi:10.1177/106342660301100206

Fabiano, G. A., Pelham, W. E., Jr., Coles, E. K., Gnagy, E. M., Chronis-Tuscano, A., & O'Connor, B. C. (2009). A meta-analysis of behavioral treatments for attention-deficit/hyperactivity disorder. *Clinical Psychology Review, 29*, 129-140. doi:10.1016/j.cpr.2008.11.001

Faraone, S. V., Biederman, J., Morley, C. P., & Spencer, T. J. (2008). Effect of stimulants on height and weight: A review of the literature. *Journal of the American Academy of Child & Adolescent Psychiatry, 47*, 994-1009. doi:10.1097/CHI.0b013e31817e0ea7

Federal Interagency Forum on Child and Family Statistics. (2005). *America's children: Key national indicators of well-being.* Federal Interagency Forum on Child and Family Statistics, Washington, DC: U.S. Government Printing Office. Retrieved from http://childstats.gov/pdf/ac2007/ac_07.pdf

Fergusson, D. M., Lynskey, M. T., & Horwood, L. J. (1997). Attentional difficulties in middle childhood and psychosocial outcomes in young adulthood. *Journal of Child Psychology and Psychiatry, 38*, 633-644. doi:10.1111/j.1469-7610.1997.tb01690.x

* Filter, K. J., & Horner, R. H. (2009). Function-based academic interventions for problem behavior. *Education and Treatment of Children, 32*(1), 1-19. Retrieved from www.csa.com

* Flood, W. A., & Wilder, D. A. (2002). Antecedent assessment and assessment-based treatment of off-task behavior in a child diagnosed with attention deficit-hyperactivity disorder (ADHD). *Education and Treatment of Children, 25*, 331-338. Retrieved from www.csa.com

* Flood, W. A., Wilder, D. A., Flood, A. L., & Masuda, A. (2002). Peer-mediated reinforcement plus prompting as treatment for off-task behavior in children with attention deficit hyperactivity disorder. *Journal of Applied Behavior Analysis, 35*, 199-204. doi:10.1901/jaba.2002.35-199

Frazier, T. W., Youngstrom, E. A., Glutting, J. J., & Watkins, M. W. (2007). ADHD and achievement: Meta-analysis of the child, adolescent, and adult literatures and a concomitant study with college students. *Journal of Learning Disabilities, 40*, 49-65. Retrieved from www.csa.com

Glass, G. V. (1976). Primary, secondary, and meta-analysis of research. *The Educational Researcher,* 10, 3-8.

Goldman, L. S., Genel, M., Bezman, R. J., & Slanetz, P. J. (1998). Diagnosis and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Journal of the American Medical Association, 279*, 1100-1107. doi:10.1001/jama.279.14.1100

Gordon, M., Mettelman, B. B., & Irwin, M. (1994). Sustained attention and grade retention. *Perceptual and Motor Skills, 78*, 555-560. Retrieved from www.csa.com

* Gordon, M., Thomason, D., Cooper, S., & Ivers, C. L. (1991). Nonmedical treatment of

ADHD/hyperactivity: The attention training system. *Journal of School Psychology, 29*, 151-159. doi:10.1016/S0022-4405(05)80007-X

Greenland, S. & O'Rourke, K. (2001). On the bias produced by quality scores in meta-analysis, and a hierarchical view of proposed solutions. *Biostatistics*, *2*, 463-471. doi: 10.1093/biostatistics/2.4.463

Gresham, F. M. (1991). Conceptualizing behavior disorders in terms of resistance to intervention. *School Psychology Review, 20*, 23-36.

Gresham, F. M., McIntyre, L. L., Olson-Tinker, H., Dolstra, L., McLaughlin, V., & Van, M. (2004). Relevance of functional behavioral assessment research for school-based interventions and positive behavioral support. *Research in Developmental Disabilities, 25*(1), 19-37. doi:10.1016/j.ridd.2003.04.003

Gresham, F., Watson, T. S., & Skinner, C. H. (2001). Functional behavioral assessment: Principles, procedures, and future directions. *School Psychology Review, 30*, 156-172.

* Gulley, V., Northup, J., Hupp, S., Spera, S., LeVelle, J., & Ridgway, A. (2003). Sequential evaluation of behavioral treatments and methylphenidate dosage for hyperactivity disorder. *Journal of Applied Behavior Analysis, 36*, 375-378. doi:10.1901/jaba.2003.36-375

* Gureasko-Moore, S., DuPaul, G. J., & White, G. P. (2006). The effects of self-management in general education classrooms on the organizational skills of adolescents with ADHD. *Behavior Modification, 30*, 159-183. doi:10.1177/0145445503259387

* Gureasko-Moore, S., DuPaul, G. J., & White, G. P. (2007). Self-management of classroom preparedness and homework: Effects on school functioning of adolescents with attention deficit hyperactivity disorder. *School Psychology Review, 36*, 647-664. Retrieved from www.csa.com

Haenlein, M., & Caul, W. F. (1987). Attention deficit disorder with hyperactivity: A specific hypothesis of reward dysfunction. *Journal of the American Academy of Child & Adolescent Psychiatry, 26*, 356-362. doi:10.1097/00004583-198705000-00014

Hall, J. A., & Rosenthal, R. (1995). Interpreting and evaluating meta-analysis. *Evaluation & the Health Professions*, *18*, 393-407.

* Hawkins, R. O., & Axelrod, M. I. (2008). Increasing the on-task homework behavior of youth with behavior disorders using functional behavioral assessment. *Behavior Modification, 32*, 840-859. doi:10.1177/0145445508318846

Hedges, L. V., & Olkin, I. (1985). *Statistical methods for meta-analysis*. San Diego, CA: Academic Press.

Hoff, K. E., Doepke, K., & Landau, S. (2002). Best practices in the assessment of children with attention deficit/hyperactivity disorder: Linking assessment to intervention. In A. Thomas, & J. Grimes (Eds.), *Best practices in school psychology IV* (pp. 1129-1150). Washington, DC: National Association of School Psychologists.

* Hoff, K. E., Ervin, R. A., & Friman, P. C. (2005). Refining functional behavioral assessment: Analyzing the separate and combined effects of hypothesized controlling variables during ongoing classroom routines. *School Psychology Review, 34*, 45-57. Retrieved from www.csa.com

Horner, R. H., Carr, E. G., Halle, J., Mcgee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71*, 165-179.

Huitema, B. E. (1985). Autocorrelation in applied behavior analysis: A myth. *Behavioral Assessment, 7*, 107-118. Retrieved from www.csa.com

Individuals with Disabilities Education Act Amendments of 1997 (IDEA; 1997), 20 U.S.C. 1400 *et seq*.

Ingram, K., Lewis-Palmer, T., & Sugai, G. (2005). Function-based intervention planning: Comparing the effectiveness of FBA function-based and non-function-based intervention plans. *Journal of Positive Behavior Interventions, 7*, 224-236. doi:10.1177/10983007050070040401

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*, 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities,*1982 *2*, 3–20.)

Jenson, W. R., Clark, E., Kircher, J. C., & Kristjansson, S. D. (2007). Statistical reform: Evidence-based practice, meta-analyses, and single subject designs. *Psychology in the Schools, 44*, 483-493. doi:10.1002/pits.20240

Johansen, E. B., Killeen, P. R., Russell, V. A., Tripp, G., Wickens, J. R., Tannock, R., . . . Sagvolden, T. (2009). Origins of altered reinforcement effects in ADHD. *Behavioral and Brain Functions, 5*:7. doi:10.1186/1744-9081-5-7

Johnson, K. A., Wiersema, J. R., & Kuntsi, J. (2009). What would Karl Popper say? Are current psychological theories of ADHD falsifiable? *Behavioral and Brain Functions, 5*:15. doi:10.1186/1744-9081-5-15

* Johnson, C. M., Yehl, J. F., & Stack, J. M. (1989). Compliance training in a child with attention deficit-hyperactivity disorder: A case study. *Family Practice Research Journal, 9*, 73-80. Retrieved from www.csa.com

* Jones, K. M., Drew, H. A., & Weber, N. L. (2000). Noncontingent peer attention as treatment for disruptive classroom behavior. *Journal of Applied Behavior Analysis, 33*, 343-346. doi:10.1901/jaba.2000.33-343

* Jurbergs, N., Palcic, J., & Kelley, M. L. (2007). School-home notes with and without response cost: Increasing attention and academic performance in low-income children with attention-deficit/hyperactivity disorder. *School Psychology Quarterly, 22*, 358-379. doi:10.1037/1045-3830.22.3.358

Kapalka, G. M., & Bryk, L. J. (2007). Two- to four-minute time-out is sufficient for young boys with ADHD. *Early Childhood Services, 1*, 181-188. Retrieved from www.csa.com

* Kayser, K. H., Wacker, D. P., Derby, K. M., & Andelman, M. S., Golonka, Z., Stoner, E. A. (1997). A rapid method for evaluating the necessity for both a behavioral intervention and methylphenidate. *Journal of Applied Behavior Analysis, 30*, 177-180. doi:10.1901/jaba.1997.30-177

Kazdin, A. E. (1982). *Single-case research designs: Methods for clinical and applied settings*. New York: Oxford University Press.

* Kelley, M. L., & McCain, A. P. (1995). Promoting academic performance in inattentive children: The relative efficacy of school-home notes with and without response cost. *Behavior Modification, 19*(3), 357-375. doi:10.1177/01454455950193006

* Kern, L., Delaney, B., Clarke, S., Dunlap, G., & Childs, K. (2001). Improving the classroom behavior of students with emotional and behavioral disorders using individualized curricular modifications. *Journal of Emotional and Behavioral Disorders, 9*, 239-247. doi:10.1177/106342660100900404

* Kern, L., Mantegna, M. E., Vorndran, C. M., Bailin, D., & Hilt, A. (2001). Choice of task sequence to reduce problem behaviors. *Journal of Positive Behavior Interventions, 3*, 3-10. doi:10.1177/109830070100300102

* Kern, L., Ringdahl, J. E., Hilt, A., & Sterling-Turner, H. E. (2001). Linking self-management procedures to functional analysis results. *Behavioral Disorders, 26*, 214-226. Retrieved from www.csa.com

* Kodak, T., Grow, L., & Northup, J. (2004). Functional analysis and treatment of elopement for a child with attention deficit hyperactivity disorder. *Journal of Applied Behavior Analysis, 37*, 229-232. doi:10.1901/jaba.2004.37-229

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M & Shadish, W. R. (2010). Single-case designs technical documentation. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/wwc_scd.pdf.

Lane, K. L., Smither, R., Huseman, R., Guffey, J., & Fox, J. A function-based intervention to decrease disruptive behavior and increase academic engagement. *Journal of Early and Intensive Behavior Intervention, 3,* 348-364.

Lee, D. L. (2001). Behavioral momentum coding protocol. Unpublished instrument.

Lee, D. L. & Axelrod, S. (2005). *Behavior modification: Basic principles.* Austin, Texas: ProEd.

Liaupsin, C. J., & Scott, T. M. (2008). Disruptive behavior. In R. J. Morris, & N. Mather (Eds.), *Evidence-based interventions for students with learning and behavioral challenges.* (pp. 59-78). New York, NY: Routledge/Taylor & Francis Group. Retrieved from www.csa.com

* Lo, L., & Cartledge, G. (2006). FBA and BIP: Increasing the behavior adjustment of African American boys in schools. *Behavioral Disorders, 31*, 147-161.

Loe, I. M., & Feldman, H. M. (2007). Academic and educational outcomes of children with ADHD. *Journal of Pediatric Psychology, 32*, 643-654. doi:10.1093/jpepsy/jsl054

* Luiselli, J. K., & Pine, J. (1999). Social control of childhood stealing in a public school: A case study. *Journal of Behavior Therapy and Experimental Psychiatry, 30*(3), 231-239. doi:10.1016/S0005-7916(99)00023-3

Luman, M., Oosterlaan, J., & Sergeant, J. A. (2005). The impact of reinforcement contingencies on AD/HD: A review and theoretical appraisal. *Clinical Psychology Review, 25*, 183-213. doi:10.1016/j.cpr.2004.11.001

Ma, H. (2006). An alternative method for quantitative synthesis of single-subject researches: Percentage of data points exceeding the median. *Behavior Modification, 30*, 598-617. doi:10.1177/0145445504272974

* Magee, S., K., & Ellis, J. (2000). Extinction effects during the assessment of multiple problem behaviors. *Journal of Applied Behavior Analysis, 33*, 313-316.

Manolov, R., Solanas, A., & Leiva, D. (2010). Comparing "visual" effect size indices for single-case designs. *Methodology, 6*, 49-58. doi:10.1027/1614-2241/a000006

Mannuzza, S., & Klein, R. G. (2000). Long-term prognosis in attention-deficit/hyperactivity disorder. *Child and Adolescent Psychiatric Clinics of North America, 9*, 711-726. Retrieved from www.csa.com

* Mathes, M. Y., & Bender, W. N. (1997). The effects of self-monitoring on children with attention deficit/hyperactivity disorder who are receiving pharmacological interventions. *Remedial and Special Education, 18*(2), 121-128. doi:10.1177/074193259701800206

* McCain, A. P., & Kelley, M. L. (1993). Managing the classroom behavior of an ADHD preschooler: The efficacy of a school-home note intervention. *Child & Family Behavior Therapy, 15*, 33-44. doi:10.1300/J019v15n03_03

* McGoey, K. E., & DuPaul, G. J. (2000). Token reinforcement and response cost procedures: Reducing the disruptive behavior of preschool children with attention-deficit/hyperactivity disorder. *School Psychology Quarterly, 15*, 330-343. doi:10.1037/h0088790

Meyer, K. A. (1999). Functional analysis and treatment of problem behavior exhibited by elementary school children. *Journal of Applied Behavior Analysis, 32,* 229-232.

MTA Cooperative Group. (1999). A 14-month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. *Archives of General Psychiatry, 56,* 1073−1086.

* Murphy, C. (2007). *An investigation of the relative effectiveness of function-based and non-function-based behavioral interventions* (Unpublished doctoral dissertation). The Pennsylvania State University, State College, PA.

Nakagawa, S. (2004). A farewell to Bonferroni: The problems of low statistical power and publication bias. *Behavioral Ecology, 15*, 1044-1045. doi: 10.1093/beheco/arh107

National Institute of Mental Health. (2008). Attention deficit hyperactivity disorder. Retrieved from http://www.nimh.nih.gov/health/publications/attention-deficit-hyperactivity-disorder/complete-index.shtml

Neef, N., & Northup, J. (2007). Attention deficit hyperactivity disorder. In P. Sturmey (Ed.), *Functional analysis in clinical treatment.* (pp. 87-110). San Diego, CA: Elsevier Academic Press.

Nelson, J. R., Mathur, S. R., & Rutherford, R.B. (1999). Has public policy exceeded our knowledge base? A review of the functional behavioral assessment literature. *Behavioral Disorders*, *24*, 169-179.

Newcomer, L. L., & Lewis, T. J. (2004). Functional behavioral assessment: An investigation of assessment reliability and effectiveness of function-based interventions. *Journal of Emotional and Behavioral Disorders, 12*, 168-181. doi:10.1177/10634266040120030401

No Child Left Behind Act of 2001, Pub. L. No. 107-110, § 115, Stat. 1425 (2002).

Northup, J., Broussard, C., Jones, K., & George, T. (1995). The differential effects of teacher and peer attention on the disruptive classroom behavior of three children

with a diagnosis of attention deficit hyperactivity disorder. *Journal of Applied Behavior Analysis, 28*, 227-228. doi:10.1901/jaba.1995.28-227

Northup, J., & Gulley, V. (2001). Some contributions of functional analysis to the assessment of behaviors associated with attention deficit hyperactivity disorder and the effects of stimulant medication. *School Psychology Review, 30*, 227-238.

Nusz, T. E. (2009). Current practices in functional behavioral assessment: A national survey of school psychologists. Unpublished doctoral dissertation: Indiana University of Pennsylvania, Pennsylvania.

Olympia, D. & Larsen, J. (2005). Functional behavioral assessment: An emerging component of best school practices for ADHD. *The ADHD Report, 5(13),* 1-5.

O'Neill, R. E., Horner, R. H., Albin, R. W., Sprague, J. R., Storey, K., & Newton, J. S. (1997). *Functional assessment and program development for problem behavior: A practical handbook*. Pacific Grove, CA: Brookes/Cole.

Oosterlaan, J., Logan, G. D., & Sergeant, J. A. (1998). Response inhibition in AD/HD, CD, comorbid AD/HD + CD, anxious, and control children: A meta-analysis of studies with the stop task. *Journal of Child Psychology and Psychiatry, 39*(3), 411-425. doi:10.1017/S0021963097002072

* Paniagua, F. A., Morrison, P. B., & Black, S. A. (1990). Management of a hyperactive-conduct disordered child through correspondence training: A preliminary study. *Journal of Behavior Therapy and Experimental Psychiatry, 21*, 63-68. doi:10.1016/0005-7916(90)90050-U

* Paniagua, F. A., Pumariega, A. J., & Black, S. A. (1988). Clinical effects of correspondence training in the management of hyperactive children. *Behavioral Residential Treatment, 3*, 19-40. doi:10.1002/bin.2360030103

Parker, R. I., Hagan-Burke, S., & Vannest, K. (2007). Percentage of all non-overlapping data (PAND): An alternative to PND. *The Journal of Special Education, 40*, 194-204. doi:10.1177/00224669070400040101

Parsonson, B. S., & Baer, D. M. (1992). The visual analysis of data, and current research into the stimuli controlling it. In T. R. Kratochwill, & J. R. Levin (Eds.), *Single-case research design and analysis: New directions for psychology and education.* (pp. 15-40). Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.

Pelham, W. E., Burrows-MacLean, L., Gnagy, E. M., Fabiano, G. A., Coles, E. K., Tresco, K. E., . . . Hoffman, M. T. (2005). Transdermal methylphenidate, behavioral, and combined treatment for children with ADHD. *Experimental and Clinical Psychopharmacology, 13*(2), 111-126. doi:10.1037/1064-1297.13.2.111

Pelham, W. E., & Fabiano, G. A. (2008). Evidence-based psychosocial treatments for attention-deficit/hyperactivity disorder. *Journal of Clinical Child and Adolescent Psychology, 37*, 184-214. doi:10.1080/15374410701818681

Pelham, W. E., Jr., Wheeler, T., & Chronis, A. (1998). Empirically supported psychosocial treatments for attention deficit hyperactivity disorder. *Journal of Clinical Child Psychology, 27*, 190-205. Retrieved from www.csa.com

Perwien, A., Hall, J., Swensen, A., & Swindle, R. (2004). Stimulant treatment patterns and compliance in children and adults with newly treated attention-deficit/hyperactivity disorder. *Journal of Managed Care Pharmacy, 10*(2), 122-129.

Petitti, D. B. (2000). *Meta-analysis, decision-analysis, and cost-effectiveness analysis: Methods for quantitiative synthesis in medicine* (2nd ed., pp. 89-93). New York, NY: Oxford University Press.

* Posavac, H. D., Sheridan, S. M., & Posavac, S. S. (1999). A cueing procedure to control impulsivity in children with attention deficit hyperactivity disorder. *Behavior Modification, 23*, 234-253. doi:10.1177/0145445599232003

Planty, M., Hussar, W., Snyder, T., Kena, G., Kewal-Ramani, A., Kemp, J., …Dinkes, R. (2009). *The Condition of Education 2009* (NCES 2009-081). Retrieved from http://nces.ed.gov/pubs2009/2009081.pdf

Public Agenda. (2004). *Teaching interrupted: Do discipline policies in today's public schools foster the common good*? New York: Author. Retrieved from http://commongood.org/assets/attachments/22.pdf

Quinn, M. M., Gable, R. A., Fox, J., Rutherford, R. B., Van Acker, R., & Conroy, M. (2001). Putting quality functional assessment into practice in the schools: A research agenda on behalf of E/BD students. *Education and Treatment of Children, 24*, 261-275.

* Radford, P. M., & Ervin, R. A. (2002). Employing descriptive functional assessment methods to assess low-rate, high-intensity behaviors: A case example. *Journal of Positive Behavior Interventions, 4*, 146-155. doi:10.1177/10983007020040030301

* Rapport, M. D., Murphy, H. A., & Bailey, J. S. (1982). Ritalin vs. response cost in the control of hyperactive children: A within-subject comparison. *Journal of Applied Behavior Analysis, 15*, 205-216. doi:10.1901/jaba.1982.15-205

Reid, R., & Maag, J. W. (1998). Functional assessment: A method for developing classroom-based accommodations and interventions for children with ADHD. *Reading & Writing Quarterly, 14*(1), 9-42. doi:10.1080/1057356980140102

* Reitman, D., Hupp, S. D. A., O'Callaghan, P. M., Gulley, V., & Northup, J. (2001). The influence of a token economy and methylphenidate on attentive and disruptive behavior during sports with ADHD-diagnosed children. *Behavior Modification, 25*(2), 305-323. doi:10.1177/0145445501252007

Reitman. D., & Passeri, C. (2008). Use of stimulus-fading and functional assessment to treat pill refusal with an 8-year-old boy diagnosed with ADHD. *Clinical Case Studies*, *7,* 224-237.

Repp, A. C., Felce, D., & Barton, L. E. (1988). Basing the treatment of stereotypic and self-injurious behaviors on hypotheses of their causes. *Journal of Applied Behavior Analysis, 21*, 281-289. doi:10.1901/jaba.1988.21-281

Rogers, L., & Graham, S. (2008). A meta-analysis of single subject design writing intervention studies. *Journal of Educational Psychology*.

* Romaniuk, C., Miltenberger, R., Conyers, C., Jenner, N., Jurgens, M., & Ringenberg, C. (2002). The influence of activity choice on problem behaviors maintained by escape versus attention. *Journal of Applied Behavior Analysis, 35*, 349-362.

Rosenthal, R., & DiMatteo, M.R. (2001). Meta-analysis: Recent developments in quantitative methods for literature reviews. *Annual Review of Psychology, 52*, 59-82.

Sagvolden, T., Johansen, E. B., Aase, H., & Russell, V. A. (2005). A dynamic developmental theory of attention-deficit/hyperactivity disorder (ADHD)

predominantly hyperactive/impulsive and combined subtypes. *Behavioral and Brain Sciences, 28*, 397-468.

* Sams, S. E. (1999*). The effects of a functional intervention on the behavior of four students labeled ADHD* (Unpublished doctoral dissertation). University of Pittsburgh, Pittsburgh, PA.

Schill, M. T., Kratochwill, T. R., & Elliott, S. N. (1998). Functional assessment in behavioral consultation: A treatment utility study. *School Psychology Quarterly, 13*, 116-140. doi:10.1037/h0088977

* Schilling, D. L., Washington, K., Billingsley, F. F., & Deitz, J. (2003). Classroom seating for children with attention deficit hyperactivity disorder: Therapy balls versus chairs. *American Journal of Occupational Therapy, 57*, 534-541. Retrieved from www.csa.com

Schlosser, R. W. (2005). Meta-analysis of single-subject research: How should it be done? *International Journal of Language & Communication Disorders, 40*, 375-377. doi:10.1080/13682820500057327

Schlosser, R. W., & Lee, D. L. (2000). Promoting generalization and maintenance in augmentative and alternative communication: A meta-analysis of 20 years of effectiveness research. *Augmentative and Alternative Communication, 16*, 208-226. doi:10.1080/07434610012331279074

Schmidt, F. L. (1992). What do data really mean? Research findings, meta-analysis, and cumulative knowledge in psychology. *American Psychologist, 47*, 1173-1181. doi:10.1037/0003-066X.47.10.1173

* Schmitt, R. (2009). *The effects of a self-monitoring and video self-modeling intervention to increase on-task behavior for children with attention-deficit/hyperactivity disorder.* (Unpublished doctoral dissertation). Indiana University, Indiana.

* Scope, C. R. (2003). *The efficacy of conjoint behavioral consultation to reduce the off-task behavior of elementary school children diagnosed with attention deficit hyperactivity disorder* (Unpublished doctoral dissertation). The University of Connecticut, Storrs, CT.

Scott, T. M., Anderson, C., Mancil, R., & Alter, P. (2009). Function-based supports for individual students in school settings. In W. Sailor, G. Dunlop, G. Sugai & R. Horner (Eds.), *Handbook of positive behavior support* (pp. 421-441). New York: NY: Springer Publishing. doi:10.1007/978-0-387-09632-2_18

Scott, T. M., Meers, D. T., & Nelson, C. M. (2000). Toward a consensus of functional behavioral assessment for students with mild disabilities in public school contexts: A national survey. *Education and Treatment of Children, 23*, 265-285. Retrieved from www.csa.com

Scotti, J. R., Evans, I. M., Meyer, L. H., & Walker, P. (1991). A meta-analysis of intervention research with problem behavior: Treatment validity and standards of practice. *American Journal on Mental Retardation, 96*, 233-256. Retrieved from www.csa.com

Scruggs, T. E., Mastropieri, M. A. (1998). Summarizing single-subject research: Issues and applications. *Behavior Modification, 22*, 221-242.

Scruggs, T. E., Mastropieri, M. A., & Casto, G. (1987). The quantitative synthesis of single-subject research: Methodology and validation. *Remedial & Special Education, 8*, 24-33. doi:10.1177/074193258700800206

Scruggs, T. E., Mastropieri, M. A., Cook, S. B., & Escobar, C. (1986). Early intervention for children with conduct disorders: A quantitative synthesis of single-subject research. *Behavioral Disorders, 11*, 260-271.

* Shabani, D. B., Wilder, D. A., & Flood, W. A. (2001). Reducing stereotypic behavior through discrimination training, differential reinforcement of other behavior, and self monitoring. *Behavioral Interventions, 16*, 279-286. doi:10.1002/bin.96

Shadish, W. R., Brasil, I. C., Illingworth, D. A., White, K. D., Galindo, R., Nagler, E. D., & Rindskopf, D. M. (2009). Using UnGraph to extract data from image files: Verification of reliability and validity. *Behavior Research Methods, 41*, 177-183. doi:103758/brm.41.1.177

Shadish, W. R., & Rindskopf, D. M. (2007). Methods for evidence-based practice: Quantitative synthesis of single-subject designs. In G. Julnes & D. J. Rog (Eds.), *Informing Federal Policies on Evaluation Method: Building the Evidence Base for Method Choice in Government Sponsored Evaluation* (pp. 95-109). San Francisco: Jossey Bass.

Shadish, W. R., Rindskopf, D. M., & Hedges, L. V. (2008). The state of the science in the meta-analysis of single-case experimental designs. *Evidence-Based Communication Assessment and Intervention, 2*, 188-196.

Shaw, S. R., Clayton, M., Dodd, J., & Rigby, B. T. (2004). Collaborating with physicians. In A. Canter, S. Carroll, L. Paige, & I. Romero (Eds.), *Helping children at home and at school: Handouts from your school psychologist* (Second Edition). Bethesda, MD: National Association of School Psychologists.

* Shimabukuro, S. M., Prater, M. A., Jenkins, A., & Edelen-Smith, P. (1999). The effects of self-monitoring of academic performance on students with learning disabilities and ADD/ADHD. *Education and Treatment of Children, 22*, 397-414. Retrieved from www.csa.com

Shine, L. C., & Bower, S. M. (1971). A one-way analysis of variance for single-subject designs. *Educational and Psychological Measurement, 31*(1), 105-113. doi:10.1177/001316447103100108

Skiba, R. J., Peterson, R. L., & Williams, T. (1997). Office referrals and suspension: Disciplinary intervention in middle schools. *Education and Treatment of Children, 20*, 295-315. Retrieved from www.csa.com

* Skinner, J. N., Veerkamp, M. B., Kamps, D. M., & Andra, P. R. (2009). Teacher and peer participation in functional analysis and intervention for a first grade student with attention deficit hyperactivity disorder. *Education & Treatment of Children, 32*, 243-266. Retrieved from www.csa.com

Smith, B. W., & Sugai, G. (2000). A self-management functional assessment-based behavior support plan for a middle school student with EBD. *Journal of Positive Behavior Interventions, 2*, 208-217. doi:10.1177/109830070000200405

Sonuga-Barke, E. J., Taylor, E., Sembi, S., & Smith, J. (1992). Hyperactivity and delay aversion: The effect of delay on choice. *Journal of Child Psychology and Psychiatry, 33*, 387-398. doi:10.1111/j.1469-7610.1992.tb00874.x

* Stage, S. A., Jackson, H. G., Moscovitz, K., Erickson, M. J., Thurman, S. O., Jessee, W., & Olson, E. M. (2006). Using multimethod-multisource functional behavioral assessment for students with behavioral disabilities. *School Psychology Review, 35*, 451-471. Retrieved from www.csa.com

Stage, S. A., & Quiroz, D. R. (1997). A meta-analysis of interventions to decrease disruptive classroom behavior in public education settings. *School Psychology Review, 26*, 333-368.

* Stahr, B., Cushing, D., Lane, K., & Fox, J. (2006). Efficacy of a function-based intervention in decreasing off-task behavior exhibited by a student with ADHD. *Journal of Positive Behavior Interventions, 8*, 201-211. doi:10.1177/10983007060080040301

* Stewart, K. G., & McLaughlin, T. F. (1992). Self-recording: Effects of reducing off-task behavior with a high school student with an attention deficit hyperactivity disorder. *Child & Family Behavior Therapy, 14*, 53-59. Retrieved from www.csa.com

Sutherland, K. S., Lewis-Palmer, T., Stichter, J., & Morgan, P. L. (2008). Examining the influence of teacher behavior and classroom context on the behavioral and academic outcomes for students with emotional or behavioral disorders. *The Journal of Special Education, 41*, 223-233. doi:10.1177/0022466907310372

Sutton, A.J. (2009). Publication bias. In H. Cooper, L. V. Hedges & J. C. Valentine (Eds.), *The handbook of research synthesis and meta-analysis* (2nd ed., pp. 436-452). New York, NY: Russell Sage Foundation.

Swanson, J. M., Elliott, G. R., Greenhill, L. L., Wigal, T., Arnold, L. E., Vitiello, B., …Volkow, N. D. (2007). Effects of stimulant medication on growth rates across 3 years in the MTA follow-up. *Journal of the American Academy of Child & Adolescent Psychiatry, 46*, 1015-1027. doi:10.1097/chi.0b013e3180686d7e

Swanson, J. M., McBurnett, K., Wigal, T., Pfiffner, L. J., Lerner, M. A., Williams, L., …Fisher, T. D. (1993). Effect of stimulant medication on children with attention deficit disorder: A "review of reviews". *Exceptional Children, 60*, 154-161. Retrieved from www.csa.com

Taylor, J., & Miller, M. (1997). When timeout works some of the time: The importance of treatment integrity and functional assessment. *School Psychology Quarterly, 12*, 4-22. doi:10.1037/h0088943

Toplak, M. E., Connors, L., Shuster, J., Knezevic, B., & Parks, S. (2008). Review of cognitive, cognitive-behavioral, and neural-based interventions for attention-deficit/hyperactivity disorder (ADHD). *Clinical Psychology Review, 28*, 801-823. doi:10.1016/j.cpr.2007.10.008

* Trahant, D. M. (2004). *Behavioral improvement in children with ADHD: Independent and combined effects of behavioral treatment and medication* (Unpublished doctoral dissertation). The University of Southern Mississippi, Hattiesburg, MS.

* Umbreit, J. (1995). Functional assessment and intervention in a regular classroom setting for the disruptive behavior of a studet with attention deficit hyperactivity disorder. *Behavioral Disorders, 20*, 267-278. Retrieved from www.csa.com

U.S. Department of Education. (2002). *Twenty-fourth annual report to congress on the implementation of the Individuals with Disabilities Education Act*. Retrieved from http://www2.ed.gov/about/reports/annual/osep/2002/index.html

Vegas, K. C. (2005). *The effectiveness of functional behavior assessment-based behavioral interventions for reducing problem behaviors: A meta-analysis* (Unpublished doctoral dissertation). The University of Utah, Utah.

Van den Noortgate, W., & Onghena, P. (2003). Combining single-case experimental data using hierarchical linear models. *School Psychology Quarterly, 18*, 325-346. doi:10.1521/scpq.18.3.325.22577

Walker, H. M., Colvin, G., & Ramsey, E. (1995). *Antisocial behavior in school: Strategies and best practices*. Belmont, CA, US: Thomson Brooks/Cole Publishing Co.

Walker, H. M., Ramsey, E., & Gresham, F. M. (2003). Heading off disruptive behavior: How early intervention can reduce defiant behavior—and win back teaching time. *American Educator, 27*(4), pp. 6–21, 45-46. Retrieved from http://archive.aft.org/pubs-reports/american_educator/winter03-04/early_intervention.html

* Walther, M., & Beare, P. (1991). The effect of videotape feedback on the on-task behavior of a student with emotional/behavioral disorders. *Education and Treatment of Children, 14*, 53-60. Retrieved from www.csa.com

Warren, J. S., Bohanon-Edmonson, H. M., Turnbull, A. P., Sailor, W., Wickham, D., Griggs, P., et al. (2006). School-wide positive behavior support: Addressing behavior problems that impede student learning. *Educational Psychology Review, 18,* 187–198.

Watson, T. S., & Skinner, C. H. (2004). *Encyclopedia of school psychology* (pp. 121-125). New York, NY: Kluwer Academic/Plenum Publishers. Retrieved from www.csa.com

White, H. D. (2009). Scientific communication and literature retrieval. In H. Cooper, L. V. Hedges & J. C. Valentine (Eds.), *The handbook of research synthesis and meta-analysis* (2nd ed., pp. 51-71). New York, NY: Russell Sage Foundation.

Wolf, F. M. (1986). *Meta-analysis: Quantitative methods for research synthesis* (pp. 9-17). Beverly Hills, CA: Sage.

* Woltersdorf, M. A. (1992). Videotape self-modeling in the treatment of attention-deficit hyperactivity disorder. *Child & Family Behavior Therapy, 14*, 53-73. doi:10.1300/J019v14n02_04

* Wright, C. B. (2006). *The efficacy of brief functional analysis procedures on assessing ADHD behaviors and the effect of stimulant medication* (Unpublished doctoral dissertation). Florida State University, Tallahassee, FL.

Wright-Gallo, G. L., Higbee, T. S., Reagon, K. A., & Davey, B. J. (2006). Classroom-based functional analysis and intervention for students with emotional/behavioral disorders. *Education and Treatment of Children, 29*, 421-436. Retrieved from www.csa.com

Zachor, D., Hodgens, B., & Patterson, C. (2009). Treatment of attention-deficit/hyperactivity disorder (ADHD). In J. L. Matson, F. Andrasik & M. L. Matson

(Eds.), *Treating childhood psychopathology and developmental disabilities.* (pp. 139-181). New York, NY: Springer Science + Business Media. Retrieved from www.csa.com

Zentall, S. S. (1986). Effects of color stimulation on performance and activity of hyperactive and nonhyperactive children. *Journal of Educational Psychology, 78*, 159-165. doi:10.1037/0022-0663.78.2.159

Zentall, S. S., & Dwyer, A. M. (1989). Color effects on the impulsivity and activity of hyperactive children. *Journal of School Psychology, 27*, 165-173. doi:10.1016/0022-4405(89)90004-6

Zentall, S. S., & Zentall, T. R. (1983). Optimal stimulation: A model of disordered activity and performance in normal and deviant children. *Psychological Bulletin, 94*, 446-471. doi:10.1037/0033-2909.94.3.4

Appendix A

Code Book

Adapted from Lee (2001) and Vegas (2005)

Study Characteristics		
Variable	**Variable Name**	**Definition**
ID	Study, experiment, and participant ID number	Enter the 3-digit study identification number, followed by the 2-digit experiment identification number, followed by the 2-digit participant identification number (i.e. 001-01-01)
REF	Reference	Enter first author's name
P_YEAR	Year of publication	Enter year of publication in 4 digits
P_TYP	Type of publication	0- Published journal article 1- Unpublished doctoral dissertation
SUBJ#	Number of subjects in study	Enter number of subjects
QUAL	Quality of SS design	Enter number of quality indicators met (1-6)
Participant Characteristics		
Variable	**Variable Name**	**Definition**
CA	Chronological Age	Enter CA in months
GRADE	Grade	Enter 1-digit grade (-1 Preschool, 0 K, etc)
GENDER	Gender	1- Male 2- Female
ETH	Ethnicity	1- Caucasian 2- African American 3- Hispanic 4- Asian 5- Not specified 6- Other
DX_IND	Individual who made diagnosis	1- Psychologist 2- Psychiatrist 3- Physician 4- School Psychologist 5- Not specified
DX_METH	Method used to arrive at	1- DSM

	diagnosis	2- Single informant rating scale 3- Multiple informant rating scale 4- Interview 5- Not specified
SUBTYP	ADHD Subtype	6- Primarily inattentive 7- Primarily hyperactive/impulsive 8- Combined 9- ADD 10- ADHD not specified 11- Other
CO_DX	Comorbid diagnosis	1- ODD 2- CD 3- Tic disorder 4- LD 5- MR 6- Autism 7- Other 8- None
MED	Participant medication status at time of study	1- Taking medication 2- Not taking medication 3- Unknown
ED_STAT	Education status	1- Regular education 2- Special education 3- Other 4- Not specified
Assessment Characteristics		
Variable	**Variable Name**	**Definition**
FBA_INC	Was an FBA conducted?	1- Yes 2- No
DESCR	What descriptive methods were used?	1- Direct observation only 2- Structured interview/rating scale 3- Informal interview 4- Informal interview & direct observation 5- Structured interview & direct observation 6- None-FA manipulations only 7- Non-FBA group
FA	Was a FA conducted?	1- FA manipulation conducted 2- No FA conducted (FBA conducted) 3- No FA conducted (Non-FBA group)
FA_LNG	Brief or typical?	1- Brief (<90 minutes) 2- Typical (>90 minutes) 3- None 4- Not specified
FA_COND	FA conditions ran	5- Typical (attention, tangible, alone, escape)

		6- Other (specify) 7- None
FA_TYP	Type of FA conducted	1- Manipulation of consequences 2- Manipulation of antecedents 3- No FA conducted (FBA conducted) 4- No FA conducted (Non-FBA group) 5- Manipulation of antecedents & consequences
FA_DESGN	Design used in FA	0- None 1- AB 2- ABA 3- ABAB 4- Multi-Treatment 5- Alternating Treatment / Multi-element 6- Multiple baseline / Probe 7- Combination Alternating Treatment with Reversal 8- Combination Multiple Baseline with Reversal 9- Other (Specify)
FBA_IND	Individual who conducted FBA	1- Teacher 2- School psychologist 3- Experimenter 4- Therapist 5- None (Non-FBA group) 6- Not specified 7- Instructional/teaching assistant
FBA_SETT	Setting of FBA/FA	1- School setting 2- Home 3- Clinic 4- Group home 5- None (Non-FBA group)
FA_SETT2	Was FA conducted in an analog or natural setting?	1- Analog 2- Naturalistic 3- Not specified 4- No FA- FBA group 5- No FA- non-FBA group
FUNC	Function of behavior	6- Gain attention 7- Gain tangible 8- Avoid/escape attention 9- Avoid/escape task 10- Automatic reinforcement 11- Multiple functions 12- Not conclusive 13- None (Non-FBA group)

Intervention Characteristics		
Variable	**Variable Name**	**Definition**
I_SETT	Setting	1- School setting 2- Non-school setting
I_LOC	Location of intervention	1- Regular education classroom 2- Special education classroom 3- Integrated (regular & special ed) 4- Hospital 5- Lab 6- Home 7- Other
I_IND	Individual delivering intervention	1- Teachers / instructional assistant 2- School psychologist 3- Experimenter 4- Experimenter & school personnel 5- Parent 6- Therapist
BX_SEV	Behavior severity	1- Level 1 – chronic behavior likely to interfere with community acceptance 2- Level 2 – more serious behavior likely to increase in severity if left untreated 3- Level 3 – dangerous behavior requiring immediate attention
I_PURP	Purpose of intervention	1- Decrease inappropriate behavior 2- Increase appropriate behavior 3- Both 4- Teach new skill 5- Other (specify)
INT_TYP	Type of intervention	1- Antecedent 2- Consequence 3- Both antecedent & consequence 4- Efficiency of behavior 5- Other (specify)
INT_LVL	Level of intervention	1- Level 1 (reinforcement) 2- Level 2 (extinction) 3- Level 3 (negative punishment) 4- Level 4 (positive punishment) 5- Level 1 & 2 combined 6- Level 1 & 3 combined
I_LNGTH	Length of intervention	Enter the number of intervention data points
I_DESGN	Experimental design for intervention	1- AB 2- ABA 3- ABAB 4- Multi-Treatment

		5- Alternating Treatment / Multi-element 6- Multiple baseline / Probe 7- Combination Alternating Treatment with Reversal 8- Combination Multiple Baseline with Reversal 9- Other (Specify)
IOA	Was IOA data collected?	1- Yes 2- No
IOA_PERC	Mean % IOA	Enter mean percent of IOA
MAIN	Did the intervention promote maintenance?	1- Yes 2- No 3- Was not included in investigation
GEN	Did the intervention promote generalization across behaviors or settings?	1- Yes 2- No 3- Was not included in investigation
SOC_VAL	Was social validity of intervention determined?	1- Yes 2- No
SOC_VAL2	How was it rated?	1- Positive 2- Neutral 3- Negative 4- Not investigated
TX_INT	Was treatment integrity investigated?	1- Yes 2- No
TX_INT2	Percent implemented with integrity	Enter percent treatment integrity

Appendix B

Quality Indicators Checklist

(Adapted from Horner, Carr, Halle, Mcgee, Odom, & Wolery, 2005)

Quality Indicators Checklist			
1	Adequate description of participants & setting • Sufficient information regarding diagnosis (how it was obtained AND who gave diagnosis)	Yes	No
2	Dependent variable is operationalized, quantifiable, precise measurement, measured repeatedly, adequate IOA (≥80%)	Yes	No
3	Independent variable is operationalized, manipulated, and fidelity examined	Yes	No
4	Baseline 5+ points	Yes	No
5	Results replicated across participants/settings/materials	Yes	No
6	Dependent variable is socially important, magnitude of change is important	Yes	No
	Total Indicators Met:		

CURRICULUM VITA

2855 FREEWOOD POINT APT. 2 • COLORADO SPRINGS, CO 80920
PHONE: 203-948-5872 • E-MAIL: FMILLER@PSU.EDU

FAITH MILLER

EDUCATION

- Doctor of Philosophy
  School Psychology, The Pennsylvania State University — August 2011
- Master of Education
  School Psychology, The Pennsylvania State University — May 2008
- Bachelor of Arts, Magna Cum Laude
  Psychology, Minor in History, Western Connecticut State University — May 2006

CERTIFICATIONS

- School Psychologist – Pennsylvania and Colorado

AREA OF SPECIALIZATION

- Behavior management

CLINICAL EXPERIENCE

- 2010-2011 - Pre-doctoral School Psychologist Intern, Academy School District 20, Colorado Springs, CO
- 2009-2010 – Student Supervisor, Penn State CEDAR Clinic, University Park, PA
- 2008-2009 – Practicum Student, State College Area School District, State College, PA
- 2007-2009 – Student Clinician, Penn State CEDAR Clinic, University Park, PA

PRESENTATIONS & PUBLICATIONS

- Miller, F. G. (2010, August). *Woodcock Johnson Tests of Cognitive Abilities Training.* Staff training for Academy District 20 school psychologists, Colorado Springs, CO.
- Miller, F. G. (2010, April). *Do functional behavioral assessments improve intervention effectiveness for students with ADHD? A single-subject meta-analysis.* Paper presented at the Behavior Analysis Research Colloquium, University Park, PA.
- Miller, F. G. (2009, April). *Pervasive developmental disorders.* In-service presentation for Hope for Kids parents and staff, State College, PA.
- Miller, F. G., & Watkins, M. W. (2009, February). *Factor index profile analysis for postsecondary students with learning disabilities.* Poster session presented at the annual convention of the National Association of School Psychologists, Boston, MA.
- Hunt, F. G. (2006). *The effect of labeling and social desirability on perceived success of a learning disabled student.* Poster session presented at Western Connecticut State University Research Day, Danbury, CT
  - Selected for publication in the *WSCU Journal of Undergraduate Psychological Research*