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The Perceived Efficacy of Tier I Intervention Strategies as a Precursor to Tier II Pull-Out Mathematics Intervention for Students with ADD/ADHD by Elementary Classroom Teachers

Dawn Campbell
Sacred Heart University

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Dawn Campbell
Sacred Heart University
EDL 689, 690, & 691
Advisor: Dr. Charles Britton

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Chapter 1: Introduction

Background

Professional organizations across the United States estimate that as many as 11% of children across the country live with attention deficit hyperactivity disorder (ADHD), a neurobiological condition characterized by the presence of severe and pervasive symptoms of inattention, hyperactivity, and impulsivity (American Psychiatric Association, 1994). In neuroimaging studies of children with ADHD, the pre-frontal cortex, (the area of the brain responsible for executive functions (EF) such as working memory, reasoning, problem solving, and abstract thinking) is smaller than average, therefore coinciding deficits in EF are to be expected. There is a strong body of research indicating that school-aged children with ADHD are more likely to have associated learning disorders in multiple academic areas and experience academic underachievement than their neurotypical peers (Colomer, Re, Miranda, & Lucangeli, 2013). Research also highlights a high rate of comorbidity between ADHD and mathematics learning difficulties among children (Colomer et al., 2013; Gremillion & Martel, 2012; Zentall, Smith, Lee, & Wieczorek, 1994; Tosto, Momi, Asherson, & Malki, 2015).

Since 2004, the recommended compulsory process for identifying learning disabilities in the U.S. includes the Response to Intervention Model (RTI). RTI is a process of providing students with high-quality research-based instruction in general education, consisting of multiple tiers of progressively more intense instruction and intervention. The process includes continuous progress monitoring of students' responses to the interventions to determine whether modifications to the instruction or intervention need

to be made. There are three tiers in the RTI process; Tier I includes the core instructional program for all students including differentiation, accommodations that allow all students to access instruction including those students with disabilities, and interventions for students with behavior difficulties. If lack of progress is noted through continuous progress monitoring, the student is provided additional Tier II interventions. Tier II involves core instruction with supplemental instruction or intervention (either in or out of the core instructional environment) that is provided in a prescribed duration and frequency using an empirically validated program or strategies. If Tier II support does not elicit adequate progress, students may then require Tier III intervention. Tier III interventions are more intensive and individualized small group or individual intervention. Tier III intervention is most likely provided outside the core instructional environment. Given the high rate of comorbidity between ADHD and math learning difficulties, the high number of students with ADHD who participate in these tiered interventions is not surprising. (Colomer et al., 2013; Gremillion & Martel, 2012; Zentall, Smith, Lee, & Wieczorek, 1994; Tosto, Momi, Asherson, & Malki, 2015).

The challenges that children with ADHD face in school from early on has inspired research around the causes for these difficulties as well as effective treatments. There is a strong body of research that points to deficits in EF as either an underlying cause or comorbid condition of ADHD (Gremillion and Martel, 2012; Daley and Birchwood, 2010)). There are also studies to support various intervention design and delivery methods (DuPaul et al., 2006; González-Castro et al., 2016; Volpe et al., 2009; Sánchez-Pérez et al., 2018). While studies on the relationship between EF and ADHD have documented the link,

there is a paucity of research associated with the influence of teachers' perceptions of intervention efficacy on the academic achievement of students with ADHD.

The Case

Orchard Hill Elementary School is located in South Windsor, Connecticut. The school is comprised of 615 students, 28 classroom teachers (K-5), and one certified Math Coach /Intervention Teacher. Approximately 30% of students identified with ADHD are recommended by their classroom teacher for Tier II pull-out math intervention at Orchard Hill. There are often discussions around the reasons for these students' struggles with mathematics. Teachers ponder whether it is the students' inattention or some underlying math disability that is impeding their progress. This frequent conundrum lead the researcher to investigate the topic further. Given the lack of research around teachers' perceptions of intervention efficacy combined with the need to form a clear picture of the interventions that are currently used with students with ADHD, the researcher posed the following research questions:

1. What Tier I interventions have been implemented in the mathematics classroom at Orchard Hill Elementary School for students with ADHD?

2. Which Tier I strategies do teachers at Orchard Hill Elementary School perceive as highly effective in accommodating students with ADHD so that they can succeed in elementary school mathematics?

3. How much variance in perceptions exists among teachers who instruct different grade levels and with different years of experience?

Purpose/Significance of the Study

The core purpose of this study was to provide insight to the staff at Orchard Hill into effective ways to address the challenges that students with ADHD face in the math classroom. By first identifying which research-based instructional strategies and behavior interventions are being used, as well as the perceived efficacy of the strategies and interventions by those implementing them day-to-day, the school community could begin to understand the efficacy of Tier I intervention for students with ADHD and identify potential needs for further research or professional development or capitalize on successful strategies and share them with the school or district-wide communities.

While there is a considerable amount of research around the causes of and interventions for mathematics academic underachievement in students with ADHD, very little research has been dedicated to the role of teachers' perceptions of the efficacy of tier I interventions in improving the achievement of children with ADHD. This study will examine this topic and contribute knowledge toward a vein of research that is missing from the existing body of research on the subject of underachievement in students with ADHD.

Research Design

This research was conducted as a case study that used an explanatory sequential mixed method design to examine the perceptions of elementary classroom teachers regarding various Tier I intervention strategies in a large elementary school in the suburban town of South Windsor, Connecticut. The survey that was used in this study was adapted from a survey designed by Dr. Gregory Fabiano, Faculty Expert on ADHD at the University at Buffalo, in a national study in 2016. The researcher consulted with Dr.

Fabiano regarding the survey's use in the present study. The survey will be made available to all classroom teachers at Orchard Hill electronically using *Google Forms.* The survey asked classroom teachers to respond to statements of how frequently they use various research-based interventions and how effective they believe those interventions to be for students with ADHD. There was one open ended question on the survey, which asked teachers to identify any other interventions/strategies they have found effective that are not mentioned in the survey. The data from the survey was cleaned, scored, analyzed, and compared based on the grade and years teaching for each classroom teacher. Themes, trends, similarities, and differences were explored further in a focus group interview. The interview was conducted to gain anecdotal information that may explain the data from the survey. The interview was transcribed and coded for themes using Microsoft Excel. Reliability and validity was established in this study using triangulation and peer debriefing.

Assumptions and Limitations

There were a few assumptions and limitations in this case study. The first is the assumption that classroom teachers at Orchard Hill know what ADHD is and are aware of the research-based interventions included in the survey. The second is a limitation; the population of this study is limited to a single school, and therefore the results can only be interpreted as relevant to this school. The third is the limitation of participants in the study. While all classroom teachers at Orchard Hill were given the opportunity to participate in the survey and some of them were asked to participate in the focus group interview, participation is strictly voluntary. As a result, some classroom teachers may have chosen not to participate and therefore further narrowed the population size.

Expected Findings

The researcher expected to find that the classroom teachers at Orchard Hill are currently implementing several Tier I interventions for students with ADHD in the mathematics classroom that they perceive as being effective in helping those students succeed in elementary school mathematics. The researcher also expected that the interventions being used most frequently for students with ADHD are behavior management interventions as opposed to content specific interventions. Finally, the researcher expected to find a variance between the types of interventions novice teachers perceive as effective and those perceived as effective by more veteran teachers.

Chapter 2: Literature Review

Introduction

The American Psychiatric Association (APA) says that around five percent of children in the US have attention deficit hyperactivity disorder (ADHD); but the Centers for Disease Control and Prevention (CDC) puts that that number at closer to 11%. ADHD is a developmental, neurobiological condition characterized by the presence of severe and pervasive symptoms of inattention, hyperactivity, and impulsivity (APA, 1994). School-aged children with ADHD are more likely to experience academic underachievement than their neurotypical peers (Colomer, Re, Miranda, & Lucangeli, 2013). In their review of literature, titled *Academic and Educational Outcomes of Children With ADHD,* Loe and Feldman (2007) found ADHD to be associated with poor grades, poor reading, and poor math standardized test scores. Daley and Birchwood (2009) point out that there are studies indicating up to 30% of ADHD children have an associated learning disorder of reading, spelling, writing and arithmetic. They also state that neuroimaging studies show a decreased size of the prefrontal cortex in children with ADHD, therefore coinciding deficits in certain prefrontal executive functions (EF) are to be expected.

Theoretical Orientation

Researchers believe that by identifying the underlying causes of the academic underachievement of children with ADHD, classroom teachers can employ various interventions to mitigate the problems (Gremillion & Martel, 2012). The most recognized formal and compulsory process for learning disability identification at the time of this study is the Response to Intervention process (RTI). RTI was introduced in the US in 2004 as a recommended method of helping to identify students with specific learning disabilities

within the reauthorization of the Individuals with Disabilities Act (IDEA). Prior to the RTI model, the primary approach to identification of student with learning disabilities (LD) was the *discrepancy model.* Sometimes referred to as the "wait to fail" model, it required students to be significantly far behind before qualifying for special services. Through the reauthorization of IDEA 2004, the role of the discrepancy model was eliminated from the identification process and replaced with RTI. According to the National Center on Response to Intervention (2010):

> Response to Intervention integrates assessment and intervention within a multi-level prevention system to maximize student achievement and to reduce behavioral problems. With RTI, schools use data to identify students at risk for poor learning outcomes, monitor student progress, provide evidence-based interventions and adjust the intensity and nature of those interventions depending on a student's responsiveness, and identify students with learning disabilities or other disabilities (p. 2).

Given the high rate of comorbidity between ADHD and learning disabilities, it is no surprise that a high number of students who participate in these tiered interventions also have ADHD. (DuPaul et al., 2006; Haraway, 2012)

Though there are few studies of the association between ADHD and mathematical abilities, most of the literature reviewed on the subject indicated that children with ADHD were more likely to have comorbid math difficulties (Colomer et al., 2013; Gremillion & Martel, 2012; Zentall, Smith, Lee, & Wieczorek, 1994; Tosto, Momi, Asherson, & Malki, 2015). In their study of the mechanisms related to the association between ADHD and

academic underachievement, Gremillion and Martel (2012) looked at the academic achievement of two groups of students between the ages of six and twelve years old: 266 students diagnosed with ADHD, 207 controls, and 73 children classified as having situational subthreshold ADHD (i.e. did not meet criteria for either ADHD or control group). The study's independent sample t-tests indicated that children with ADHD had significantly lower semantic language, mathematics achievement, verbal working memory, and full-scale IQ than non-ADHD comparison children. Furthermore, some of the literature indicated a more prevalent negative occurrence for children with the inattentive domain of ADHD (ADHD-I) as opposed to the hyperactivity-impulsivity (ADHD-H) or combined (ADHD-C) domains (Tosto et al., 2015).

Loe and Feldman (2007) assert that "pharmacologic treatment and behavior management are associated with reduction of the core symptoms of ADHD and increased academic productivity, but not with improved standardized test scores or ultimate educational attainment" (p. 82). They call for future studies to examine which types of interventions can improve academic and educational outcomes of children with ADHD. Before we can investigate successful strategies, we need to understand what is happening right now in the tier I learning environment. This study will examine classroom teachers' perceived efficacy of tier I intervention strategies as a precursor to tier II pull-out mathematics content intervention for students with ADHD.

To conduct this literature review, a search was done on "ADHD in School Children" to gain background knowledge around the challenges children with ADHD face in the classroom. Subsequent searches for "ADHD', 'Math', and 'elementary intervention

strategies'" produced a reasonable number of results that were focused on various interventions and for elementary aged students. For the purposes of this literature review, only journal articles were considered. When one article cited another document, an additional search was executed to locate that article as well. If the document was determined to be relevant, it was included as part of the literature review.

Review of Research and Methodological Literature

In this literature review, an overview of research regarding the etiology and interventions associated with ADHD and academic underachievement are presented, analyzed, and considered as they relate to elementary mathematics instruction. The contributing factors considered are various Executive Functions (EF) and semantic language deficits. The types of interventions vary in content (behavioral, academic) and delivery (computer-based, consultation-based). For each category, research relevant to the topic of this study are cited.

Etiology

A significant amount of the literature reviewed focused on the various mechanisms believed to contribute to the academic underachievement of children with ADHD. Because of the chronic nature of the disorder, ADHD is often treated with the goal of managing symptoms as opposed to treating the underlying causes (Abed, 2014). To best determine the most appropriate interventions, it would make sense for one to first understand the causes of students' mathematical skill deficits. Throughout this literature review, the most prevalent contributing mechanisms explored were deficits in the EF skills of children with ADHD; another was semantic language deficits.

Executive Functioning Deficits

Executive function skills are cognitive skills which call upon the brain's prefrontal cortex, a part of the brain known to be differently engaged in children with ADHD than in neurotypical children. EF skills include flexibility, focus, self-awareness, self-control, organization, working memory, time management, and planning. In a study focused on numerical and calculation abilities in children with ADHD, Colomer et al., (2013) found that, "The main theoretical explanation for the ADHD symptomatology is related to executive function deficits, with important weaknesses found in planning, working memory, response inhibition and vigilance" (p.1). One of the most common EF skills to come up during this literature review was working memory (WM). According to Gremillion and Martel (2012), "approximately 30% of children diagnosed with ADHD exhibit deficits in WM" (p. 1340), in fact they cited research which indicated that children with ADHD develop verbal WM skills at a slower rate than their neurotypical peers. Verbal WM abilities specifically are shown to predict later mathematical ability. Etiological research indicates that ADHD and extreme academic underachievement share genetic influences and executive function deficits (Gremillion and Martel, 2012; Daley and Birchwood, 2010). Daley and Birchwood (2010) point out research that shows EF deficits to be present specifically in children with ADHD-I; children with ADHD-H did not display the difficulties with EF. In their study of over 500 children, Gremillion & Martel (2012) found that verbal WM partially explained the relationship between ADHD symptoms and mathematics underachievement, but that the association was not specific to one domain of ADHD. Gremillion and Martel note that,

> Elucidation of the mechanisms by which ADHD is associated with reading and mathematics underachievement is critical for use of early identification strategies and the development of early targeted interventions that might be able to circumvent the later academic underachievement frequently associated with ADHD (p. 1339).

These finding suggest that the information gleaned from research can help practitioners more accurately pinpoint potential interventions to implement in the tier I classrooms to help students with ADHD before they begin to struggle.

Semantic Language Deficits

Gremillion and Martel (2012) assert that an "underexplored shared associative feature" (p. 1340) between ADHD and academic underachievement is semantic language, more commonly referred to as vocabulary. Semantic language skills involve providing definitions of lexical items. Their research concluded that semantic language deficits significantly mediated the association between ADHD symptoms and reading underachievement and significantly partially mediated the association between ADHD symptoms and mathematics underachievement. In a 1994 study by Zentall et al., of the mathematical outcomes of ADHD, the researchers identified the need to control for semantic language issues. To achieve that control, the group used three types of computer-generated word problems which differed only in the placement of the unknown. This altered the schema by changing the order of information without changing the information or the vocabulary in the problem. Zentall et al. (1994) also cites previous research that

suggests visual-perceptual and visual-motor deficits as potential factors connecting ADHD to underachievement.

Interventions

There is an extensive body of research devoted to the efficacy of various pharmacological interventions for managing behaviors associated with ADHD. In a critical review of the diagnosis, intervention and treatment of ADHD, Mohaned Abed (2014) states that, "pharmacological interventions - which mainly covers medications, such as methylphenidate (MPH) and dexamphetamine - are the most frequently utilized of medicinal interventions, and thus seem to be the preferred option for dealing with those children with ADHD". Many of the medications prescribed for ADHD are classified as stimulants. In their review of interventions for students with ADHD, Raggi and Chronis (2006) point out that:

> Stimulant medication has been found to produce large, robust effects on a number of outcome measures including symptoms of ADHD, on-task behavior, disruptive behavior, and compliance. There is also strong evidence to suggest that stimulants improve academic productivity (i.e., task completion) and academic accuracy in the short-term within classroom analogue settings. In contrast, no evidence is currently available to suggest that stimulant medication has an effect on long-term academic achievement (p. 87).

Given that the current study focuses on interventions that can be implemented in classrooms in a public school, research around pharmacological interventions was not considered in this literature review. However, it is important to bracket the research with

consideration of pharmacological interventions because without it, the research base for this study would not be complete. Pharmacological interventions are contributing factors in much of the research of other non-pharmacological interventions. While literature regarding the research around the use of stimulant medications was not reviewed on its own, the use of these medications was mentioned throughout the body of reviewed literature, as it related to the studies being conducted.

There are several studies that investigate the effects of specific, non-pharmacological interventions on the achievement of students with ADHD. These studies investigate either the content/focus of the intervention or the manner in which an intervention is delivered. Researchers vary in their recommendations of the most appropriate non-pharmacological interventions for students with ADHD. In their study of the predictors of academic achievement in elementary school students with ADHD, DuPaul et al., (2004), points out that although the disruptive external behaviors are what teachers naturally see, these are not the problems that should be targeted when designing interventions to improve academic performance. Instead, academic interventions should target EF deficits and symptoms of inattention. Regarding academic interventions, Raggi and Chronis (2006) state that:

> [Academic interventions] may offer increased generalizability and maintenance of gains, as they often teach skills or use techniques that may be applied to a wide variety of situations. Finally, direct targeting of academic impairment may reduce the risk for negative long-term outcomes associated with increased academic problems in older children and adolescents with ADHD. (p. 88)

Furthermore, in her 2012 article, *Monitoring Students with ADHD within the RTI Framework*, Dana Haraway states that key components of all interventions should be focused on increasing positive behaviors, carefully identifying appropriate behaviors, and "setting realistic goals to ensure the student experiences success" (p. 20).

Literature re: intervention content

Although there are fewer studies around non-pharmacological interventions for children with ADHD, the most well-recognized strategy is behavioral therapy. Behavior therapies involve manipulating environmental factors that may contribute to an individual student's problematic behaviors with the goal of increased on-task behavior and decreases in disruptive behavior (Daley & Birchwood, 2010; Goldstein & Naglieri, 2008). In his critical review of the literature regarding treatments of ADHD, Mohaned Abed (2014) explains that although these interventions are common, "There is a shortage of empirical evidence to verify the long-term effects of behavioral treatments, and this is mainly why some authors tend to state that behavioral treatment alone is not an effective intervention for ADHD symptom treatment" (p.120). According to Goldstein & Naglieri (2008), such interventions may include, "Positive and negative contingent teacher attention, token economies, peer mediated and group contingencies, time-out, home-school contingencies, reductive techniques based on reinforcement, and cognitive behavioral strategies" (p. 869). They go on to highlight studies conducted using interventions focused on developing the EF skill of planning through strategy instruction. "These intervention studies focused on the concept that children can be encouraged to plan better when they complete academic tasks and that the facilitation of plans positively impacts academic performance" (p. 870). In studies

conducted by Naglieri & Gottling (1995, 1997), Planning Strategy Instruction (PSI) was shown to improve children's performance in math calculation. The students participated in a two-month intervention in either one-on-one tutoring sessions (Naglieri & Gottling, 1995) or in the classroom by the teacher (Naglieri & Gottling, 1997) two to three times per week for 30 minutes. Goldstein & Naglieri (2008) highlight another study conducted by J.S. Iseman that examined PSI in children with learning disabilities and ADHD. The PSI group received instruction designed to encourage effective strategies in mathematics. Upon analyzing students with and without cognitive weaknesses in both the PSI and control groups, Iseman found that students with cognitive weaknesses in planning, with and without ADHD, demonstrated greater benefit from the PSI than they did from normal instruction alone. All of these studies had positive outcomes for students with ADHD experiencing improvement in targeted behavioral and academic achievement. This indicates that the use of some behavioral interventions can be beneficial in improving students' academic achievement. However, the extent to which these results can be applied to the population of ADHD students as a whole is limited by the narrow scope of the research conducted.

Another study of a specific behavioral intervention for students with ADHD was conducted by Langberg et al., (2012). Langberg and his colleagues evaluated the Homework, Organization, and Planning Skills (HOPS) intervention in middle school students with ADHD. The participants were 47 students with ADHD and academic difficulties in grades 6-8 across 12 schools in five districts. Students who were taking medications prescribed for ADHD were allowed to participate in this study, thus the researchers had to adjust their randomized assignment of students to an intervention

provider. Several measures were used including parent and teacher ratings pre- and post-intervention for the sample and control groups as well as a 3-month follow-up for intervention students, the Children's Organizational Skills Scale (COSS), The Vanderbilt ADHD Diagnostic Parent Rating Scale (VADPRS), a parent skills implementation questionnaire, and satisfaction surveys for parents and intervention providers. Based on their results, Langberg et al., (2012) believe that the HOPS intervention is likely to be an effective school-based intervention for improving the organizational skills and academic performance of students with ADHD. They do recognize that further research comparing the intervention to an active control group and with a stronger evaluation of fidelity is necessary before efficacy can be confidently endorsed.

Literature re: intervention design/ delivery methods

A few of the reviewed studies conducted around academic interventions for students with ADHD were focused on the design and/or delivery method of the intervention. One such study, titled *Consultation-Based Academic Interventions for Children with ADHD: Effects on Reading and Mathematics Achievement* was conducted by DuPaul et al. in 2006. This study evaluated the relative efficacy of two consultation-based models for designing academic interventions and enhancing the academic functioning of 167 children with ADHD. The children were, "Randomly assigned to one of two consultation groups, Individual Academic Intervention (IAI; interventions designed using a data-based decision-making model that involved ongoing feedback to teachers) and Generic Academic Intervention (GAI; interventions designed based on consultant - teacher collaboration, representing 'consultation as usual')" (p.635). Both groups utilized a variety of intervention

delivery methods including teacher-mediated, peer-mediated, computer-assisted, and self-mediated strategies. The most common delivery method was teacher-mediated with 84.9% of the GAI and 86.2% of the IAI participants receiving at least one teacher-mediated intervention across the 15-month period. Intervention content (math and/or reading) was determined by the areas each student demonstrated difficulties in. All of the consultation groups had access to the same interventions for example,

> In the area of mathematics, interventions such as cover-copy-compare (Skinner, Turco, Beatty, & Rasavage, 1989), reciprocal peer tutoring (Fantuzzo, King, & Heller, 1982), class wide student tutoring teams (Harper & Maheady, 1999), and schema-based problem solving (Jitendra & Hoff, 1996; Jitendra, Hoff, & Beck, 1999) were found in both groups (DuPaul et al., 2006, p.642).

Overall DuPaul and his colleagues (2006) concluded that the consultation-based model of intervention produced significant improvement in academic skills in a large sample of children with ADHD, however the "consultation as usual was essentially equivalent to a more individualized, data-based approach" (p. 646). Using the same data to study school function outcomes, Jitendra et al., (2007) found corroborating results when comparing traditional data-based academic interventions (TDAI) to intensive data-based academic interventions (IDAI). The results of these studies may indicate that the intensive, individualized data-based models that many schools/districts are leaning towards with their RTI models of intervention may not be necessary to produce positive growth in academic achievement for students with ADHD.

Studies evaluating computer-based interventions or computer assisted instruction as a delivery method of interventions have been shown to improve students' mathematics performance in both general- and special-education settings (González-Castro et al., 2016; DuPaul et al., 2006; Volpe et al., 2009). The first study that was reviewed involving computer-based interventions was *Improvement of Word Problem Solving and Basic Mathematics Competencies in Students with Attention Deficit/Hyperactivity Disorder and Mathematical Learning Disabilities* by Paloma González-Castro and colleagues (2016). The authors developed a computer intervention strategy aimed at improving mathematical competencies and word problem solving skills in children with ADHD. They proposed a computer-based intervention because they believed that it would maintain the attention and be able to be done independently by students with ADHD. González-Castro and colleagues (2016) state that:

> The key problems in mathematics competence affecting students with math learning disabilities (MLD) are believed to lie in the abilities to comprehend, assess, and then apply mathematics in a variety of contexts in order to solve problems in everyday situations in which mathematics plays a key role (p. 142).

They go on to stress that students with comorbid MLD and ADHD are a population which requires targeted interventions designed specifically for their needs with a heavy focus on word problem solving. In their research, González-Castro and colleagues (2016) identified studies that showed explicit strategy training and external representation techniques to be effective in helping children solve math word problems. With that in mind, the team identified a computer-based intervention that incorporated this external representation

technique to build mathematical competencies and train students to attack and solve math word problems; the program is called integrated dynamic representation (IDR). The study of over 200 children, compared the use of IDR to typical mathematics instruction for students with MLD, ADHD, and MLD+ADHD. The interventions were conducted over 45 fifty-minute sessions (4 days a week), with all of the sessions taking place during the regular math instructional period. The teacher introduced the program at the beginning of each session, illustrated the four levels of representation, and supervised the students' execution with the computer. Based on the results of the study of IDR, González-Castro and colleagues (2016) concluded that all the subgroups that used the IDR computer-based intervention showed significant improvement compared to the "business as usual" (p.151) group. Upon deeper analysis, the authors point out that the MLD subgroup improved the most with IDR and the MLD+ADHD subgroup improved the least. This may indicate the extreme difficulties in learning that students with comorbid ADHD and MLD have, even with explicit and engaging interventions.

Noelia Sánchez-Pérez and colleagues published another study of a computer-based intervention titled, *Computer-Based Training in Math and Working Memory Improves Cognitive Skills and Academic Achievement in Primary School Children: Behavioral Results* (2018). Though this study did not identify participants specifically who were diagnosed with ADHD as a focus population, when discussing the results, the team cites the research connecting EF and specifically WM difficulties and ADHD. This study highlights the convenience and efficacy of using a computer-based training program to provide interventions to students. The participants were 137 non-bilingual, regular education

students from seven to twelve years old. The intervention took place in two 30-minute sessions per week for 13 weeks. Sánchez-Pérez et al., (2018) discussed that:

> Students involved in the training group outperformed those in the control group in math fluency, math grades, reading abilities, inhibition, and non-verbal IQ. Moreover, most of these improvements were associated with their performance on WM tasks, suggesting that the WM intervention leads to more near and far transfer effects than mathematical activities alone, although the contribution of both types of intervention must be considered to improve certain mathematical skills, i.e. math grades and math fluency (p. 7).

Sánchez-Pérez and colleagues (2018) go on to highlight the effects the training program had on the inhibition measure as it may relate to students with ADHD;

> Improvements in inhibition have been found after WM training with clinical samples, i.e., ADHD children and young people with social, emotional and behavioral difficulties (Klingberg et al., 2005; Roughan and Hadwin, 2011). This far transfer effect could be explained by the well-established co-occurrence of WM and inhibition, which means that they support each other and are interdependent on one another (for a review, see Diamond, 2013). Thus, WM training sessions may help children to inhibit their prepotent responses by actively reminding them (WM) to follow the instructions. (p.7)

The results of this study indicate the potential for similar improvements in students with ADHD, but further research is necessary to draw that conclusion. Nonetheless, the positive impacts this type of intervention has had on the non-bilingual, regular education students

in this study is reason enough to look for further research regarding its effects on special populations.

Teacher Perceptions

The amount of research regarding the causes and treatment efficacy for children with ADHD continues to grow; however, the relationships between teacher perceptions of interventions and the achievement of students with ADHD is an area that needs further development. A comprehensive search of the leading journals in education yielded one study that was directly related to this subject. The research was published in 2014 by Curtis, Hamilton, Morre, & Pisecco in an article titled *Are Teachers' Beliefs Related to Their Preferences for ADHD Interventions? Comparing Teachers in the United States and New Zealand*. The article begins by pointing out that classroom teachers often charged with managing and implementing strategies and interventions for children with ADHD; and that "understanding teachers' perceptions regarding the acceptability, effectiveness and rate of change for ADHD classroom interventions may help facilitate the adoption and use of more effective classroom behavioral strategies" (p. 2). A given intervention or strategy may have been shown to be effective, but if teachers do not believe in it's potential in their classrooms, the intervention is likely to have little benefit to the students. Though this study did not investigate the effects teachers' perceptions have on the achievement of their students, it does examine the extent to which teachers perceived personal efficacy or control ideology (custodial or humanistic) may influence their likelihood to use a particular type of intervention. The results of the study indicated that, "teachers' control ideology displayed a significant main effect, where their preferences for classroom strategies

increased (overall) in association with greater ratings of custodial beliefs" (Curtis, Hamilton, Morre, & Pisecco, 2014; p.12).

> Custodial orientations connote beliefs that students are in need of clear, well-defined boundaries for behavior within disciplined and highly structured classroom environments. Teachers with those beliefs tend to be strict and give priority to order and control within their classrooms (p. 2).

When presented with a vignette featuring a student who demonstrates ADHD-like behaviors (hyperactivity, impulsivity, etc.), a teacher in the US was more likely to choose an individualized type of intervention from the menu of options than a whole-class system if the teacher identified as having a primarily custodial control ideology in the context of the vignette. This study prompts more questions around whether interventions can be implemented to promote improved academic achievement regardless of whether the teacher/implementer perceives the intervention to be acceptable, effective, and timely.

Synthesis of Research Findings

The high rates of comorbid learning difficulties and disabilities among children with ADHD is well documented and researched by experts in the fields of psychology, neuropsychology, pharmacology, and education. The challenges that children with ADHD face in school has inspired research regarding the underlying causes for specific struggles as well as the possible treatments and their efficacy. There is a strong body of research that points to deficits in Executive Functioning Skills as either an underlying cause or comorbid condition of ADHD. There are also studies to support various intervention design and

delivery methods including data-based consultation design models that entail intervention implementers (typically classroom teachers) consulting with a school psychologist or social worker to design intervention plans for students with ADHD. The few studies exploring the use of computer-based interventions indicated positive results in improving academic achievement in students with ADHD and warrants further consideration when designing the methods and questions for the present study. The lack of literature and research around the impact teachers' perceptions of intervention efficacy have on the academic achievement of students with ADHD emphasizes the need for further investigation into the subject.

Critique of Previous Research

Each of the studies reviewed has its own limitations. There are some that were conducted using small sample sizes or small subset sizes, some lacked a non-disability comparison group, one only studied boys with ADHD, some failed to control for the contextual factors that may influence achievement such as socioeconomic status, and there were various approaches to accounting for children who were medicated for ADHD. All of these limitations prevent from the ability to generalize the results to the ADHD population. A major limitation of the research was the lack of significant research into the perceptions of teachers and the influence it has on student achievement. This is an area that requires further investigation and analysis to fully understand

Summary Statement

While there is a considerable amount of research around the causes of and interventions for academic underachievement, very little research has been dedicated to the role of teachers' perceptions of the efficacy of tier I interventions in improving the achievement of children with ADHD.

Chapter 3: Methods

Purpose/Research Questions

The research that was reviewed highlighted the prevalence of comorbidity between ADHD and mathematical learning difficulties and disabilities. The research also revealed a lack of insight into the perceptions of teachers regarding the efficacy of the Tier I interventions they provide students in improving mathematical skills and knowledge and mitigating the need for Tier II pull-out mathematics intervention. The purpose of the RTI process is to provide students with tiered research-based interventions to identify students who may have a learning disability based on their lack of response to intervention. With more than 10 students at Orchard Hill Elementary School having been referred for Tier II pull-out mathematics intervention in a given year who also struggle with ADHD or ADHD-like symptoms, there was a question as to what Tier I strategies have been implemented with the goal of mitigating the students' deficits in mathematics. As such, the purpose of this study was to explore the perceptions of elementary classroom teachers with regards to the efficacy of Tier I intervention strategies as a precursor to Tier II pull-out mathematics intervention for students with ADHD. This study explored the following questions:

1. What Tier I interventions have been implemented in the mathematics classroom at Orchard Hill Elementary School for students with ADHD?

2. Which Tier I strategies do teachers at Orchard Hill Elementary School perceive as highly effective in accommodating students with ADHD so that they can succeed in elementary school mathematics?

3. How much variance in perceptions exists among teachers who instruct different grade levels and with different years of experience?

By identifying the Tier I interventions that teachers believe to be highly effective and least effective in accommodating students with ADHD, the faculty at Orchard Hill Elementary School could begin to understand and evaluate their Tier I intervention procedures and determine best fit interventions for students with ADHD. This study was a step toward expanding the research base on the long-term effects of interventions on mathematics achievement of students with ADHD.

Research Design

This research was a case study of one elementary school in the state of Connecticut. Creswell (2012), states that "a case study is an in-depth exploration of a bounded system based on extensive data collection" (p.465). Creswell also describes mixed methods research design as:

> A procedure for collecting, analyzing, and "mixing" both quantitative and qualitative methods in a single study or a series of studies to understand a research problem (Creswell & Plano Clark, 2011). The basic assumption is that the uses of both quantitative and qualitative methods, in combination, provide a better understanding of the research problem and question than either method by itself. (p.535)

This study followed a mixed methods research design combining both qualitative and quantitative methods to better understand the problem of determining effective intervention strategies for students with ADHD in the mathematics classroom.

This study began with quantitative research around the intervention strategies being used at Orchard Hill, which informed the development of qualitative measures used to explain the relationships found in the quantitative data. This study used an explanatory

sequential mixed methods design. This design allowed the researcher to gain a general picture of the research problem using the quantitative data and extend and explain the general picture through the qualitative data (Creswell, 2012).

Participant Selection

This case study was conducted in the fall of 2018 at Orchard Hill Elementary School in the town of South Windsor, Connecticut. At the time of this study, Orchard Hill was the largest of four elementary schools in the suburban district. With roughly 615 students, 28 classroom teachers (K-5), and one certified Math Coach/ Intervention Teacher in the school, the importance of effective tier I intervention for those students who struggle in mathematics is paramount. To fully investigate the types and perceived efficacy of the intervention strategies being used at Orchard Hill, all of the classroom teachers were invited to take part in a survey to collect quantitative data. The researcher then selected a sample population to participate in focus groups to better understand the data collected from the survey and the implications the data has for the use of various interventions at Orchard Hill for students with ADHD.

Data Collection Methods: (Procedures and Instruments)

Initial data for this study was collected anonymously through a survey generated in Google Forms. South Windsor Public Schools uses Google for email, surveys, data collection and communication with families. Prior to the survey being distributed to classroom teachers at Orchard Hill, the survey was shared with the school principal and the district's Assistant Superintendent for review. The survey link was included in an email to all classroom teachers at Orchard Hill at the start of the 2018-2019 school year. This email

included an explanation of the survey and indicated that the survey was optional and anonymous. Participants in the survey were required to provide the grade they teach and the number of years they have been teaching. Because data was collected using a survey at only one point in time, Creswell (2012) identifies it as cross-sectional survey design.

For the purposes of this research study, multiple measures of quantitative and qualitative data were collected to investigate the research questions. The data collection methods that were utilized are outlined in Table 3.1.

Table 3.1

Data collection methods by research question

Research Questions	Method(s)
1. What Tier I interventions have been implemented in the mathematics classroom at Orchard Hill Elementary School for students with ADHD?	• Online Survey
2. Which Tier I strategies do teachers at Orchard Hill Elementary School perceive as highly effective in accommodating students with ADHD so that they can succeed in elementary school mathematics?	• Online Survey • Interview Questions
3. How much variance in perceptions exists among teachers who instruct different grade levels and with different years of experience?	• Online Survey

Each of these data collection methods is described below.

Surveys

Creswell (2012) defines survey research design as "procedures in quantitative research in which investigators administer a survey to a sample or to the entire population of people to describe the attitudes, opinions, behaviors, or characteristics of a population" (p. 376). The quantitative data in this study was collected using a web-based survey; an instrument that is conducted on a computer (Creswell, 2012). *Google Forms* was used to generate and distribute the survey to all classroom teachers at Orchard Hill. The majority of the survey was comprised of close-ended questions; specifically, statements that require a response on a four- or five-point Likert scale. According to Creswell (2012), in close-ended questions the researcher assigns a numerical value to the responses and statistically analyzes the data. There was one open-ended question that allowed teachers to identify other intervention strategies they use which may not have been included in the close-ended questions. The data gathered from this question was analyzed for themes and used to inform the design of focus group interview questions.

The survey being used in this study looked at the various types of Tier I Interventions as well as teachers' perceptions of the efficacy of these strategies for students with ADHD in the mathematics classroom. The survey being used in this study was adapted from the *Classroom Management Techniques Classroom Questionnaire;* a survey designed by Dr. Gregory Fabiano, Faculty Expert on ADHD at the University at Buffalo. Dr. Fabiano's questionnaire was used in Hart et al.'s 2016 study of *Elementary and Middle School Teachers' Self-Reported Use of Positive Behavioral Supports for Children with ADHD: A National Survey.* For the purposes of this study, adaptations were made to the

questionnaire to eliminate intervention strategies which were inappropriate for use by elementary classroom teachers such as restrictions or supplements to the student's diet and individual or small group therapy. Additional research-based intervention strategies specific to mathematics were added to the questionnaire to gather information about content specific interventions that students may receive. The survey asked classroom teachers to respond to statements of how frequently they use various research-based interventions and how effective they believe those interventions to be for students with ADHD, using Likert scales. There was one open ended question on the survey which asks teachers to identify any other interventions/strategies they have found effective that are not mentioned in the survey. These adaptations were reviewed and vetted by a group of 14 Connecticut educators prior to administration of the survey.

Focus Group Interviews

Being an explanatory sequential research design, this study used the qualitative measures to collect data that allowed the researcher to examine and refine the results from the quantitative data (Creswell, 2012). The primary source of qualitative data from this study was collected by conducting a focus group interview to explore the relationships and themes that emerged from the data collected in the survey and more completely answer the research questions regarding teachers' perceptions of the efficacy of interventions.

Data Analysis

The researcher began by collecting the survey data from the responses provided to the online survey. That data was entered into Microsoft Excel and "cleaned". The researcher scored the data by assigning a numerical score to each response category to

make data analysis possible. A codebook was used to assist in assigning and interpreting scores. Summed scores provided a detailed analysis to identify intervention strategy frequency and perceived effectiveness. Individual item responses were averaged to arrive at an overall score for a given intervention (Creswell, 2012).

The researcher conducted a thorough preliminary exploratory analysis (PEA) of the qualitative data collected. Creswell (2012) describes PEA as "exploring the data to obtain a general sense of the data, memoing ideas, thinking about the organization of the data, and considering whether you need more data" (p.243). Creswell goes on to point out that during a PEA:

> You read the transcripts in their entirety several times. Immerse yourself in the details, trying to get a sense of the interview as a whole before breaking it into parts. Writing memos in the margins of field notes or transcripts, or under photographs, helps in this initial process of exploring the data. These memos are short phrases, ideas, concepts, or hunches that occur to you. (p.243)

The themes that emerge while analyzing the qualitative data were organized and coded as it related to the research questions.

Creswell (2012) states that, "reliability means that individual scores from an instrument should be nearly the same or stable on repeated administrations of the instrument and that they should be free from sources of measurement error and consistent" (p.627). He goes on to define validity as, "the development of sound evidence to demonstrate that the intended test interpretation…matches the proposed purpose of the test. This evidence is based on test content, responses processes, internal structure,

relations to other variables, and the consequences of testing" (p.630). Though the two are separate ideas, they often go hand-in hand. Validity and reliability for this study was determined using triangulation and peer debriefing. During the data analysis process, the researcher identified themes through coding and triangulating the data allowed the researcher to find evidence that supported each theme and result constructed (Creswell, 2012). If the results are reliable, there would be multiple points of data which support each conclusion.

Expected Findings

At the time of this study, the researcher was employed as the Elementary Math Coach/Intervention Teacher at the subject school. In this role, the researcher frequently observed classroom instruction as well as worked directly with students in all tiers of intervention. Being a researcher-in-residence may have posed the potential for researcher bias. To avoid specific biases, the survey data was collected anonymously, and the data and researcher's findings were reviewed by a group of 14 veteran educators in the state of Connecticut, who are well versed in research methods.

The researcher expected to find that the classroom teachers at Orchard Hill are currently implementing several Tier I interventions for students with ADHD in the mathematics classroom that they perceive as being effective in helping those students succeed in elementary school mathematics. The researcher also expected that the interventions being used most frequently for students with ADHD were behavior management interventions as opposed to content specific interventions. Finally, the

researcher expected to find a variance between the types of interventions novice teachers perceive as effective and those perceived as effective by more veteran teachers.

Chapter 4: Results and Discussion

The Study and the Researcher

The purpose of this study was to investigate teachers' perceptions of the efficacy of Tier I interventions for students with ADHD in the mathematics classroom at Orchard Hill Elementary School. The following research questions directed this study:

1. What Tier I interventions have been implemented in the mathematics classroom at Orchard Hill Elementary School for students with ADHD?
2. Which Tier I strategies do teachers at Orchard Hill Elementary School perceive as highly effective in accommodating students with ADHD so that they can succeed in elementary school mathematics?
3. How much variance in perceptions exists among teachers who instruct different grade levels and with different years of experience?

This chapter presents and discusses the practices and perceptions of classroom teachers at Orchard Hill Elementary School and identifies the common and differing beliefs among them.

As previously discussed, multiple measures of data were used to gather information from participants. A quantitative online survey was given to classroom teachers in the single elementary school. The results were used to inform a focus group discussion of a sample of the classroom teacher population to gather qualitative data around the research questions.

At the time of the study, the researcher was serving her 8th year as the Math Coach/ Intervention Teacher at the school being studied. In this role, the researcher regularly provided Tier II and III math content intervention to students as well as instructional coaching and professional development to classroom teachers. The researcher conducted the study as a graduate student studying educational leadership and had participated in multiple graduate

courses focused on conducting action research and case studies. To collect the data for this study, the researcher distributed an anonymous online survey to subjects electronically and facilitated the focus group discussion. She analyzed the data and shared the results with a group of peers who were also studying the research approach to ensure the interpretation of the results were free of any bias on the part of the researcher. Since the researcher is a member of the faculty in the school being studied, there may be some effects on participants' responses. While the anonymous nature of the survey likely made participants feel that they could be honest without apprehension, the face-to-face focus group could have made some participants guard their true opinions.

Description of the Sample

To answer the research questions, the researcher began by inviting all 28 classroom teachers at Orchard Hill Elementary School to participate in an anonymous, online survey via *Google Forms*. Nineteen classroom teachers responded to the survey. The demographic information collected from the survey participants is outlined in Table 4.1.

Table 4.1
Survey Participants Demographic Information

	Current Grade Level Taught						**Years of Teaching**					
	Kinder	**First**	**Second**	**Third**	**Fourth**	**Fifth**	**0-4**	**5-9**	**10- 14**	**15- 19**	**20- 24**	**25+**
N	3	4	3	2	3	4	1	3	3	1	6	5

58% of survey participants had been teaching for 20 years or more; 21% had been teaching for 10-19 years and 21% had been teaching for fewer than 10 years. All grade levels were represented among the survey participants. The only grade level with less than 60% participation was third grade with 40% of the classroom teachers participating in the survey.

Because the survey was anonymous and only one of the classroom teachers at Orchard Hill Elementary School is not a female, participants were not asked to share their gender as this would provide identifiable information for the only male classroom teacher.

Upon reviewing the survey data, the researcher noted questions and invited 14 classroom teachers to participate in a focus group interview. The researcher chose to invite half of the teacher at each grade level, ensuring that they varied in their years of teaching. Of those invited, five classroom teachers chose to participate. The demographic information for focus group volunteers is outlined in Table 4.2.

Table 4.2
Focus Group Participants Demographic Information

	Current Grade Level Taught						**Years of Teaching**					
	Kinder.	**First**	**Second**	**Third**	**Fourth**	**Fifth**	**0-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25+**
N	1	0	2	0	1	1	1	1	0	0	0	3

60% of the focus group participants have been teaching for more than 25 years while 40% have been teaching for fewer than 10 years. Not all grade levels were represented among the participants however, there were participants from both primary (k-2) and intermediate (3-5) groups. No participants responses were excluded from either the survey sample or the focus group.

Research Methodology and Data Analysis

This study followed an explanatory sequential mixed methods research design. The researcher gathered quantitative data and extended and explained the general picture through the qualitative data. The quantitative data in this study was collected using a web-based survey

(Appendix A). *Google Forms* was used to generate and distribute the survey to all 28 classroom teachers at Orchard Hill Elementary School. 14 teachers responded initially; the researcher sent out a reminder email a week after the initial invitation which resulted in an additional five response for a total of 19. The survey asked participants to identify how frequently they use each of the 27 intervention techniques for ADHD students in the mathematics classroom. Responses were on a four-point scale; 1 being, *I NEVER use this intervention,* and 4 being, *I ALWAYS use this intervention*. The survey also asked participants to choose how effective they believe each intervention technique to be. The researcher assigned a numerical code to the responses to calculate the mean for each intervention technique; 0: N/A (I have not used this intervention), 1: Not at all effective, 2: Somewhat effective, 3: Moderately effective, 4: Highly Effective. There was one open-ended question on the survey which allowed participants to identify other intervention strategies they use which may not have been included in the close-ended questions. The data gathered from this question was analyzed for themes and along with the analysis of the quantitative results, was used to inform the design of focus group interview questions.

The survey results were exported to a *Microsoft Excel* spreadsheet. The researcher assigned the numerical code to the data and calculated the mean for each question. The data was then disaggregated by what grade level participants are currently teaching and the number of years they had been teaching. The mean for the disaggregated groups was then calculated for each question. The data was examined and analyzed for trends and themes, leading the researcher to develop discussion points for focus group interviews.

Email invitations were sent to half of the classroom teachers in each grade level (14). Five of the 14 teachers volunteered to participate. The focus group was conducted before school began on a full day of school. The early time of day may have impacted the number of

volunteers for the focus group. The researcher presented graphs and data tables to the focus group which illustrated survey results such as discrepancies between frequency of usage and perceived efficacy and asked the group to discuss their interpretation and suggest possible explanations. The researcher transcribed the focus group discussion, coding each person's statements with their grade level and years taught. The transcript was read and reread several times. The researcher made notes in the margins and used color coded highlighting of the transcripts to identify themes in the participants' statements to address the research questions. Because the focus group was so small and not all grade levels and years teaching were represented, the themes that the researcher identified specific to those categories are limited in their validity as they may not be opinions shared by many of the members of that group. The results from the survey and focus groups will be discussed in the following sections in relation to the three research questions presented in this case study.

What Tier I interventions have been implemented in the mathematics classroom at Orchard Hill Elementary School for students with ADHD?

The data was first analyzed to identify the tier I interventions that have been implemented in the mathematics classrooms at Orchard Hill Elementary School for students with ADHD. The survey that was used addressed intervention techniques that have been shown in previous research to influence the achievement of students with ADHD, (Hart et al., 2016). To determine which intervention techniques are being used at Orchard Hill Elementary School, the data around the frequency of use for each intervention was analyzed. The mean was calculated for each intervention technique. Table 4.3 displays the intervention techniques in order from most to least frequently used.

Table 4.3: Mean Frequency of Intervention Use

Survey Item	***Intervention Abbreviation***	**Mean (N=19)**
3	Post Classroom Rules	3.53
5	Ignore minor inappropriate behaviors	3.42
6	Praising appropriate behaviors	3.42
9	Modified instructional procedures	3.37
29	Post visual models of mathematical ideas	3.37
28	Assign hands-on learning activities and open-ended task	3.32
26	Re-teaching lessons	3.26
24	Perceptual/sensory stimulation	3.21
7	Giving appropriate commands	3.16
4	Seat Children with ADHD in the front of the classroom	2.95
18	Group or class-wide contingencies	2.89
15	If...then contingencies	2.84
10	Homework assignment book	2.79
11	Daily Home Note	2.68
27	Pre-teaching lessons	2.63
21	Carrel/ "Office"	2.53
12	Weekly Home Note	2.42
16	Point or token reward system	2.42
25	Individual or small group cognitive training	2.42
23	Individual or small group social skills training	2.26
13	Daily report card with target goals and feedback	2.21
22	Taped behavioral reminders on the student's desk	2.21
8	Reprimands for inappropriate behavior	2.11
19	Time Out	2.11
14	Weekly report card with target goals	2.05
20	Send to principal/ disciplinarian office	1.95
17	Response-cost system	1.79

The frequency data in Table 4.3 shows that the most frequently used intervention techniques are a combination of behavioral, and academic in nature while the least frequently used are punitive in nature.

In addition to the 27 intervention techniques listed, the final question on the survey was an open-ended question that asked participants to list any additional intervention techniques which they have used and believe to be highly effective in helping students with ADHD in the

mathematics classroom. Of the ten participants who responded to this question, four mentioned having ADHD students working with a peer who was either a tutor or model to reinforce expected behavior and promote engagement.

Which Tier I strategies do teachers at Orchard Hill Elementary School perceive as highly effective in accommodating students with ADHD so that they can succeed in elementary school mathematics? How much variance in perceptions exists among teachers who instruct different grade levels and with different years of experience?

After identifying which interventions are used at Orchard Hill Elementary School, the data was then analyzed to determine which interventions are considered by classroom teachers to be the most highly effective in helping students with ADHD to be successful in the math classroom. The 19 survey participants ranked each intervention according to the following; 0: N/A (I have not used this intervention), 1: Not at all effective, 2: Somewhat effective, 3: Moderately effective, and 4: Highly Effective. The mean was calculated for each intervention technique and is presented in Table 4.4 in order from the most to the least effective. There were not any intervention techniques considered to be “highly effective” by all participants, however four of the five techniques with mean values of 3.00 or higher are focused on instruction and only one is focused on undesirable behaviors.

Table 4.4 Mean Intervention Effectiveness

Survey Item	***Intervention Abbreviation***	***Mean (N=19)***
9	Modified instructional procedures	3.42
28	Assign hands-on learning activities and open-ended tasks	3.26
26	Re-teaching lessons	3.16
29	Post visual models of mathematical ideas	3.05
5	Ignore minor inappropriate behaviors	3.00
6	Praising appropriate behaviors	2.95
7	Giving appropriate commands	2.84
15	If...then contingencies	2.84
18	Group or class-wide contingencies	2.68
27	Pre-teaching lessons	2.68
24	Perceptual/sensory stimulation	2.63
4	Seat Children with ADHD in the front of the classroom	2.58
3	Post Classroom Rules	2.42
21	Carrel/ "Office"	2.37
25	Individual or small group cognitive training	2.32
11	Daily Home Note	2.26
16	Point or token reward system	2.21
23	Individual or small group social skills training	2.16
10	Homework assignment book	2.11
13	Daily report card with target goals and feedback	2.11
19	Time Out	2.00
22	Taped behavioral reminders on the student's desk	1.89
8	Reprimands for inappropriate behavior	1.74
12	Weekly Home Note	1.74
14	Weekly report card with target goals	1.63
20	Send to principal/ disciplinarian office	1.63
17	Response-cost system	1.53

The researcher examined the frequency and effectiveness data, comparing them and noting questions that arose to use to guide a discussion among a focus group of classroom teachers. Table 4.5 illustrates the comparison of the frequency with which teachers at Orchard Hill use these intervention techniques and how effective they perceive each one to be. The table

is sorted from most to least effective and color-coded to highlight similarities and differences between the level of effectiveness and frequency of use.

Table 4.5: Comparing Frequency of Use to Perceived Effectiveness

Survey Item	***Intervention Abbreviation***	***Frequency Mean (N=19)***	***Effectiveness Mean (N=19)***
9	Modified instructional procedures	3.37	3.42
28	Assign hands-on learning activities and open-ended task	3.32	3.26
26	Re-teaching lessons	3.26	3.16
29	Post visual models of mathematical ideas	3.37	3.05
5	Ignore minor inappropriate behaviors	3.42	3.00
6	Praising appropriate behaviors	3.42	2.95
7	Giving appropriate commands	3.16	2.84
15	If...then contingencies	2.84	2.84
18	Group or class-wide contingencies	2.89	2.68
27	Pre-teaching lessons	2.63	2.68
24	Perceptual/sensory stimulation	3.21	2.63
4	Seat Children with ADHD in the front of the classroom	2.95	2.58
3	Post Classroom Rules	3.53	2.42
21	Carrel/ "Office"	2.53	2.37
25	Individual or small group cognitive training	2.42	2.32
11	Daily Home Note	2.68	2.26
16	Point or token reward system	2.42	2.21
23	Individual or small group social skills training	2.26	2.16
10	Homework assignment book	2.79	2.11
13	Daily report card with target goals and feedback	2.21	2.11
19	Time Out	2.11	2.00
22	Taped behavioral reminders on the student's desk	2.21	1.89
12	Weekly Home Note	2.42	1.74
8	Reprimands for inappropriate behavior	2.11	1.74
14	Weekly report card with target goals	2.05	1.63
20	Send to principal/ disciplinarian office	1.95	1.63
17	Response-cost system	1.79	1.53

One of the immediate differences noted by the researcher was that, although *Post Classroom Rules* is the most frequently used intervention technique (Frequency Mean: 3.53), it is

not perceived to be among the most effective interventions, (Effectiveness Mean: 2.42). Similarly, *Perceptual/Sensory Stimulation* (Frequency Mean: 3.21; Effectiveness Mean: 2.63), *Praising Appropriate Behaviors* (Frequency Mean: 3.42; Effectiveness Mean: 2.95), and *Giving Appropriate Commands* (Frequency Mean: 3.16; Effectiveness Mean: 2.84) are all used frequently but are not seen as moderately to highly effective. All the five intervention techniques with an Effectiveness Mean of 3.00 or higher also have Frequency Means above 3.25. Alternately, the intervention techniques that teachers use least often, *Response-cost systems* (Frequency Mean: 1.79; Effectiveness Mean: 1.53) and *Send to Principal/ Disciplinarian* (Frequency Mean: 1.95; Effectiveness Mean: 1.63) are also perceived to be the least effective. All of this indicates that teachers at Orchard Hill are most frequently using interventions that they believe are effective, or somewhat effective, and least frequently using those interventions they believe to be ineffective.

The researcher next disaggregated the data based on teachers' current grade-level placement and years teaching to determine whether variance in perceptions exists among the subgroups. The researcher noted significant similarities among the mean data for Kindergarten through second grade teachers as well as among third through fifth grade teachers. She chose to calculate the mean for primary grades (K-2nd) and intermediate grades (3rd-5th) and compare them to one another. Table 4.6 shows the Effectiveness Mean for primary and intermediate grade teachers for each intervention technique in order from most to least effective for the K-2nd grade teachers. This table is color coded to highlight the similarities and differences in the perceived effectiveness of each group of teachers for each intervention technique. The most obvious discrepancy is that the teachers in the intermediate grades perceive the *Homework Assignment Book* to be a moderate to highly effective intervention technique (Intermediate Mean: 3.14)

whereas the primary grade teachers perceive it to be the least effective technique (Primary Mean: 1.17) a difference between the means of 1.97.

Table 4.6: Mean Perceived Effectiveness by Grade Level

Survey Item	***Intervention Abbreviation***	**K-2nd Mean (N=10)**	**3rd - 5th Mean (N=9)**
9	Modified instructional procedures	3.42	3.31
28	Assign hands-on learning activities and open-ended task	3.33	3.19
26	Re-teaching lessons	3.08	3.19
29	Post visual models of mathematical ideas	3.03	2.94
15	If...then contingencies	3.00	2.61
6	Praising appropriate behaviors	2.97	2.78
5	Ignore minor inappropriate behaviors	2.92	2.92
7	Giving appropriate commands	2.75	2.75
21	Carrel/ "Office"	2.75	1.83
24	Perceptual/sensory stimulation	2.64	2.58
18	Group or class-wide contingencies	2.56	2.78
27	Pre-teaching lessons	2.53	2.75
3	Post Classroom Rules	2.53	2.28
16	Point or token reward system	2.50	1.92
22	Taped behavioral reminders on the student's desk	2.33	1.39
25	Individual or small group cognitive training	2.31	2.25
4	Seat Children with ADHD in the front of the classroom	2.28	2.84
11	Daily Home Note	2.20	2.61
23	Individual or small group social skills training	2.03	2.25
19	Time Out	2.00	1.97
20	Send to principal/ disciplinarian office	1.81	1.36
12	Weekly Home Note	1.75	1.86
13	Daily report card with target goals and feedback	1.72	2.61
8	Reprimands for inappropriate behavior	1.72	1.72
17	Response-cost system	1.53	1.53
14	Weekly report card with target goals	1.50	1.67
10	Homework assignment book	1.17	3.14

Aside from the *Homework Assignment Book,* the intervention techniques that are viewed as moderately to highly effective by the intermediate teachers are also seen as such by the primary teachers; these include, *Modified Instructional Procedures, Assign Hands-On Learning Activities and Open-Ended Tasks,* and *Reteaching Lessons.* There are two intervention

techniques that primary teachers believe to be moderately to highly effective while intermediate teachers only rate them to be somewhat to moderately effective. The first is *Post Visual Models of Mathematical Ideas (*Primary Mean: 3.03; Intermediate Mean: 2.94) for which the difference between the means is 0.08. The second is *If...Then Contingencies* (Primary Mean: 3.00; Intermediate Mean: 2.61) for which the difference is 0.39.

The researcher presented these findings to the focus group of 5 classroom teachers to better understand the reasons for some of the discrepancies and gauge the variance in perceptions between the two groups. When asked about the discrepancy between the frequent use and perceived effectiveness of the *Post Classroom Rules* intervention, all five of the teachers' noted that this was a common best practice used for the benefit of all students, not only students with ADHD. This quote from one of the focus group participants is representative of the group's responses, "posting class rules is an intervention for all students; it's just best practice, but that doesn't mean that all students will take advantage of it or use it successfully". The group also believed that this intervention isn't always successful for students with ADHD because their impulsivity often makes it difficult for them to follow rules. This quote from one of the focus group participants is representative of the group's responses, "they want to follow the rules, but they just can't; they don't want to screw up, but they often don't realize that they have until it's already too late". Similar responses were given when asked about the discrepancies for *Praising Appropriate Behavior* and *Giving Appropriate Commands.* One teacher is quoted as saying, "those are things we do because we are good teachers, it works for some students and doesn't work for others; every student has different needs".

The only intervention techniques to have frequency and efficacy means 3.00 regardless of the grade level or number of years teaching (see Tables 4.7 and 4.8) were *Modified Instructional*

Procedures and *Assign Hands-On Learning Activities and Open-Ended Tasks.* The researcher asked the members of the focus group to discuss their use of the technique and speak to possible reasons the latter is not used more frequently (the frequency means for all sub-groups was 3.50). The focus group members spoke about the day-to-day demands of an elementary classroom and the lack of time to plan and implement hands-on activities that are well thought out and purposeful. One of the participants stated, "If it was just part of the curriculum more than it already is, it would be easier to make every lesson 'hands-on', but we are spread extremely thin and those types of lessons take time to do and do well". Another participant pointed out that, "open-ended tasks aren't always beneficial for students with ADHD, they often still need lots of structure to be able to complete the open-ended tasks successfully".

Tables 4.7 and 4.8 show the mean frequency of use and mean effectiveness disaggregated by the number of years teaching. To have sample sizes larger than one person, the samples were grouped as follows, 0-9 years, 10-19 years, and 20+ years. The group of teachers who had been teaching for 20 years or more identified the fewest number of interventions as being least effective (4 items with mean <2.00) and the largest number of intervention techniques as being somewhat effective or higher (23 items with mean 2.00) when compared to the teachers in the other samples.

Table 4.7: Mean Frequency of Use by Years Teaching

		Years Teaching		
Survey Item	***Intervention Abbreviation***	***0-9 (N=4)***	***10-19 (N=4)***	***20+ (N=11)***
3	Post Classroom Rules	3.75	3.75	3.36
4	Seat Children with ADHD in the front of the classroom	3.50	3.00	2.73
5	Ignore minor inappropriate behaviors	2.75	3.50	3.64
6	Praising appropriate behaviors	3.50	3.00	3.55
7	Giving appropriate commands	3.50	3.00	3.10
8	Reprimands for inappropriate behavior	2.50	2.50	1.82
9	Modified instructional procedures	3.00	3.25	3.55
10	Homework assignment book	1.50	3.75	2.91
11	Daily Home Note	3.00	2.25	2.72
12	Weekly Home Note	2.75	2.50	2.27
13	Daily report card with target goals and feedback	1.75	2.50	2.27
14	Weekly report card with target goals	1.75	2.25	2.10
15	If...then contingencies	3.00	2.50	2.91
16	Point or token reward system	3.00	1.75	2.45
17	Response-cost system	1.75	2.00	1.73
18	Group or class-wide contingencies	3.25	2.50	2.91
19	Time Out	2.00	1.60	2.36
20	Send to principal/ disciplinarian office	2.00	1.50	2.09
21	Carrel/ "Office"	2.25	2.25	2.73
22	Taped behavioral reminders on the student's desk	2.50	1.50	2.36
23	Individual or small group social skills training	2.00	2.00	2.45
24	Perceptual/sensory stimulation	3.25	2.75	3.36
25	Individual or small group cognitive training	2.25	1.75	2.73
26	Re-teaching lessons	2.50	3.00	3.64
27	Pre-teaching lessons	2.00	2.50	3.00
28	Assign hands-on learning activities and open-ended task	3.25	3.00	3.45
29	Post visual models of mathematical ideas	3.25	2.50	3.73

Table 4.8: Mean Effectiveness by Years Teaching

		Years Teaching		
Survey Item	***Intervention Abbreviation***	***0-9 (N=4)***	***10-19 (N=4)***	***20+ (N=11)***
3	Post Classroom Rules	2.50	2.25	2.45
4	Seat Children with ADHD in the front of the classroom	2.50	3.00	2.45
5	Ignore minor inappropriate behaviors	2.50	3.00	3.20
6	Praising appropriate behaviors	2.75	2.75	3.10
7	Giving appropriate commands	3.00	2.50	2.91
8	Reprimands for inappropriate behavior	1.75	1.75	1.73
9	Modified instructional procedures	3.00	3.25	3.67
10	Homework assignment book	0.50	2.75	2.45
11	Daily Home Note	1.75	1.75	2.64
12	Weekly Home Note	1.25	1.75	1.91
13	Daily report card with target goals and feedback	0.50	3.00	2.36
14	Weekly report card with target goals	0.50	2.00	1.91
15	If...then contingencies	3.25	2.75	2.73
16	Point or token reward system	2.50	1.50	2.36
17	Response-cost system	1.25	1.25	1.73
18	Group or class-wide contingencies	3.00	2.50	2.64
19	Time Out	1.50	1.25	2.45
20	Send to principal/ disciplinarian office	1.00	1.00	2.09
21	Carrel/ "Office"	2.25	1.75	2.64
22	Taped behavioral reminders on the student's desk	2.00	1.00	2.18
23	Individual or small group social skills training	1.50	2.25	2.36
24	Perceptual/sensory stimulation	2.25	2.50	2.82
25	Individual or small group cognitive training	1.75	1.50	2.82
26	Re-teaching lessons	2.50	3.00	3.45
27	Pre-teaching lessons	2.50	2.75	2.82
28	Assign hands-on learning activities and open-ended task	3.25	3.00	3.36
29	Post visual models of mathematical ideas	3.00	2.75	3.82

The group of teachers who had been teaching for 0-9 years identified the fewest number of intervention techniques as somewhat effective or higher and the largest number of techniques as being the least effective when compared to the other samples. When this was discussed by the focus group it was noted that most of the novice teachers in the building are in the primary

grades, one teacher stated that "a lot of these are developmentally not as appropriate for younger students as they are for older students." Another teacher pointed out that novice teachers "haven't had as much time and experience with these interventions so haven't had the opportunity to see them succeed." While there is some variance among teachers based on the number of years they have been teaching, there were eight intervention techniques among the 27 for which the effectiveness means were within the same range (1 - 1.99, 2 - 2.99, or 3 - 3.99). The two most effective were *Modified Instructional Procedures* and *Assign Hands-on Learning Activities and Open-Ended Tasks.* There were three techniques in the 2-2.99 ranges for all samples; *Post Classroom Rules, Perceptual/Sensory Stimulation,* and *Pre-teaching Lessons.* Finally, there were three techniques in the 1-1.99 range for all samples; *Reprimands for Inappropriate Behavior, Weekly Home Notes,* and *Response - Cost Systems.*

Summary

This chapter discussed the results among quantitative and qualitative data collected throughout this case study. The researcher set out to explore the perceptions of elementary classroom teachers around the efficacy of Tier I interventions for students with ADHD in the mathematics classroom. This case study focused on the perception of classroom teachers at Orchard Hill Elementary School in Connecticut. Based on the data analysis the researcher concludes that many Tier I interventions have been frequently implemented in the mathematics classroom at Orchard Hill Elementary School for students with ADHD. The most frequently used interventions include behavior interventions (*Posting Classroom Rules, Ignoring Minor Inappropriate Behaviors,* and *Praising Appropriate Behaviors)* and academic/ content interventions (*Modified Instructional Procedures, Posting Visual Models of Mathematical Ideas,* and *Assigning Hands-On Learning Activities and Open-Ended Tasks).* Frequency of use does not

necessarily mean that teachers believe the intervention to be highly effective for helping students with ADHD to succeed in the mathematics classroom. The Tier I strategies do teachers at Orchard Hill Elementary School perceive as the most effective in accommodating students with ADHD so that they can succeed in elementary school mathematics are primarily academic in nature; *Modifying Instructional Procedures, Assigning Hands-On Learning Activities and Open-Ended Tasks, Re-teaching Lessons,* and *Posting Visual Models of Mathematical Ideas.* There is some variance in perceptions among teachers who instruct different grade levels. Most of the discrepancies are based on the developmental level of the students, for example, primary grade teachers do not find using a homework assignment book to be an effective intervention because they do not regularly assign homework to students, while intermediate level teachers believe it to be somewhat to moderately effective and use it extremely frequently. Greater variance exists in the perceptions among teachers who have been teaching for 0-9 years, 10-19 years, and 20 years or more. The data indicates that the longer someone has been teaching, the more effective they believe some interventions to be.

Chapter 5: Conclusions and Implications

The purpose of this case study was to provide insight to the staff at Orchard Hill Elementary School into effective ways to address the challenges that students with ADHD face in the math classroom. By first identifying which research-based instructional strategies and behavior interventions are currently being used, as well as the perceived efficacy of the strategies and interventions by those implementing them day-to-day, the school community can begin to understand the efficacy of Tier I intervention for students with ADHD and identify potential needs for further research, professional development or capitalize on successful strategies and share them across the school or district-wide communities. The specific research questions in this case study were:

1. What Tier I interventions have been implemented in the mathematics classroom at Orchard Hill Elementary School for students with ADHD?
2. Which Tier I strategies do teachers at Orchard Hill Elementary School perceive as highly effective in accommodating students with ADHD so that they can succeed in elementary school mathematics?
3. How much variance in perceptions exists among teachers who instruct different grade levels and with different years of experience?

Prior to the study, the researcher expected to find that the classroom teachers at Orchard Hill were already implementing several Tier I interventions for students with ADHD in the mathematics classroom that they perceive as being effective in helping those students succeed in elementary school mathematics. The researcher also expected that the interventions being used most frequently for students with ADHD would be behavior management interventions as opposed to content specific interventions. Finally, the researcher expected to find a variance

between the types of interventions novice teachers perceive as effective and those perceived as effective by more veteran teachers.

The quantitative data from the classroom teacher survey, and the qualitative data from the focus group interviews presented in chapter four indicate that there are many Tier I interventions that classroom teachers at Orchard Hill are currently using to accommodate students with ADHD in the mathematics classroom. The top third of the interventions ranked for frequency of use are a combination of behavior management interventions and academic content/instructional interventions, with the top three being behavior based (see Table 5.1).

Table 5.1: Most Frequently Used Interventions

Behavioral/ Instructional	***Intervention Abbreviation***	**Mean (N=19)**
B	Post Classroom Rules	3.53
B	Ignore minor inappropriate behaviors	3.42
B	Praising appropriate behaviors	3.42
I	Modified instructional procedures	3.37
I	Post visual models of mathematical ideas	3.37
I	Assign hands-on learning activities and open-ended task	3.32
I	Re-teaching lessons	3.26
B	Perceptual/sensory stimulation	3.21
B	Giving appropriate commands	3.16

Classroom teachers at Orchard Hill believe that the most effective types of interventions at the Tier I level are not behavioral interventions/accommodations but more focused on the design and delivery of content instruction. While none of the interventions in the survey were deemed "highly effective" by all classroom teachers, there were a few interventions that were believed to be moderately effective in helping students with ADHD meet with success. This researcher believes the reasons for the less frequent use of some of the more effective academic interventions when compared to the behavioral interventions is because of the amount of time

and effort required to adequately plan and implement these interventions. For example, *Assigning Hands-On Learning Activities and Open-Ended Tasks* is regarded among the most effective however teachers admit to not using it as frequently because it is not explicitly designed in parts of the prescribed curriculum and therefore requires intense amounts of additional planning to implement this intervention effectively.

There is clearly a variance among teachers at different grade levels regarding the interventions they believe to be effective in helping students with ADHD in the math classroom. This makes sense given the varying levels of responsibility and developmental nature of sustaining attention. Classroom teachers of intermediate grade students find some effectiveness in frequent use of *Homework Assignment Books* whereas primary grade teachers who assign very little to no homework do not find this strategy effective at all in helping students manage ADHD in the math classroom. The intermediate grade teachers find this strategy moderately effective for several reasons. First, it helps students keep track of their assigned homework, helping compensate for any working memory difficulties. Also, the planners that the school provides to all students have pages with mathematical vocabulary words and definitions and various tools (i.e. 100 grid, multiplication chart, conversion charts for measurement, etc.) to aid students in completing their work when not in school with resources in the classroom at their disposal. Finally, the books work as a convenient home-school communication tool, informing and engaging the family in the student's work.

According to Goldstein & Naglieri (2008), there is limited research to suggest long term success for interventions such as, "positive and negative contingent teacher attention, token economies, peer mediated and group contingencies, time-out, home-school contingencies, and reductive techniques based on reinforcement" (p. 869). Much like

Goldstein & Naglieri, teachers at Orchard Hill have not found interventions of this nature to be very effective in helping students with ADHD in particular. While they do use them occasionally, it is often as part of a class behavior management strategy and not individualized for students with ADHD.

Implications

This study has revealed the need for examination and possible revision of the current K-5 mathematics curriculum to more regularly and explicitly incorporate hands-on learning activities and open-ended tasks to engage, not only students with ADHD but all students in authentic math learning. Such revision should be done in collaboration with classroom teachers to achieve the desired outcome of having a curriculum rich in authentic, hands-on learning activities that are well thought out and designed with all students in mind. This researcher recommends creating grade-level math curriculum committees with representatives from each elementary school across the district. These committees should examine and revise the existing curriculum to address the need for increased opportunities for hands-on learning experiences and thoroughly design revisions to be accessible to all teachers and students.

This study has also revealed the need for collaboration among teachers in varying grade-levels and with varying levels of experience. There are many instances where teachers at one grade-level or with more (or sometimes less) teaching experience are finding success implementing practices that benefit students with ADHD. This researcher recommends creating vertical professional learning communities (PLCs) among elementary grade teachers across the district. Making use of the district's early release Wednesday schedule to promote and foster this vertical collaboration will help teachers share what they are finding success with and gain new

ideas and insight from other teachers. This level of professional development and learning has the potential to positively impact all students across the district.

Suggestions for Future Research

Now that there is a clearer understanding of the different interventions that classroom teachers at Orchard Hill Elementary School are using to help students with ADHD meet success in the mathematics classroom, the school community should move on to documenting the use and effects of these interventions in the RtI process. It is recommended that the school's Student Assistance Team (SAT) study the actual effects of the specific interventions that teachers believe to be moderately effective, on the academic achievement of students with ADHD. The SAT should also continue to closely monitor the academic progress of those students with ADHD who are also participating in Tier II and III math intervention to determine whether the ADHD is the primary cause of the math learning difficulties or if there may be a comorbid learning disability for some of the students (Daley & Birchwood, 2009).

Limitations

The first limitation of this study was the limited scope of the study. This study was done in a single school and therefore the results and implications can only be used to recommend action for the population of that school. The second limitation is the small sample sizes for the specific grade-levels and years of experience sub-groups could limit the ability to generalize the disaggregated data to those populations. The third and final limitation is time. Because of the short time-period (6 weeks) for collecting all of the data, and the early morning time for the focus group, the number of participants in the focus group was very small and therefore the data collected from that discussion may not be representative of the whole population.

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