TEACHER INTERPRETATION AND APPLICATION OF GRAPHED BEHAVIORAL DATA THROUGHOUT THE RTI PROCESS

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ABSTRACT OF THE DISSERTATION

Teacher Interpretation and Application of Graphed Behavioral Data

Throughout the RTI Process

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Students with or at-risk of High Incidence Disabilities (HID) experience a multitude of negative outcomes. To intervene early, many schools have elected to implement evidence-based practices within Response to Intervention (RTI). RTI targets the academic and behavioral progress of students deemed "at risk" for HID with increasingly intensive interventions. Throughout the RTI process, teachers play a critical role in data-based decision-making by collecting, interpreting, and applying behavioral data. However, very limited research has explored teacher ability, confidence, or usefulness to engage in this role. As such, the purpose of this study was to explore pre-service and in-service teachers' ability, confidence, willingness, and perceived usefulness to interpret and apply behavioral data before and after a brief behavior analytic training titled "Collecting, Interpreting, and Applying Graphed Behavioral Data" (CIA-GBD), and the factors that influenced each outcome. One hundred and one participants completed a survey and 24 participants attended CIA-GBD. Results indicated that, prior to CIA-GBD, teachers were somewhat able to find specific information in the graphed data, but were challenged to interpret the effects of intervention or make decisions based on the data. After training, teacher ability increased in all aspects; with the exceptions of data application. In addition, teacher confidence and willingness to interpret and apply graphed behavioral data increased. These data suggest the

benefits of a brief training to increase teacher data use and application.

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DEDICATION

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CHAPTER I

PROBLEM STATEMENT

An increasing number of students with and at-risk of High Incidence Disabilities (HID) have negative short and long term academic and behavioral outcomes (Friend & Bursuck, 2012; Mercer & Pullen, 2009). To intervene early and prevent unnecessary classification of a student with a HID, federal law suggests the implementation of evidence-based interventions and progress monitoring to determine student response (RTI). Effective data interpretation and application are integral parts of the process with a necessary emphasis on visual inspection of graphed data to inform these decisions. Although this is a necessary process and teacher ability is vital to ensure positive student outcomes, it is only one component to a much more complex process. Ultimately, it will be important to tie in teacher ability, confidence, willingness, and perceived usefulness to interpret and apply graphed behavioral data to administrator buy in, procedural fidelity, and student outcomes, all of which are essential components to this complex process. The following paragraphs illustrate the potential negative outcomes for students with and at-risk of HID to illustrate the immense need for intervention that must include the interpretation and application of graphed behavioral data by teachers.

Students with disabilities account for approximately 6,500,000 of the students in the United States (Snyder, De Brey, and Dillow, 2018) and individuals with HID account for approximately 3,489,000 of students in the education system and are served through special education under the categories of learning disability (LD), emotional disturbance (ED), and Other Health Impaired (OHI) (Snyder et al., 2018). In this study, HID is defined as learning disabilities (LD), emotional disturbance (ED), and attention deficit hyperactivity disorder (ADHD) as they are the most prevalent disabilities as reported by the Department of Education

(DOE). Further, students classified in each of these categories may demonstrate behavioral difficulties of interest in this study (DOE, 2018; Gage, Lierheimer, & Goran, 2012). Although ADHD is not a category covered under special education, students with ADHD tend to receive special education services within LD, ED, or the OHI IDEIA category (Forness & Kavale, 2002). IDEIA developed specific criteria for individuals with HID. The IDEIA (2004) criteria for LD includes one or more of the basic psychological processes involved in:

> understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. (Sec. 300.8(c)(10).

The IDEIA (2004) criteria for ED includes one or more of the following characteristics over a long period of time and to a degree that impacts a child's education:

> (a) an inability to learn that cannot be explained by intellectual, sensory, or health factors, (b) an inability to build or maintain satisfactory interpersonal relationships with peers and teachers, (c) inappropriate types of behavior or feelings under normal circumstances, (d) a general pervasive mood of unhappiness or depression, and (e) a tendency to develop physical symptoms or fears associated with personal or school problems. (Sec. 300.8(c)(4)).

The IDEIA (2004) criteria for OHI includes:

> having limited strength, vitality, or alertness, including a heightened alertness to environmental stimuli, that results in limited alertness with respect to the educational environment, that: (a) is due to chronic or acute health problems such as asthma, attention deficit disorder or attention deficit hyperactivity disorder, diabetes, epilepsy, a heart

> condition, hemophilia, lead poisoning, leukemia, nephritis, rheumatic fever, sickle cell anemia, and Tourette syndrome; and (b) adversely affects a child's educational performance (Sec. 300.8(c)(9)).

According to the Department of Education and National Center for Education Statistics in the 2014-2015 school year, approximately 2,278,000 students were identified with a Specific Learning Disability, 349,000 students with Emotional Disturbance, and 862,000 students classified with Other Health Impaired (Snyder, et al., 2018). As previously mentioned, these categories represent the majority of students served through special education services.

Research suggests that students with HID share similar academic and behavioral characteristics (Barkley, 2006; Gage et al., 2012; Gregg, 2009; Hallahan, Kauffman, & Pullen, 2009; Reschly, Tilly, & Grimes, 1999; Sabornie, Evans, & Cullinan, 2006). Gage et al. (2012) conducted a study to investigate the similarities and differences in individuals with HID. The authors concluded that students with HID in all categories perform similarly across cognitive and academic domains with some differences in the behavioral domain. Academic performance had the fewest differences. However, students with HID significantly differ in the behavior domain with students with ED having higher rates of behavior problems and suspension than the other disabilities (Gage et al., 2012). Although these students may have the cognitive ability to meet the same standards as students without disabilities with additional supports and services, students with HID continue to struggle academically and behaviorally (Friend & Bursuck, 2012; Mercer & Pullen, 2009).

Students at-risk of HID are known to struggle academically and behaviorally throughout their academic experiences. Risk factors include poor academic skills, social problem-solving skills, quality of instruction, and peer relationships (Murray, 2003). As such, early identification

and prevention is necessary to address the negative academic and behavioral outcomes of students that will be discussed in this chapter. For the greatest effect to be achieved, identification and prevention is based on data, the provision of high-quality instruction, and intervention with continual interpretation and application of student outcome data. If data interpretation suggests that students are responding to intervention, then prevention has occurred and the student is unlikely to experience a host of negative outcomes frequently experienced by youth with HID. In this chapter, I present those outcomes and the supporting research to accentuate the importance of using behavioral data interpretation and application to inform high quality instruction prior to students experiencing these poor outcomes.

Academic Outcomes of Students with HID

Students with or at-risk of HID often experience negative short-term academic outcomes in the areas of reading, writing, and mathematics (see Figure 1), which in turn, negatively impact their standardized test scores and academic progression. In the following sections, I describe the specific struggles in each area as revealed through empirical study.

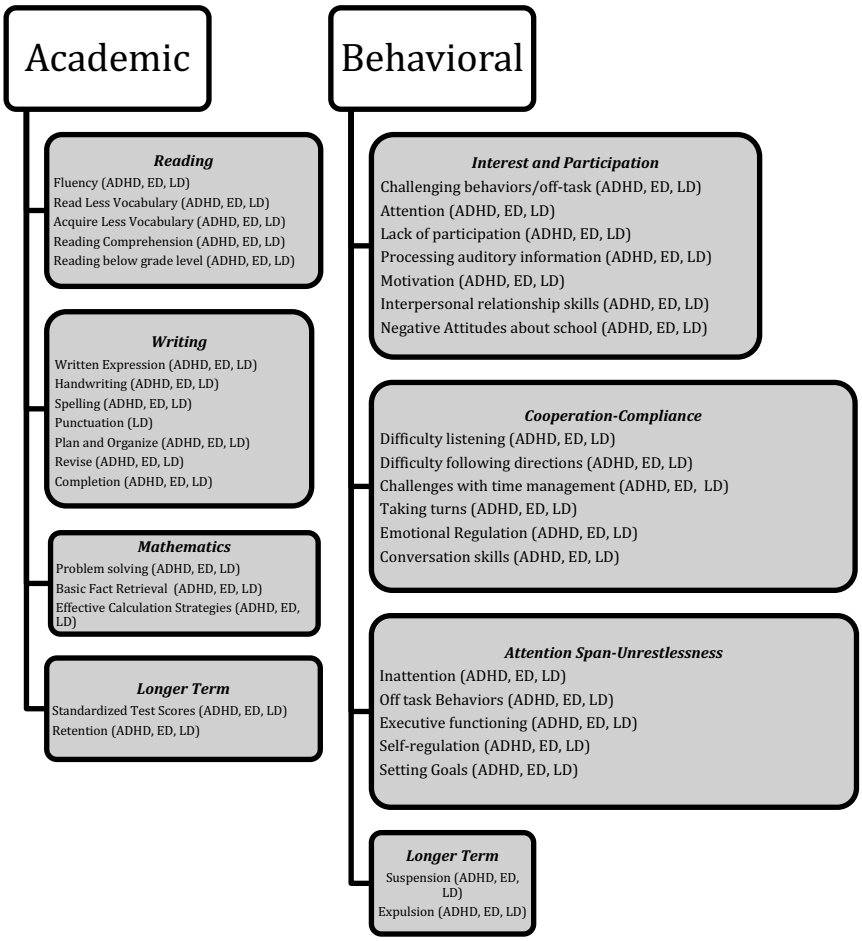

Figure 1. Academic and Behavioral Negative Short-and-Long Term Outcomes for Individuals with High Incidence Disabilities (HID).

Reading

Research indicates that students with HID frequently struggle with reading fluency, vocabulary, and reading comprehension (Garwood, Ciullo, & Brunsting, 2017; Graesser, Singer, & Trabasso, 1994). Specifically, studies have revealed that students with LD struggle with reading fluency; therefore, they read less text and acquire less vocabulary (Nagy & Townsend, 2012). Similarly, students with ED tend to read one to two years below grade level in comparison to their peers without difficulties and may have the slowest growth in reading across other disabilities (e.g. ADHD, LD) once they begin middle school (Lane, Barton-Arwood, Nelson, & Wehby, 2008; Kauffman, 2001; Yakimowski, Faggella-Luby, Kim, & Wei, 2016).

Furthermore, students with ADHD and ED may be able to read the words accurately and somewhat fluent, but struggle with working memory, managing their behaviors, motivation, and organization (Cortiella & Horowitz, 2014; Geurts, Verté, Oosterlaan, Roeyers, & Sergeant, 2005; Nelson, Benner, Neill, & Stage, 2006), all of which have the potential to negatively impact reading fluency and comprehension (Benner, Nelson, Ralston, & Mooney, 2010; Miller et al., 2013). Difficulties in reading can impede a child's ability to learn to their potential in all subject areas and impact their future education and career path. As such, if early academic and behavioral prevention services are not provided, students with or at-risk of HID are likely to fall behind their peers in reading.

Writing

Adding further difficulties, students with difficulties with reading often struggle with writing. As such, students with HID often have difficulties in one or more area(s) of the writing process (Cortiella, & Horowitz, 2014; Mercer & Pullen, 2009). For example, research suggests that students with LD perform at a significantly lower level than their peers in written expression, specifically in the areas of spelling, punctuation, and word usage (Cortiella, & Horowitz, 2014; Mercer & Pullen, 2009; Viel-Ruma, Houchins, & Frederick, 2007). Students with LD tend to have difficulty selecting and/or implementing strategies necessary to plan and organize, develop a written product, and/or revise the product (Cortiella, & Horowitz, 2014; Mercer & Pullen, 2009; Montague, Maddux, & Dereshiwsky, 1990). Similarly, students with ED and ADHD tend to underachieve in writing/written expression (Lane et al., 2008; Re, Pedron, and Cornoldi, 2007). For example, Re et al., (2007) found that handwriting, spelling, and written expression requires focus and attention; therefore, individuals with ADHD, ED, and LD struggle with the writing process and completion of final products (Harris, Graham, MacArthur, Reid, &

Mason, 2011; Mercer & Pullen, 2009; Nelson, Benner, Lane, & Smith, 2004). These studies demonstrate that the writing process can be a complex and difficult process for individuals with or at-risk of HID.

Mathematics

Although there is a more prominent focus on literacy achievement in the scientific literature, many students with or at-risk of HID struggle with mathematics (Anderson et al., 2001; Cortiella, & Horowitz, 2014; Mercer & Pullen, 2009). Between 3 and 8% of the school population is estimated to have a math disability (Geary, 2004) and approximately 70%-85% of students with LD have difficulties in mathematics such that they fall below the average range on standardized testing. Challenges are specifically realized in the areas of mathematical calculations and applied mathematics problems (Cortiella, & Horowitz, 2014). Further, many individuals with LD tend to lack foundational mathematics skills, such as number fluency and mathematical reasoning skills, which are important for academic achievement (Cortiella, & Horowitz, 2014; Powell, Fuchs & Fuchs, 2013).

In addition, challenges in mathematics for individuals who struggle with working memory, inattention, and/or verbal reasoning (e.g., LD, ED, ADHD; (Anderson et al., 2001; Cortiella, & Horowitz, 2014; DuPaul & Volpe, 2009; Hasselbring, Goin, & Bransford, 1988; Zentall & Ferkis, 1993; Reid, Gonzalez, Nordness, Trout, & Epstein, 2004; Parmar, Cawley, & Frazita, 1996; Rivera, 1997; Rogers et al., 2011; Zentall & Ferkis, 1993) include difficulties with problem solving, basic facts retrieval due to lack of automaticity (Hasselbring et al., Zentall & Ferkis, 1993), processing speed, and use of effective calculation strategies (Rivera, 1997). Furthermore, students with HID tend to have difficulty with inattention, which may result in failure to automatize basic skills that would allow students to concentrate on more conceptually

difficult problems. As a result of these difficulties, students with HID continuously struggle to meet expectations in mathematics.

Standardized Test Scores

As a result of reading, writing, and mathematics difficulties, students with or at-risk of HID have higher rates of poor standardized test scores. Specifically, students with LD often have lower scores on state tests than their typically developing peers (Buzick & Weeks, 2018). Carr-George, Vannest, Willson, and Davis (2009) found that only 44% of 56% of students with ED met minimum standards on the reading high stakes testing and Temple-Harvey and Vannest (2012) found that only 34% of students with ED met mathematics minimum standards on high stakes testing. Furthermore, DuPaul and Volpe (2009) found that students with ADHD score between 10 and 30 points lower than typically developing students on standardized tests (DuPaul & Volpe, 2009). These studies clearly demonstrate the challenges students with or at risk of HID encounter when taking standardized tests, which can potentially lead to retention.

Retention

In addition to poor standardized test scores, poor academic performance often results in retention (i.e., repeating an academic year of school**).** For example, Barnett, Clarizio, and Payette (1996) found that 71% of students with LD had been retained prior to a referral into special education. Currie and Stabile (2006) found a correlation between symptoms of ADHD, scores on academic standardized tests, and grade retention and the number of behavioral symptoms and academic achievement. Results suggested that students with symptoms of ADHD were more likely to be retained than their typically developing peers (Currie & Stabile, 2006). Furthermore, grade retention of students with ED is similar to students with other disabilities at approximately 22% and rises to approximately 38% in high school (Bradley, Doolittle, &

Bartolotta, 2008). Thus, it appears that poor academic performance for students with HID may lead to retention.

Behavioral Outcomes of Students with HID

Students with or at risk of HID often experience negative behavioral outcomes. Specifically, students with HID struggle to demonstrate interest and participation, cooperation and compliance, maintain attention and use self-regulation skills in the classroom (see Figure 1; Alexander et al., 1993; Barkley, 2006; Graham et al., 1992). All of these behaviors are needed to be successful in the classroom. Further, as a result of these behaviors, students with or at-risk of HID are given more discipline referrals resulting in suspension and expulsion than their typically developing peers thus losing out on essential instructional time.

Interest-Participation

Interest-Participation is defined as demonstrating enthusiasm and actively engaging in academic lessons and/or independent tasks. Behaviors that represent Interest-Participation are demonstrated during teacher-led instruction and independent tasks and include academic exchanges, such as raising hands, answering questions, contributing ideas verbally, and completing independent tasks (Alexander et al., 1993).

Students with or at-risk of HID typically demonstrate less involvement in academic lessons and activities and participate less in whole group instruction than their typically developing peers (McIntosh,Vaughn, Schumm, Haager, & Lee, 1993). In addition, students with or at-risk of HID tend to have lower rates of on-task behavior when passive classroom activities or monotonous unexciting tasks, such as reading aloud are mandatory (Harrison, Kwong, Evans, & Mathews, 2019; Junod, DuPaul, Jitendra, Volpe, & Cleary, 2006). Specifically, students with ADHD-Inattentive type and LD have difficulty paying attention in class and may appear to be

withdrawn; therefore, resulting in lack of participation (Mercer & Pullen, 2009; Mikami, Huang-Pollock, Pfiffner, McBurnett, & Hangai, 2007). Similarly, students with HID may struggle to participate in class due to challenges with risk taking, perseverance, and processing auditory directions, resulting in a limited amount of participation and peer interaction (Benner, Nelson, & Epstein, 2002; Cortiella & Horowitz, 2014; McIntosh et al., 1993; Mercer & Pullen, 2009; Nagro, Hooks, Fraser, & Cornelius, 2016). In contrast, students with ADHD-combined type and ED exhibit challenging behaviors, such as noncompliance and aggression, which are likely to prevent them from participating and engaging in classroom activities at a rate similar to their typically developing peers (Barkley, 2006; Bradley, Doolittle, & Bartolotta, 2008; Mulcahy, Krezmien, & Maccini, 2014; Sutherland & Oswald, 2005; Weeden, Wills, Kottwitz, & Kamps, 2016). In addition to the previously stated challenges, other characteristics of students with HID that might interfere with interest and participation in the classroom include lack of motivation, deficits in interpersonal relationship skills, and negative attitudes about school (Kauffman & Landrum, 2013; Lane, 2004; Sutherland, Lewis-Palmer, Strichter, & Morgan, 2008; Mercer & Pullen, 2009; Wehby, Lane, & Falk, 2003). In summary, these challenges may prevent individuals with or at risk of HID from engaging in teacher-led academic lessons and independent tasks.

Cooperation-Compliance

Cooperation-Compliance is defined as the process of following directions and working together to attain a goal and is a social skill required for collaborating with peers and following teacher directives. Behaviors that represent Cooperation-Compliance are demonstrated during teacher instructions and group work and include following the directives of the teacher, problem solving, listening to peers, taking turns in conversation, waiting for turns, and initiating and

maintaining conversations. Students who are cooperative, share, offer pleasant greetings, ask questions, provide information, and make conversation tend to have positive interactions with their peers (Gresham, 1982).

However, individuals with or at-risk of HID struggle to follow directions and cooperate and comply in the classroom (DuPaul & Stoner, 2003; Gresham & MacMillan, 1997; Kavale and Forness, 1996). As previously mentioned, students with HID may exhibit hyperactive and impulsive behaviors; therefore, they may have difficulty listening to teacher directions (American Psychiatric Association, 2013; Mercer & Pullen, 2009). If students with HID have difficulty listening to directions, they will ultimately have trouble following through with those directions. In addition, students with HID tend to have deficits in temporal processing which leads to difficulty with time management (e.g. under estimating time; Cancio, West, & Young, 2004; Luman, Oosterlaan, & Sergeant, 2008; Mercer & Pullen, 2009; Toplak, Dockstader, & Tannock, 2006;). This challenge may result in difficulty waiting their turn in conversations or games with peers (Toplak & Tannock, 2005). Due to these challenges and in combination with difficulty with emotional regulation (Bryan, Burstein, & Ergul, 2004; Fonseca, Seguier, Santos, Poinso, & Deruelle, 2009; Sjowall, Roth, Lindqvist, & Thorell, 2013), students with HID may engage with their peers in an abrupt, impulsive manner, which prohibits them from interacting appropriately with peers in a conversation and may limit their ability to respond appropriately to social cues (Coie & Jacobs, 1993; DuPaul & Stoner, 2003; Stroes, Alberts, & van der Meere, 2003; Walker, Colvin, & Ramsey, 1995). Further, it is common for students with LD to have difficulty understanding verbal directions and to communicate with others which may inhibit their ability to follow directions and engage in group activities in the classroom (Mercer &

Pullen, 2009). In response to the challenging behavior of students with HID in the area of cooperation and compliance, peers may exclude these students from group activities.

Attention Span-Unrestlessness

Attention Span-Unrestlessness is defined as the ability to initiate, maintain, and shift attention appropriately and to self-regulate physical activity and is frequently referred to as passive engagement. Behaviors that represent Attention Span-Unrestlessness are demonstrated during teacher instructions/lessons, group work, and independent work and include using eye contact, sitting still, and self-regulating behavior. Students who pay attention in class, are able to self-manage their behaviors, and set goals often outperform their peers who struggle in this area (Lan, 2005; Reid, Harris, Graham, & Rock, 2012).

However, students with or at risk of HID tend to have difficulties with attention, academic engagement, and self-regulation (Briesch & Briesch, 2016; Kauffman & Landrum, 2013; Junod et al., 2006; Kotkin, Forness, & Kavale, 2001; Reid et al., 2012; Sutherland, et al., 2008). Specifically, students with ADHD and ED and some students with LD (e.g., approximately 40-80%) exhibit inattentive behaviors (DuPaul & Volpe, 2009; Fergusson & Horwood, 1995; Maggin, Wehby, Partin, Robertson, & Oliver, 2011; Sutherland, et al., 2008), which may lead to limited understanding of the lesson material and lower rates of on task behavior than their typically developing peers (Kauffman & Landrum, 2013; Junod et al., 2006; Kotkin, Forness, & Kavale, 2001; Sutherland, et al., 2008). This inattention ultimately impacts their education as they are missing important and relevant information to their studies (Godwin et al., 2016). In addition, students with HID tend to struggle on executive functioning tasks (Coleman, 2012; Cortiella, & Horowitz, 2014; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005); therefore, often demonstrate challenges with memory, planning, and coordinating

everyday tasks (e.g. morning routine, completing assignments). Finally, students with HID struggle to self-regulate their behavior and may struggle to set goals and manage their behaviors in order to complete those everyday tasks (Briesch & Briesch, 2016, Kauffman, 2005; Reid et al., 2012). In summary, students with or at risk of HID struggle to maintain attention and self-regulate their behaviors, and thus struggle with executive functioning tasks, which has a significant educational impact.

Suspension and Expulsion

As a result of these behavioral challenges, students with or at risk of HID are frequently placed in in-school or out-of-school suspension. In-school suspension is defined as "instances in which a child is temporarily removed from his/her regular classroom(s) for disciplinary purposes but remains under the direct supervision of school personnel," (USDOE, 2010, p. 6). Out-of-school suspension is defined as "Instances in which a child is temporarily removed from his/her regular school for disciplinary purposes to another setting (e.g., home, behavior center)," (USDOE, 2010, p. 6). Expulsion is defined as "An action taken by the Local Education Agency (LEA) removing a child from his/her regular school for disciplinary purposes for the remainder of the school year or longer in accordance with LEA policy," (USDOE, 2010, p. 6). These definitions can be used as a reference throughout this section.

Students with or at-risk of HID have higher rates of suspension and expulsion than their typically developing peers (American Psychiatric Association, 2008; Blackorby et al., 2003; Cortiella, & Horowitz, 2014; Fabelo et al., 2011). For example, the United States Department of Education (USDOE) (2018) data in 2013-2014 demonstrated that approximately 2,710,924 students without a diagnosed disability had been suspended and/or expelled at least once. Out of those two million students, 568,234 with a disability had been suspended or expelled at least

once. In addition, USDOE (2018) data demonstrated that in 2013-2014, 177,127 students without a diagnosed disability and 47,360 with a disability had a referral to law enforcement. These data represent that approximately 20% of students with at least one suspension had a disability and approximately 27% of students with at least one referral to law enforcement had a disability. Further, Fabelo et al. (2011) demonstrates a difference in behavioral difficulties by disability with 76.2% of individuals with LD and 90.2% of individuals diagnosed with ED having at least one disciplinary action. Regarding students with LD, Cortiella and Horowitz (2014) had similar findings, reporting that one out of every two students with LD experiences either suspension or expulsion. Regarding students with ADHD, Gage et al. (2012) had similar findings, demonstrating that individuals with ED were suspended at much greater rates than students with other disabilities and individuals with an OHI classification, specifically diagnosed with ADHD, were among the second highest rated disability to receive suspensions. Students with or at risk of HID tend to have higher suspension and expulsion rates than their typically developing peers, which may have negative long-term outcomes.

Long-Term Outcomes

Poor academic and behavioral performance may likely lead to deleterious long-term outcomes for students with disabilities, such as high dropout rates, underemployment and unemployment, and incarceration (see Table 1).

Table 1
Negative Short and Long-term Outcomes of Individuals with HID

Short-Term		Long-Term
Academic Outcomes	Behavioral Outcomes	Dropping out of school
Poor academic achievement (i.e. reading, writing, math)	Inappropriate classroom behaviors (i.e. interest-participation, cooperation and compliance, and attention)	Underemployment & unemployment
Retention	Suspension and expulsion	Incarceration
		Mental health disorders

Note. This table illustrates the negative short-term and long-term outcomes of individuals with HID (Friend & Bursuck, 2012; Mercer & Pullen, 2009; Lochner & Moretti, 2004; Morgan, Salomon, Plotkin, & Cohen, 2014; Un ruh, Gau, & Waintrun, 2009).

Dropout

Students with or at risk of HID dropout of school at higher rates than their peers (Chapman, Laird, Ifill, & KewalRamani, 2011; Cortiella, & Horowitz, 2014; Fredriksen et al., 2014). Chapman, et al. (2011) found that students with HID dropout of high school twice as often as their typically developing peers. Specifically, national dropout rates in 2012 differentiate between event dropout rates (i.e. students who leave high school between the beginning of one school year and the beginning of the next school year without earning a high school diploma) and status dropout rates (i.e. students not enrolled in high school and have not earned a high school credential; Stark & Noel, 2015). Stark and Noel (2015) found that students with disabilities had higher event dropout rates compared to students without disabilities (e.g. 10 percent vs. 3.2 percent). In addition, persons ages 18–24 with disabilities had higher status dropout rates and had a lower status completion rate (81.5 percent) than their peers without disabilities (91.7 percent; Stark and Noel, 2015). In comparison, McFarland, Stark and Cui (2016) found that young adults with HID graduated at lower rates than their peers without disabilities with a completion rate of 83% for individuals with HID and a 93% graduation rate

for individuals without disabilities. Specifically, according to disability, approximately 19% of students with LD (Cortiella, & Horowitz, 2014), approximately 32% of students with ADHD (Breslau, Miller, Chung, & Schweitzer, 2011), and 55% of students with ED (National Longitudinal Transition Study-2, 2007) drop out. Furthermore, research has demonstrated that the behavioral challenges exhibited by students with ED may result in dropout rates higher than their other peers with disabilities (Cortiella, & Horowitz, 2014). In summary of dropout, individuals with HID dropout at higher rates than their peers, ultimately, leaving them unemployed or underemployed.

Unemployment and Underemployment

As a result of students with HID dropping out of school, students with or at risk of HID may be unemployed and underemployed. According to the U.S. Department of Labor's Bureau of Labor Statistics (2015), unemployment is defined as "people who are jobless, actively seeking work, and available to take a job," (What are the basic concepts of unemployment? section, para. 15) and underemployment is defined as "…those working part time for economic reasons... or an inability to find a full-time job," (What are the basic concepts of unemployment? section, para. 15). These definitions can be used as a reference throughout this section.

Students with HID are more likely to be unemployed or underemployed than individuals without disabilities (Rojewski, Lee, & Gregg, 2014). The United States Department of Labor (2019) found that individuals with disabilities were unemployed at a rate of 6.9 and individuals without disabilities were unemployed at a rate of 3.2 in October 2019, demonstrating a 3.7 rate difference from individuals without disabilities. Further, these statistics show percentages of unemployment, as a result of dropping out, for individuals with less than a high school diploma is 12.4% in comparison to 8.4% of individuals with a high school diploma, and a drastic

decrease to 4.5% when they have obtained a bachelor's degree. Specifically, according to disability, approximately 7.9% of students with LD are unemployed and 46% of individuals with LD are not in the labor force (Cortiella, & Horowitz, 2014), approximately 16-30% of students with ADHD (Kuriyan et al., 2013), and 50-70% of students with ED are unemployed (Wagner, Kutash, Duchnowski, & Epstein, 2005).

In addition, researchers have found that individuals with HID are most often only able to obtain an entry-level position with minimum wage and/or part time work (Newman, Wagner, Cameto, Knokey, & Shaver, 2010; Wagner, Newman, Cameto, Garza, & Levine, 2005).

Further, the number of hours individuals with HID work was significantly less than individuals without disabilities, leaving them with less of an income (Rojewski et al., 2014). Similarly, Cortiella and Horowitz (2014) provided results from the United States Bureau of Labor Statistics stating that the median income of individuals without a high school diploma was $471 per week in comparison to individuals with a high school diploma making $652 per week, and individuals with a bachelor's degree making $1,066 per week. These statistics demonstrate the correlation between education (e.g. graduating from high school) on employment and income. In summary of unemployment and underemployment outcomes, individuals with HID are unemployed and underemployed at higher rates than adults without a disability, and therefore, their problematic behaviors may persist which may lead to incarceration.

Incarceration

Individuals with HID are more likely to be incarcerated than individuals without disabilities (Bronson, Maruschak, & Berzofsky, 2015; Leone, Rutherford, & Nelson, 1991; Zhang, Barrett, Katsiyannis, & Yoon, 2011). For example, Sickmund, Sladky, Kang, and

Puzzanchera (2011) reported that approximately 70,000 youth were detained in the juvenile justice system in 2010. Specifically, research has found that approximately 33–70% of individuals who are incarcerated have a disability or a mental illness in comparison to 10– 12% of individuals who are incarcerated without a disability or mental illness (Leone et al. 1991; Quinn, Rutherford, Leone, Osher, & Poirier, 2005). Similarly, results from the Transition Research on Adjudicated Adolescents Returning to Community Settings (TRACS) study, which was a 5-year longitudinal study of 531 incarcerated youth, determined that approximately 58% of the population in the correctional system were individuals with disabilities (Bullis et al., 2002). Although research about the types of disabilities most commonly found among incarcerated youth is limited, a few studies estimate that approximately 10-39% of individuals with LD, 50% of individuals with ADHD, and 48% of individuals with ED make up the distribution of incarcerated individuals with disabilities (Cortiella & Horowitz, 2014; Quinn et al., 2005). Unfortunately, these results demonstrate an overrepresentation of individuals with disabilities in the juvenile justice system (Zhang, et al., 2011).

Researchers have found a correlation between poor school achievement and frequent disciplinary actions (e.g. suspension, expulsion) with delinquency (Morgan, Salomon, Plotkin, & Cohen, 2014), demonstrating the significance of the academic and behavioral negative outcomes previously mentioned. Similarly, research has shown that adolescents who drop out of school are at a heightened risk of incarceration by approximately 3 times in comparison to adolescents who receive a high school diploma (Unruh, Gau, & Waintrup, 2009; Lochner & Moretti, 2004). Further, these individuals with disabilities were three times more likely to return to the juvenile justice system and two times less likely to become involved in work or school than individuals without a disability (Bullis et al., 2002). In summary, individuals with HID are

incarcerated at higher rates than adults without a disability, and therefore, demonstrate the importance of intervening on these negative academic and behavioral short-term outcomes at the onset of school (Cortiella & Horowitz, 2014).

Intervening in the Negative Trajectory with Data

As demonstrated by this lengthy account of negative outcomes, it is essential that educators intervene early to stop this negative trajectory prior to students who are at-risk becoming students with disabilities. Effective early intervention with students requires educators to utilize research-based interventions and monitor their effectiveness with data, as is prescribed in the multi-tier system of support framework, including response to intervention (RTI).

The RTI process will be thoroughly described in chapter II. However, it is important to note here that RTI requires teachers to be data literate (Johnson et al., 2006; Kovaleski et al., 2008). As such, teachers must be able to translate data collected and displayed visually (i.e, graphed) into useful information and apply that information to make any necessary changes to instruction or intervention for students. The ultimate goal is to provide children all possible learning opportunities and measure their progress, providing more support if needed based on data to intervene and determine if a student is truly in need of special education services or if early intervention services can mitigate the risk. However, as described in the following literature review (Chapter II), preliminary research suggests that teachers (pre-service and in-service) struggle with the use of academic data and very little is known regarding their ability to collect, interpret, or apply behavioral data. In addition, very little is known regarding the effects of training educators to interpret and apply behavioral data to inform decisions nor the factors that influence teachers' data literacy, confidence in their abilities, willingness, and perceived

usefulness to utilize behavioral data in decision making.

Purpose

The purpose of this dissertation is to fill critical gaps in the literature and inform research and practice by determining teachers' ability to visually inspect behavioral graphed data, interpret that data, and utilize that interpretation to inform decisions regarding instruction and behavioral intervention. In an attempt to fill the gap, I conducted a survey, a brief 3-series training, and explored factors that predict teacher ability to interpret and apply graphed data, their confidence, willingness, and usefulness to utilize graphed behavioral data and will discuss each component in my study in the following chapter when found in the literature.

In the following chapter, I discuss the importance of data-based decision making per the Individuals with Disabilities Improvement Act (IDEIA, 2004) and the academic and behavioral data collection, interpretation, and application procedures within each tier of the RTI process to emphasize the many instances when teachers must be able to utilize data. Finally, I review the literature in relation to: (a) pre-service and in-service teachers' ability to interpret academic data, (b) pre-service and in-service teachers' ability to interpret behavioral data, (c) pre-service and in-service teachers' ability to apply academic data, and (d) pre-service and in-service teachers' ability to apply behavioral data. Further I discuss the findings of the minimal literature that explores the effects of training on teacher ability, confidence, and perceived usefulness of utilizing graphed behavioral data to inform decisions. Within these sections, teachers' perceived confidence and usefulness to interpret and apply data will be reviewed when it was covered in the literature.

CHAPTER II

LITERATURE REVIEW

In the context of schools, data are defined as "information that is systematically collected and organized to represent some aspect of schooling," and "data-based decision making refers to making decisions based on these data," (Schildkamp & Poortman, 2015, p.1). Data is collected in the form of assessments, direct observations, and survey/questionnaire results (Schildkamp & Poortman, 2015) and can be graphed for ease of interpretation. The Individuals with Disabilities Education Improvement Act (IDEIA, 2004) mandates procedures for determining the need for special education services and emphasizes the use of academic and behavioral data in decision-making prior to and after determining that a student has a disability.

The Individuals with Disabilities Education Improvement Act and Data

In 1975, the first law passed protecting and advocating for individuals with disabilities titled the Education for All Handicapped Children Act (Cortiella, 2006). Throughout approximately 35 years since that date, the law has been reauthorized several times. It was first reauthorized in 1990 and renamed the Individuals with Disabilities Education Act (IDEA). The Individuals with Disabilities Education Act (IDEA) protects the rights of individuals with disabilities by ensuring they have the right to a free and appropriate public education in the least restrictive environment. In 2004, the most recent version was revised, renamed the Individuals with Disabilities Education Improvement Act (IDEIA), and reauthorized by Congress.

Prior to the reauthorization of IDEIA in 2004, districts were required to determine if a discrepancy existed between a child's IQ and achievement to determine eligibility for special education services; however, congress expressed concerns with the IQ-discrepancy model and stressed that "a state must not require the use of discrepancy to identify a student with a learning

disability," (Mercer & Pullen, 2009, p. 22). The major concern with the IQ-discrepancy model was that students were required to "wait to fail" prior to a referral to special education for services (Mercer & Pullen, 2009). This model was called the "wait to fail" model because it would take years before a severe discrepancy was apparent between a child's IQ and academic performance and intensive specialized services were provided to intervene (Mercer & Pullen, 2009). In addition, it was suspected that students were found eligible for special education without the opportunity to respond to evidence-based instructional strategies (Hughes & Dexter, 2013).

With the challenges in identifying children with a disability through the IQ-Achievement Discrepancy model, IDEIA (2004) provided schools with another option for eligibility determination that included early intervention services prior to the need for special education. The process provides schools with the option of using RTI (see Table 2; Fuchs, Mock, Morgan, & Young, 2003), a multitiered process that utilizes scientific, research-based interventions and progress monitoring, including data collection, interpretation, and analysis prior to a special education referral. As demonstrated in the next section, throughout this tiered process, data on student performance is utilized to determine student response to intervention, the need for more intensive services if the student is not responding to intervention, or ultimately the need for intensive special education services (Cortiella, 2006).

Importance of Data in Response to Intervention

Tier 1

Primary (Tier 1) is defined as the provision of high-quality classroom instruction, screening, and group interventions (Cortiella, 2006). During Tier 1, all students receive the same high quality, scientifically-based instruction and behavioral strategies and are screened with

universal screening tools for academic and/or behavior progress to determine response to this instruction. An established RTI team meets after each universal screening (i.e. approximately 3 times a year) to determine student movement through tiers (Kovaleski, Roble, & Agne, 2008). As such, the purpose of Tier 1 is to identify students who are "at risk" of academic failure or behavioral disorders (Bohanon, Goodman, McIntosh, & Talk, 2011).

Throughout the implementation of Tier 1, teachers and the RTI team interpret data collected from the screening tool and apply those findings to inform decisions regarding academic instruction and behavioral strategies (Johnson et al, 2006). In addition to screening tools, progress monitoring assessments are used and the purpose is to monitor progress of a specific academic or behavioral skill to prevent students from unnecessarily being placed in Tier 2 (Johnson et al., 2006). In academic RTI, data collected in Tier 1 includes screenings three times per year and may include the use of curriculum-based measurement (Johnson et al, 2006). In behavior RTI or Positive Behavioral Interventions and Supports (PBIS), data collected in Tier 1 includes office discipline referrals and other behavioral data (McIntosh et al., 2010). Results of these data can be presented in graphed format (see Appendix A) for ease of interpretation, which are used to make decisions regarding students' grouping, intervention, and/or movement through tiers.

From data collected during Tier 1, students are identified as "not at risk" or "at risk" for failure. Fuchs and Fuchs (2006) share two options to identify students as "at risk". One option requires districts to interpret high stakes testing data (e.g., state mandated standardized achievement test) and select a criterion (e.g. students who score below the 25th percentile). Alternatively, another option requires school districts to assess students in a particular subject area or skill using a screening tool with a performance benchmark to determine student's

movement through tiers (Fuchs & Fuchs, 2006). If the child does not make adequate progress in Tier 1 according to the academic and behavioral data collected, the child moves to Tier 2. Approximately 80% of students typically respond to tier 1 strategies (Johnson et al,, 2006); however, approximately 20% of the students do not benefit from this instruction and are moved to Tier 2 for more intensive services.

Tier 2

Secondary (Tier 2) is defined as Targeted Interventions (Cortiella, 2006), which are provided to the 20% of students who did not respond to Tier 1 services. During Tier 2, students receive intensive small group targeted instruction or behavioral strategies. According to RTI Action Network (2019), the intensity of interventions differ in Tier 2 according to "group size, frequency and duration of intervention, and level of training of the professionals providing the intensive intervention," (What is RTI? Tier 2 Section, para. 6). An established RTI team meets approximately twice a month to determine student progress (Kovaleski, Roble, & Agne, 2008). The purpose of Tier 2 is to help students who did not respond to Tier 1 instruction make progress and meet grade level expectations.

Throughout the implementation of Tier 2, teachers continue to monitor academic and behavioral progress, demonstrating the student's level of performance and rates of progress in current classwork, skill acquisition tasks, and behavioral progress with both informal and formal assessments, which may include graphed data. However, more of a focus is placed on informal assessment during tier 2 than in tier 1(Dexter & Hughes, 2011). For example, teachers monitor academic progress using curriculum-based measures, probes, checklists, direct observations, portfolios, interviews, rating scales, quizzes, repeated readings, math fluency timings, and student self-reports (Chard, Ketterlin-Geller, Baker, Doabler, & Apichatabutra, 2009; Mercer &

Pullen, 2009; Rathvon, 2003). Behavioral progress is monitored with direct observation, daily behavior reports (Hawken & Horner, 2003), direct behavior ratings (Chafouleas, Riley-Tillman, & Christ, 2009), social skills training groups (Hawken & Horner, 2003), anger management groups (Hawken & Horner, 2003), homework clubs (Hawken & Horner, 2003), progress monitoring tools such as the BASC-3 BESS (Kamphaus & Reynolds, 2015), Check in/Check out intervention (Crone, Horner, & Hawken, 2003), teacher interviews to identify functions of behavior (Crone et al., 2003), self-monitoring systems (Todd, Horner, & Sugai, 1999), and First Step to Success (Walker et al., 1998). In addition, it is suggested that Functional Behavior Assessments (FBA's) are included in Tier 2 to determine the intervention (Carter & Horner, 2009; March & Horner, 2002; McIntosh, Campbell, Carter, & Dickey, 2009); however, as previously mentioned, RTI teams utilize a variety of options throughout the process and it is more likely that group interventions are utilized during this tier. These data are utilized to make decisions within the classroom.

Throughout Tier 2, decisions are made from the data collected to determine the appropriate intervention, intensity and frequency of intervention, and changes in both. As such, graphed behavioral data (see Appendix A) provides an opportunity for data to be closely monitored and decisions regarding student response to intervention to be made quickly. Ultimately, teachers and RTI teams interpret and apply the data to make a decision for the student to either move back to Tier 1 or to Tier 3 with more intensive, one-on-one support. Approximately 15% of students typically learn from this instruction (Johnson et al., 2006). Although students are getting group support in Tier 2 for behavior, questions exist regarding whether Tier 2 should incorporate individualized plans prior to a referral to Tier 3 (McIntosh, Campbell, Carter, & Rossetto Dickey, 2009).

Tier 3

Tertiary (Tier 3) is defined as intensive interventions and comprehensive evaluations (Cortiella, 2006). Typically, during Tier 3, students receive intensive, individualized instruction and behavioral interventions; however, this varies by school district (Harlacher, Sanford, & Nelson Walker, 2014; Johnson et al., 2006). Some districts begin special education testing in Tier 3 and others continue with pre-referral services. An established RTI team meets at least twice a month to interpret data and determine student progress (Kovaleski et al., 2008). Regardless, the purpose of Tier 3 is to identify student's skill strengths and deficits through previous tiers in order to provide supplementary individualized, intensive instruction (Cortiella, 2006).

Throughout the implementation of Tier 3 instructional and behavioral strategies, teachers closely monitor student progress and response to intervention. Data collection methods are primarily the same as Tier 2; however, the data are individualized. Further, Functional Behavior Assessments (FBA) are frequently conducted during Tier 3 to select Functional Assessment Based Interventions (FABI) (Lane et al., 2015; Lane, Weisenbach, Phillips, & Wehby, 2007). An FBA is a systematic process of determining the function of a problem behavior (Cooper, Heron, & Heward, 2007). Data within the FBA process includes graphed behavioral data that is applied to progress monitoring and intervention selection for both academics and behavior (Johl et al., 2016; McIntosh, Bohanon, & Goodman, 2010).

In addition, Tier 3 behavioral supports can involve diagnostic assessment, including brief experimental analysis (Daly, Andersen, Gortmaker, & Turner, 2006) and can't do/won't do assessment (VanDerHeyden & Witt, 2008). As such, the primary difference is the involvement and intensity with data collection, data interpretation, and decision making. For example,

progress-monitoring data may be reviewed daily by the classroom teacher and/or intervention teacher in order to make decisions about interventions in Tier 3 (Johnson et al., 2006; McIntosh, Bohanon, & Goodman, 2010). Students who make progress may move to Tier 1 or 2 (Kovaleski, Roble, & Agne, 2008). Students who continue to struggle in Tier 3 and have demonstrated a lack of progress with these supports may be referred to the special education evaluation process (Kovaleski et al., 2008).

Data collected, interpreted, and applied in Tier 3 are used for decision making in order to determine if the student should move back to Tier 1 or 2 or may need special education services (Fuchs et al., 2003). If the student does not respond and make adequate progress during Tier 1, 2, and 3, the child is then considered for eligibility of special education services under IDEIA (2004). The data during Tier 1, 2, and 3 are included in making the eligibility decision (Cortiella, 2006). Throughout the RTI process, interventions are implemented and classroom-based data are collected, interpreted, and applied by the classroom teacher with the assistance of the pre-referral/RTI team (Johnson et al., 2006). Although assistance from the RTI team is available, meetings occur approximately every two weeks, leaving the classroom teacher and/or intervention teacher with the responsibility of reviewing the data to make daily decisions (Johnson et al., 2006; Kovaleski et al., 2008). Approximately five percent of students typically learn from this instruction (Johnson et al., 2006).

Table 2
*RTI Tier*s

	Tier 1	**Tier 2**	**Tier 3**
Components	High quality classroom instruction, scientifically-based instruction, group interventions	Targeted interventions	Intensive interventions, comprehensive evaluations
Type of Grouping	Whole Class	Small group	Individual
Academic Data Collected/Interpreted	Screening Tools, Progress Monitoring, Assessment	Formal assessments, informal assessments, curriculum-based measures, probes, checklists, direct observations, portfolios, interviews, rating scales, quizzes, repeated readings, math fluency timings, and student self-reports	Same as Tier 2, but individualized
Behavioral Data Collected/Interpreted	Office Discipline Referrals	Direct observation, daily behavior reports (Hawken & Horner, 2003), direct behavior ratings (Chafouleas, Riley-Tillman, & Christ, 2009), social skills training groups(Hawken & Horner, 2003), anger management groups (Hawken & Horner, 2003), homework clubs (Hawken & Horner, 2003), progress monitoring tools such as the BASC-3 BESS	Same as Tier 2, but includes FBA's, brief experimental analysis (Daly, Andersen, Gortmaker, & Turner, 2006) and can't do/won't do assessment (VanDerHeyden & Witt, 2008).

		(Kamphaus & Reynolds, 2015), Check in/Check out intervention (Crone, Horner, & Hawken, 2003), teacher interviews to identify functions of behavior (Crone et al., 2003), self-monitoring systems (Todd, Horner, & Sugai, 1999), and First Step to Success (Walker et al., 1998)	
Frequency of Analyzing Data with Team	3x/year	2x/month	2x/month
Percentage of Students in each Tier	80%	15%	5%

Note. This table illustrates the components, type of grouping, academic data collected/interpreted, behavioral data collected/interpreted, frequency of data analysis with an RTI team, and percentage of students in each tier per RTI tier.

Data Interpretation and Application

As noted in the previous section, data are collected throughout each tier of the RTI process. Once data are collected, it is interpreted and applied to inform decisions. Within the RTI process, decisions regarding movement through tiers are made by a team of individuals, which consists of administrators, general education teachers, special education teachers, the classroom teacher presenting information on the student, academic specialists, behavior specialist/Board Certified Behavior Analyst (BCBA), school psychologist, and data manager (Batsche, 2008; Kovaleski et al., 2008). However, depending on the tier, the RTI team may only meet from as few as three times a year to two times a month (Kovaleski et al., 2008), leaving the daily decisions to collect, interpret, and apply data and interventions at the discretion of the classroom

and/or intervention teacher (Johnson et al., 2006). As such, it is important that all team participants, including the teachers, must be able to understand and interpret data to inform research-based interventions (Batsche, 2008; Johnson et al., 2006).

Further emphasizing the importance of teacher skill in utilizing data, teacher preparation standards at the national and state levels and professional organizations require teachers to be able to interpret data and graphs and apply the data to inform instruction and student interventions (Council for Exceptional Children, 2015; NCATE, 2010; Wagner, Hammerschmidt-Snidarich, Espin, Seifert, and McMaster, 2017).

Data Interpretation

For the purposes of this study, data interpretation is defined as the ability to derive meaning from graphed numerical data. As mentioned throughout the discussion of the tiers of RTI, teachers interpret academic data through visual inspection of graphed data from curriculum-based measurement data and other graphed academic achievement results (van den Bosch, Espin, Chung, & Saab, 2017; Wagner, Hammerschmidt-Snidarich, Espin, Seifert, & McMaster, 2017; Zeuch et al., 2017). Further, teachers interpret behavioral data through visual inspection of graphed data of direct observations, functional behavior assessments, and/or behavior rating scales (Dowdy, Ritchey, & Kamphaus, 2010; Eklund & Dowdy, 2014; Eklund, Renshaw, Dowdy, Jimerson, Hart, Jones, & Earhart, 2009; McDougal, Chafouleas, & Waterman, 2006).

Graphed data can be interpreted through two similar methods described in the literature. First, one method of graph interpretation is to read the data, read behind the data, read between the data, and read beyond the data (see Figure 2; Galesic & Garcia-Retamero, 2011). This method is used in several of the studies described in the following literature review (e.g., van den Bosch et al., 2017; Zeuch et al., 2017). “Reading the data” is defined as “finding specific

information in the graph" (e.g., mean, mode). "Reading between the data" is defined as "recognizing and describing relationships " (e.g., trend, variability). "Reading beyond the data" is defined as "making inferences and predictions based on the data" (e.g., continue, discontinue, or change the intervention) (Galesic and Garcia-Retamero, as cited in Zeuch et al., 2017, p. 62). Additionally, Shaughnessy (2007) added a fourth step called "reading behind the data," which is defined as the "integration of information that goes beyond the graphical representation and puts the presented data into a specific context," (e.g., intervention selection) (as cited in Zeuch et al., 2017, p. 62).

Another similar method is visual analysis used in single case literature and described in detail by Kratochwill et al. (2010) in the What Works Clearinghouse (WWC) Standards for Single Case Design Studies. Specifically, graphed data are visually analyzed by evaluating the level (read the data), trend (read between the data), variability (read between the data), immediacy of effect (read between the data), and overlap of data patterns across baseline and intervention phases (read between the data). Level is the comparison of the mean before and during intervention. Trend is interpreted by comparing the line of best fit before and during intervention. Variability is the bounciness of the data around the best fit line. Immediacy of effect "refers to the change in level between the last three data points in one phase and the first three data points of the next phase," (Kratochwill et al., 2010, p. 18). Overlap "refers to the proportion of data from one phase that overlaps with the data from the previous phase," (Kratochwill et al., 2010, p. 18). These two methods will be discussed within the literature on evaluations of teachers' ability to interpret and apply graphed data in the following sections.

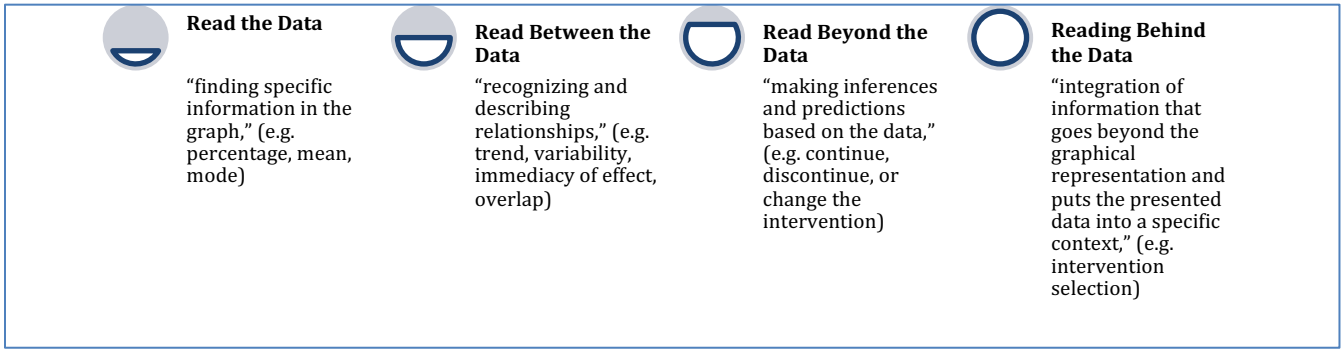

Figure 2. Explanation of Behavioral Graph Reading Skills. This figure illustrates the four behavioral graph reading skills.
Note. These previously used academic graph reading skills have been modified for the purposes of this study to incorporate behavioral graph interpretation skills from Galesic and Garcia-Retamero, as cited in Zeuch et al., 2017, p. 62), Shaughnessy, as cited in Zeuch et al., 2017, p. 62), and in combination with What Works Clearinghouse.

Pre-service teacher interpretation of academic data. Studies have been conducted to evaluate pre-service teacher competence in interpretation of academic performance with graphed data. In the following sections, two studies are described that indicate pre-service teachers struggle to interpret graphed academic data. It should be noted that the first study, Zeuch et al. (2017) included both pre-service and in-service teachers and will only be discussed in this section.

Zeuch et al. (2017) compared pre-service teachers and in-service teachers' ability to interpret graphed math and reading data. The authors were interested in teacher focus on four aspects of data-literacy, (a) reading the data, (b) reading between the data, (c) reading beyond the data, and (d) reading behind the data. The researchers measured graph literacy using an established graph reading test, Learning Progress Assessment (LPA), and interviews with a sample of thirty-six pre-service special education teachers and three in-service teachers. Zeuch et al. (2017) presented teachers with eight line graphs with simulated reading and math data with a description and asked teachers to rate the appropriateness of the description to match the graph (i.e., 1- very bad to 5 - very good). In addition, the researchers interviewed ten teachers to

investigate their thought process while interpreting the graphs.

Results indicated pre-service and in-service teachers struggled to read and interpret graphed data on the LPA test (M = 106.54, SD = 17.31) and general graph reading test (M = 20.26, SD = 3.17) even when the task was limited to rating given statements. Further, between 40% and 60% of participants spontaneously read the data, between 0% and 93.3% of participants spontaneously read between the data, between 20% and 80% of participants spontaneously read beyond the data, and between 20% and 80% of participants spontaneously read behind the data. Although reading between the data, beyond the data, and behind the data show some high percentages, there is a large range showing that some teachers were more competent than others. In addition, there were no statistically significant differences between in-service and pre-service teachers on the LPA test (student teachers: M = 107.23, SD = 17.11; teachers: M = 104.17, SD = 18.04; t = .95, df = 158, p >.05) or on the general graph reading test (student teachers: M = 20.41, SD = 3.30; teachers: M = 19.72, SD = 2.68; t = 1.15, df = 158, p >.05). Lastly, hints were beneficial for participants who struggled to spontaneously read and interpret the graphed data with 40% to 55% of the remaining participants (i.e. not included in able to spontaneously read) were able to read the data after being given a hint, between 0% and 20% of the remaining participants (i.e. not included in able to spontaneously read between the data) were able to read between the data after being given a hint, between 10% and 27.5% of the remaining participants (i.e. not included in able to spontaneously read beyond the data) were able to read beyond the data after being given a hint, and between 0% and 40% of the remaining participants (i.e. not included in able to spontaneously read behind the data) were able to read behind the data after being given a hint.

Wagner, Hammerschmidt-Snidarich, Espin, Seifert, and McMaster (2017) compared pre-

service special education teachers to experts' ability to read graphs and interpret the data from the graphs. In addition, the researchers evaluated the change in pre-service special education teachers' ability to interpret CBM progress monitoring graphs after student teaching. The researchers measured CBM graph reading and interpretation skills by using a think aloud methodology with a sample of thirty-six pre-service special education teachers and three experts. The think aloud methodology consisted of the presentation of one graph at a time by the researcher and each participant was independently asked to describe the graph. The experts completed the think alouds once while the pre-service teachers completed them twice (i.e., once at the beginning of their student teaching experience and once at the end). The researchers coded the number of words said by each participant, CBM graph interpretation components (i.e. framing the data, describing baseline, goal setting, data in each intervention phase, evaluating goals), progress information, and interpretative statements and accuracy. The researchers found that pre-service teachers said fewer words than experts before and after student teaching. During pre and post student teaching, pre-service teachers mentioned less CBM graph interpretation components (out of nine) than experts. Pre-service teachers were less sequentially coherent pre and post student teaching, less specific, less reflective, and less accurate than experts, which was similar to findings in previous studies. The results also indicate that the number of graph interpretation components mentioned by the pre-service teachers was statistically significantly lower at post-student teaching than pre-student teaching. In addition, the percentage of reflective statements was statistically significantly greater at post student teaching compared to pre-student teaching.

In summary, when verbally describing academic graphed data, pre-service teachers were less specific, reflective, and accurate than experts (Wagner, et al., 2017; Zeuch et al., 2017). Specifically, they struggled with reading behind and beyond the data in order to make decisions to

inform instruction (Wagner et al., 2017; Zeuch, 2017). Although some pre-service teachers were able to interpret the basic information from the data with hints or support from researchers/coaches, most studies identified the everyday struggles of these pre-service teachers (Zeuch, 2017).

In-service Teacher Interpretation of Academic Data. Similar to pre-service teachers, a few studies evaluated in-service teachers' ability to interpret graphed academic data. In the following section, I describe one study; however, it should be noted that Zeuch et al. (2017) (mentioned above) also conducted their study with in-service teachers.

Van den Bosch et al. (2017) studied teachers' ability to read, interpret, use and comprehend CBM graphs to inform instructional practices by using a think aloud methodology of both fictitious graphs and graphs of actual student data. In addition, the researchers examined whether graph literacy affected graph comprehension with a sample of twenty-three elementary and secondary teachers and seven "graph reading" experts. The "graph reading" experts were separated into three types of experts, which included General graph experts (GE), Education graph experts (EE), and CBM graph experts (CBME). The researchers asked teachers to engage in a think aloud methodology when reading, interpreting, and using information from graphs. Data was analyzed through quantitative comparison of teacher and expert scores on a graph-literacy measure and through the application of Curcio (1981) and Friel, Curcio, and Bright (2001) framework for graph interpretation that included reading the data, reading between, and reading beyond the data.

Results indicated that teachers graph literacy self-report scores were statistically significantly lower than experts' scores. Further, reading scores were lower on the graph reading skills test, although not statistically significantly lower than that of the experts. Teachers

accurately read the data similar to all experts; however, teachers were less able to provide complete descriptions of the data similar to GE, but lower than descriptions provided by EE and CBME. Teachers struggled to describe the data in a sequential manner, similar to EE, more than CBME, and less than GE. In addition, teachers had difficulty with reading beyond and interpreting the data in relation to all experts. Further, teachers struggled immensely with utilizing the data to create academic goals for the students similar to GE and EE, but not similar to CBME. Lastly, teachers struggled immensely with reading beyond the data and linking data to instruction similar to GE, but more than EE and CBME.

In summary, in-service teachers struggled to interpret and link graphed academic data to instruction, make inferences based on data, and understand how to translate multiple data points into useful information. In-service teachers were most likely to focus on reading between the data and less likely to focus on reading the data, beyond, or behind the data. Although some in-service teachers were able to interpret the basic information from the graphed data with or without hints or support from researchers/coaches, in-service teachers continued to struggle with academic data interpretation.

Pre-Service Teachers Interpretation of Behavioral Data. To my knowledge, no study has evaluated pre-service teacher data interpretation skills with graphed data.

In-Service Teacher Interpretation of Behavioral Data. Similar to research of pre-service teacher use of behavioral data, minimal research has been conducted on in-service teachers' behavioral data interpretation with graphed data. One publication that encompassed three studies reviewed in the following sections were conducted within the context of Applied Behavior Analysis (ABA) and three studies within the context of graphed data interpretation in functional assessment-based intervention (FABI). Although behavior therapists are not teachers

per se, I included these studies because the findings have the potential to inform a study of teacher ability to visually interpret behavioral graphs.

In relation to ABA therapists, Fisher, Kelley, and Lomas (2003) examined the ability of ABA therapists and adults in an ABA training program to visually inspect and interpret single case data in three studies. In Study 1, Fisher et al. (2003) developed and validated changes of the split middle (SM) method called the dual criteria (DC) method (see Figure 3). The DC method involved superimposing the trendline and meanline from baseline on the treatment phase and specifying the number of data points required to be above both lines to indicate intervention effectiveness. Results suggest that the dual criteria (DC) method controlled the rates of false positive results more effectively than the split middle method.

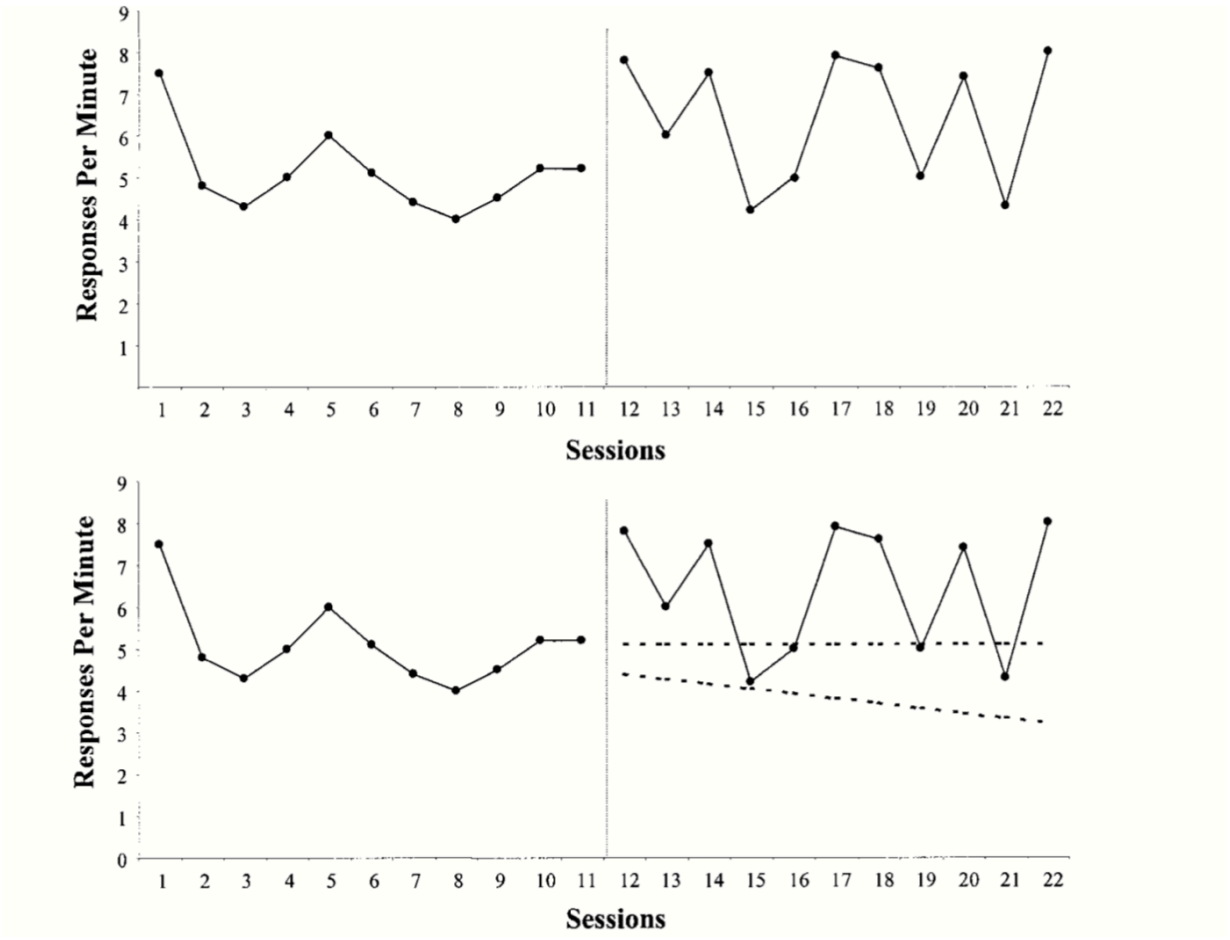

Figure 3. Explaining split middle method and dual criteria method
Note. This graph was taken from Fisher, Kelley, and Lomas (2003) to show a visual representation of the dual criteria method. "The top panel shows a computer-generated A-B graph without visual aids; the bottom panel shows the same graph with the dual-criteria (DC) visual aids," (Fisher, Kelley, & Lomas, 2003, p. 392).

In Study 2, the researchers examined the ability of five behavior therapists to use the DC method when provided with directions and modeling. The behavior therapists worked at a facility that concentrated on working with individuals with severe behavioral problems. Participants were given 20 graphs. During a one-time training, participants were provided with directions on applying rules and were asked to review and interpret the graph to determine if a treatment had a reliable effect. Results indicated that an increase in accuracy of interpretation was found from with a baseline mean of 55% prior to training to a mean of 94% after training.

In Study 3, the researchers examined the ability of staff members to use the DC method when provided with a fifteen-minute slideshow presentation on the same training procedure in study 2 with a sample of eighty-seven adults attending a workshop on behavior analysis. Initial baseline data was collected. Participants were shown a set of 20 graphs on a screen and were asked to interpret them. Results indicated that an increase in accuracy of interpretation was found with a baseline mean of 71% prior to training and a treatment mean of 95% after training.

In the context of functional assessment-based interventions (FABI), Lane et al. (2015) examined the effectiveness of a year-long professional development series to support teachers in a systematic approach to FABI developed by Umbreit and colleagues (2007). The FABI approach included graphed data interpretation in step 3 titled "Collect Baseline data," which was conducted prior to step 4: "Designing the Intervention" to interpret the graphs.

The study assessed teachers' perceived knowledge, confidence, and usefulness of FABI and actual knowledge of concepts and strategies learned in the training series by using pre and

post training surveys with a sample of forty-eight general education and special education teachers. Although forty-eight participants completed the pre-training survey, only thirty-nine completed the post-training survey. During the training session, school-based teams discussed one student and applied each step of the FABI process. The training consisted of teachers learning how to conduct FABIs with the support of district level coaches. The overall four-day training series was designed to teach educators how to design, implement, and evaluate FABIs for students exhibiting challenging behaviors.

The researchers found that there was a statistically significant difference between the pre-training survey and the post-training survey results. Specifically, teachers demonstrated a statistically significant increase in their levels of perceived knowledge, confidence, and usefulness of FABIs. Furthermore, teachers perceived and actual knowledge increased on the post-training survey, resulting from an increase in total scores on the survey.

Similarly, Johl et al. (2016) examined the actual knowledge and perceived knowledge, confidence, usefulness, and applications of skills and concepts of FABI of 148 educators from 29 teams with 9 coaches. These skills and concepts were covered in a professional learning series by replicating Lane et al. (2015)'s work. After participants attended the five-day professional development, the researchers examined FABI completion levels of school-based teams. Participants included general education teachers, special education teachers, administrators, related service providers, and school staff members. The researchers asked teachers to engage in a professional learning series and to complete a pre-training and post-training measure. During the training session, each team selected one student to focus on for the FABI process. The training series focused on a different step of the FABI process each day with graphed data interpretation throughout the training process. School-based teams submitted a checklist and documents to their

district coach as they completed each step of the FABI process. District coaches supported school-based teams with implementation of the steps in the FABI process during the training and in between sessions to support students who required Tier 3 interventions.

Results indicated that teachers perceived and actual knowledge of learned concepts and strategies of FABI and confidence increased. Teachers demonstrated a statistically significant increase in their levels of perceived knowledge, perceived confidence, and perceived usefulness of the information applied. Furthermore, participants made significant improvements in their actual knowledge. Specific to graphed data, the researchers found that teachers struggled to complete the required graphs in the FABI process with only 31% of the teams graphing data.

Finally, Hagopian et al. (1997) examined the ability of predoctoral interns to visually inspect functional analysis graphs. The researchers used a sample of three psychology predoctoral interns in an approved APA internship. In addition, the three interns were in the process of successfully completing 6 months of advanced training in ABA in an outpatient unit. Three predoctoral interns were asked to interpret twenty-six functional analysis graphs by applying rules (i.e. trends, mean, magnitude of effects) learned throughout their studies and interrater observer agreement (IOA) was calculated. Results indicated that IOA was low ($M = 0.46$). Next, the authors developed a set of structured criteria based on expert consensus. Finally, predoctoral interns were trained to use the developed criteria for visual inspection of the functional analyses graphs and the researchers measured their accuracy. Results indicated that the structured criteria for visual inspection lead to an increase in the mean IOA of .81.

In summary, preliminary data suggests that behavior therapists and students with specialized training in ABA were able to visually inspect graphs accurately when provided with training, a set criterion, and continued support from researchers and coaches. Further, teachers

were able to determine the function of the behavior, select an intervention, and implement the intervention with training and continued support from the researchers. However, the degree to which graphed data was utilized is unclear; further, the amount of support provided in the research probably does not reflect the degree of support provided in a typical classroom setting. Therefore, we need to interpret these results with caution and further explore teacher ability in authentic settings without support. In addition, teachers perceived confidence, usefulness, and knowledge and actual knowledge on the content of behavioral data with coaching support increased. Nonetheless, teachers lacked confidence in utilizing these strategies in practice.

Data Application

For the purposes of this study, data application is defined as the action of putting results of data interpretation into practice when making instructional decisions. Teachers are expected to apply graphed academic data by making needed changes to instruction, student work, and intervention. Teachers apply graphed behavioral data to decisions by selecting interventions, creating behavioral plans, making changes to instruction, and making changes to student work.

Preservice teachers' application of academic data. To my knowledge, no study has evaluated pre-service teachers' academic data application skills with graphed data.

In-service teachers' application of academic data. The minimal research that is available indicates that in-service teachers struggle to apply results of graphed academic data to inform instruction. In the following paragraphs, I describe three studies of in-service teacher application of data.

Fuchs, Fuchs, Hamlett, Phillips, and Bentz (1994) examined teacher use of data collected with curriculum-based measures (CBM) within general education math instruction with a sample of forty teachers. The researchers measured five different areas: treatment fidelity, instructional

planning, achievement, satisfaction, and data collection. Data collection was evaluated through direct observation. The researchers randomly assigned teachers to one of the following groups: (a) CBM with class-wide reports that provided a summary, including graphed data and suggestions on instructional changes needed; (b) CBM with reports which included graphed data, but no suggestions; or (c) no CBM. Within their general education math class, teachers chose one student who scored academically low and received special education services, one student who scored within the academically low range and not referred for a special education evaluation, and one student who scored within the average range. Teachers were trained in CBM with corrective feedback and assessed student performance weekly with the use of CBM. Results indicated that teachers who were provided with data that was interpreted with instructional recommendations addressed more skills, taught more operations, provided more one-to-one instruction, delivered more instruction by a peer, and used systematic motivation systems more frequently than the other two groups.

Similarly, Förster, Kawohl, and Souvignier (2018) examined teachers' use of data to make instructional decisions with a sample of twenty-eight third grade classrooms and teachers. Teachers were randomly assigned to one of the two conditions: (a) LPA- Reading Sportsmanship (RS), an enhanced computer-generated curriculum-based measure with differentiated information about student learning progress and teacher prepared materials for differentiated instruction and two training sessions or (b) a control group. Participants were provided with graphed student progress data in the areas of reading accuracy, speed, and comprehension every three weeks. In addition, the participants completed a survey to assess their use of the LPA data to make instructional decisions. The participants reported that they used the LPA results to alter instruction more frequently for individual students than for the whole class. However, researchers

questioned teacher data use as instructional decisions did not match student needs.

Finally, Fuchs, Fuchs, Hamlett, and Stecker (1991) examined the impact of training teachers to interpret graphed results of CBM with (a) expert instructional consultation, (b) CBM without consultation, and a (c) control condition without any training with a sample of thirty-three teachers on instructional changes made for two students in their classes. Teachers engaged in four weeks of CBM training, which included school workshops and individual meetings. After the initial training, staff met with the teachers in the consultation group once every one to two weeks for twenty to forty minutes to discuss graphs, student performance, and assist teachers with problem solving for instruction. Control teachers implemented standard protocol to monitor student progress. The study consisted of twenty weeks of implementation. Results indicated a significant difference in program adjustments between groups. Teachers in the CBM groups made more instructional adjustments than the control group. Further, the CBM consultation group utilized a more diversified set of instructional tools to modify student programs in comparison to the CBM alone group, which continued to use the same teaching strategies.

In summary, the results of these studies indicated that in-service teachers struggled to apply graphed academic data to instruction without support. Although some in-service teachers were able to apply data with or without support from researchers, most studies identified the struggles of these in-service teachers to apply the information from data to inform instruction. Specifically, teachers struggled to make improvements to their instructional planning and decision making in the classroom and to utilize instructional strategies based on student need. Furthermore, teachers had a higher perception of their ability to accurately apply graphed data to inform instruction than their actual performance.

Preservice teachers' application of behavioral data. To my knowledge, no studies

have been conducted evaluating pre-service teachers' ability to apply graphed behavioral data in the classroom.

In-service teachers' application of behavioral data. Results from preliminary studies have indicated that in-service teachers struggle to apply graphed behavioral data to instruction without support. In the following paragraphs, I describe two studies of in-service teacher application of behavioral data.

Keohane and Greer (2005) examined the ability of teachers in a school for children with autism to use verbally governed algorithms to analyze teacher data interpretation and application of data to select strategies with a sample of three teachers and six students through single case design methodology. Teachers were trained to follow scripted instruction, and to graph, and analyze student responses. Teachers received instruction and supervision weekly. Results indicated that the training procedure had a functional relationship to changes in teacher decision making, after instruction, and during probing sessions. Teachers' scientifically governed behavior (i.e. behavior following verbal rules) increased and teachers' decision errors decreased.

Similarly, Maffei-Almodovar, Feliciano, Fienup, and Sturmey (2017) examined the effects of intensive instruction (i.e. modeling, rehearsal, and feedback) on three special education teachers' ability to interpret graphs in order to make decisions and determine when instructional changes were necessary by using a behavior analytic training, titled behavioral skills training (BST). The teachers provided ABA services with children with autism in their home. Teachers who were struggling to apply behavioral data and determine when instructional changes should be made were selected for participation. Participants were trained through a behavioral skills training program in which they were taught to analyze behavioral graphs based on trend (i.e., flat, ascending, descending) and apply data-based decision rules (e.g., descending data indicating a

need for change). Results indicated that teacher data-based decision making increased and their error rate decreased after intense training was provided.

In summary, although preliminary data suggests that in-service teachers struggle to apply behavioral data to instructional changes without support, research suggests that teachers are capable of applying student behavioral data to inform instruction with intensive training and support from researchers. Both studies demonstrated an increase in teacher data-based decision making and a decrease in error rates. Although teachers' data-based decision making increased, both studies were in specialized settings with ABA training, such as a home-based ABA program and a school for individuals with autism and behavioral disorders, which is not typical of a classroom in public school settings. In addition, it appears that the setting and training may have an impact on a teacher's ability to apply the data to instruction. However, the impact on teacher ability remains unclear.

Gaps in the Literature

As previously demonstrated in Chapter I, students with and at-risk of HID have negative short and long term academic and behavioral outcomes (Friend & Bursuck, 2012; Mercer & Pullen, 2009). It is essential that educators intervene early by implementing evidence-based interventions and progress monitoring to determine student response (RTI) as suggested by federal law in order to prevent unnecessary classification of a student with a HID.

Effective data interpretation and application are integral parts of the process. Visual inspection of graphed data is needed to inform these decisions. Two forms of visual inspection (see Figure 2) include that developed by What Works Clearinghouse (WWC) (2010) and described by Curcio (1981), Friel et al. (2001), Galesic and Garcia-Retamero (2011) and Shaughnessy (2007). Many gaps exist in the literature as very little is known regarding teacher

ability/skill to visually interpret graphed behavioral data and their ability to apply this information to inform instructional decisions and student interventions.

First, preliminary research has indicated that pre-service and in-service teachers can interpret basic academic graphed data with support and struggle to read behind and beyond the data to make instructional decisions. However, limited research with pre-service and in-service teachers in a school setting, not designed specifically for students with severe disabilities, has been done to determine if the same is true for behavioral data.

Second, research on academic and behavioral data interpretation has evaluated interpretation through the use of a simplified version (i.e., trend, variability, goal) of the WWC visual analysis procedures; however, none have utilized the Galesic and Garcia-Retamero (2011) model for behavioral data interpretation. This information is important to evaluate because the Galesic and Garcia-Retamero (2011) model will help the researcher to quantify whether the teacher can recognize relationships, make inferences and predictions, or integrate information beyond the graphical representation and put it into specific context.

Third, we do not know the ability of pre-service and in-service teachers to apply graphed behavioral data to inform instruction in general education or special education settings. Research exists within the context of ABA-based home services and a specialized school for individuals with autism and behavioral disorders.

Fourth, limited studies have evaluated factors that influence a teachers' ability, confidence, or willingness to interpret or apply graphed behavioral data to instructional decisions or changes made to interventions. However, results have indicated that knowledge and training may increase a teacher's ability to use data to inform instruction. In addition, training might increase perceived confidence, knowledge, usefulness and actual knowledge, but not the

confidence to apply these strategies in the classroom.

Current Study

As such, the purpose of the current study is to investigate how pre-service and in-service teachers interpret and apply behavioral data. This study will answer the following research questions:

Research Question 1. To what extent do pre-service and in-service teachers interpret and apply data to inform decisions (e.g. read the data, read between, behind, and beyond the data) using behavioral graphs prior to the "Collecting, Interpreting, and Applying-Graphed Behavioral Data" (CIA-GBD) intervention?

Hypothesis 1. I hypothesized that teachers would have difficulty interpreting the graphed behavioral data and applying that information to intervention selection prior to the CIA-GBD intervention.

Research Question 2. What malleable factors (i.e., prior training, type of setting, expectation to collect data) predict pre-service and in-service teacher ability to interpret and apply graphed behavioral data prior to the CIA-GBD intervention?

Hypothesis 2. I hypothesized that teachers with increased training (i.e., more college courses, in and out of district workshops), working in more specialized settings (e.g., special education setting with more intensive behavioral support), and with an expectation to collect data in a district would improve in their ability to interpret or apply graphed behavioral data.

Research Question 3. What is the effect of the CIA-GBD intervention on pre-service and in-service teacher: (a) overall ability to interpret and apply graphed behavioral data; (b) to read the data; (c) read between the data; (d) read beyond the data; and (e) read

behind the data? Was there a difference of effects between pre-service and in-service teachers?

Hypothesis 3. I hypothesized that teachers' ability to interpret and apply graphed behavioral data would improve from participating in the 3-series intervention titled CIA-GBD.

Research Question 4. What factors influence pre-service and in-service teacher confidence to interpret and apply graphed behavioral data in classrooms prior to the CIA-GBD intervention?

Hypothesis 4. I hypothesized that increased training (i.e., more college courses, in and out of district workshops), more specialized settings (e.g., special education setting with more intensive behavioral support), and an expectation to collect data in a district would improve teacher confidence to interpret and apply graphed behavioral data in classrooms.

Research Question 5. What factors influence pre-service and in-service teacher willingness to interpret and apply graphed behavioral data in classrooms prior to the CIA-GBD intervention?

Hypothesis 5. I hypothesized that increased training (i.e., more college courses, in and out of district workshops), more specialized settings (e.g., special education setting with more intensive behavioral support), and an expectation to collect data in a district would improve teacher willingness to interpret and apply graphed behavioral data in classrooms.

Research Question 6. What factors influence pre-service and in-service teacher perceived usefulness of interpreting and applying graphed behavioral data in classrooms prior to the CIA-GBD intervention?

Hypothesis 6. I hypothesized that increased training (i.e., more college courses, in and out of district workshops), more specialized settings (e.g., special education setting with more intensive behavioral support), and an expectation to collect data in a district would improve teachers' perceived usefulness of interpreting and applying graphed behavioral data to inform instruction, student interventions, and throughout the I&RS process.

Research Question 7. Does the CIA-GBD intervention increase teacher confidence, willingness, and perceived usefulness in interpreting and applying graphed behavioral data to make decisions? Was there a difference of effects between in-service and pre-service teachers?

Hypothesis 7. I hypothesized that teacher confidence, willingness, and perceived usefulness in interpreting and applying graphed behavioral data to make decisions would improve after participating in the 3-series intervention titled CIA-GBD.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

In this chapter, I describe the methodology used to answer the research questions in the current quantitative study. The following sections describe the participants, setting, procedures, measure, and data analysis. The study includes two components. The first is a survey only component and the second is a survey and intervention component. Procedures for each follow.

Method

Participants

Participants (*N*=125) in the study included pre-service teachers, in-service teachers, and other education professionals (See Table 5, 6, & 7). Specifically, 33 pre-service teachers, 63 in-service teachers, and five other education professionals participated in Stage 1 of the study (i.e., survey only). Further, 12 pre-service teachers and 12 in-service teachers participated in Stage 2 of the study (i.e., survey and intervention).

Of the 125 participants from Stage 1, 43 participants were general education teachers, 16 were special education teachers, 45 were students in the field of education, five were other education professionals, and 16 participants had been both general education and special education teachers. Other education professionals were a school psychologist, learning consultant, school counselor, physical therapist, and an administrator.

In addition, 44 participants also reported being elementary education teachers, 19 were secondary education teachers, 45 were students in the field of education, five were other education professionals, and 12 were both elementary education and secondary education teachers.

The majority of participants were female (n = 107) followed by 16 males, and two

individuals who preferred not to answer. They ranged in age between 20 and 61+. A majority of participants identified as Caucasian/White (*n*=111) followed by five participants who identified as Asian/Pacific Islander, four participants who identified as Latino/Latina, two participants who identified as multicultural, two participants who preferred not to answer, and one participant who identified as African American/Black. The majority of participants were between the ages of 20-25 (*n* = 50) followed by 17 participants between the ages of 26-30, 31 participants between the ages of 31-40, 16 participants between the ages of 41-50, 8 participants between the ages of 51-60, and three participants ages 61+.

The majority of participants held a Bachelor's degree (*n* = 52) followed by 40 participants holding a high school diploma, 32 participants holding a Master's degree, and one participant holding a Doctorate degree. Sixty-seven participants earned their highest degree between the years of 2015-2019, 19 participants between the years of 2010-2014, 12 participants between the years of 2005-2010, 11 participants between the years of 2000-2005, four between the years of 1995-2000, seven between the years of 1990-1995, two between the years of 1980-1985, and three between the years of 1980 or earlier. Further, participants had been in the profession for the following number of years: 68 participants had been in the profession for 0-5 years, 26 participants between 6-10 years, 12 participants between 11-15 years, nine participants between 16-20 years, eight participants between 21-30 years, and two participants in the profession for 31 years or longer.

Participants reported working with populations of students as follows: five participants worked with only general education students, 12 participants worked with general education and special education students with mild disabilities, 37 participants worked with general education students and special education students with severe disabilities, 0 participants worked with only

students with mild disabilities, 15 participants worked with only students with severe disabilities, and 56 participants worked with students in all populations.

Finally, participants reported working in various settings: 21 participants worked in the general education setting only, 56 participants had worked in a special education setting (e.g. inclusion classroom, resource room, language learning delayed), 41 participants worked in an intensive special education setting (e.g. autism classroom, multiply disabled classroom), and 7 participants worked in a different setting. It is important to note that if participants selected more than one population or setting, the most intensive population or setting was used for coding purposes.

Setting

This study was conducted in three settings. First, in stage 1 (i.e., survey only participants), 101 participants, including 33 pre-service teachers, 63 in-service teachers, and five other education professionals completed the survey at their own leisure and choice of setting. Pre-service teachers were students from two New Jersey Universities and in-service teachers were employed at a local school district in New Jersey.

Second, stage 2 (i.e., survey and workshop group) was conducted in three settings, a classroom at the local school district with 9 pre-service teachers conducting their practicum in the participating school district, a classroom at Rutgers University with 3 pre-service teachers, and the media center in the participating school district (not named per district regulations) with 12 in-service teachers.

At Rutgers University, the sessions were conducted following their seminar course and the researcher provided dinner. The intervention did not have any consequences for the course. To avoid any possible perception of coercion, participation in the study was voluntary.

At the participating school district, the sessions were conducted prior to the start of the day for pre-service teachers in their practicum and in-service teachers at their place of work. The researcher provided breakfast. The intervention did not have any consequences at their place of work. To avoid any possible perception of coercion, participation in the study was voluntary.

Rutgers University is a university in New Jersey with 50,254 students and approximately 6,800 full-time and part-time faculty. Specifically, Rutgers had 36,039 undergraduates and 14,215 graduate students during the 2017-2018 academic calendar. The university has 50% male and 50% female. Students enrolled are as follows: 26.2% Asian, 7.1% Black or African American, 12.2% Hispanic/Latino, 0.2% Native Hawaiian or Pacific Islander, 3.3% Two or more races, 37.6% White or Caucasian, and 13.5% Other, Unknown, or International.

The participating district is a suburban district in New Jersey with 9,721 students enrolled across 10 schools during the 2017-2018 school year. The district has four K-3 elementary schools, one elementary school with grades 3-5, one elementary school with grades 4-5, two middle schools, and two high schools. The district has 51.3% male and 48.7% female. Students enrolled are as follows: 69% Asian, 5% Black or African American, 4.6% Hispanic, 0.1% Native Hawaiian or Pacific Islander, 1.3% Two or more races, and 19.9% White or Caucasian. In addition, 5% of students were identified as economically disadvantaged as evidenced by a membership in the free and reduced lunch program. The special education population is 9.8% and 4% of students are English language learners.

Procedures

The procedures of this study were conducted in six phases (see Figure 4): (a) survey development, (b) survey recruitment, (c) intervention development, (d) intervention recruitment, (e) intervention implementation, and (f) data analysis, each described in the following sections.

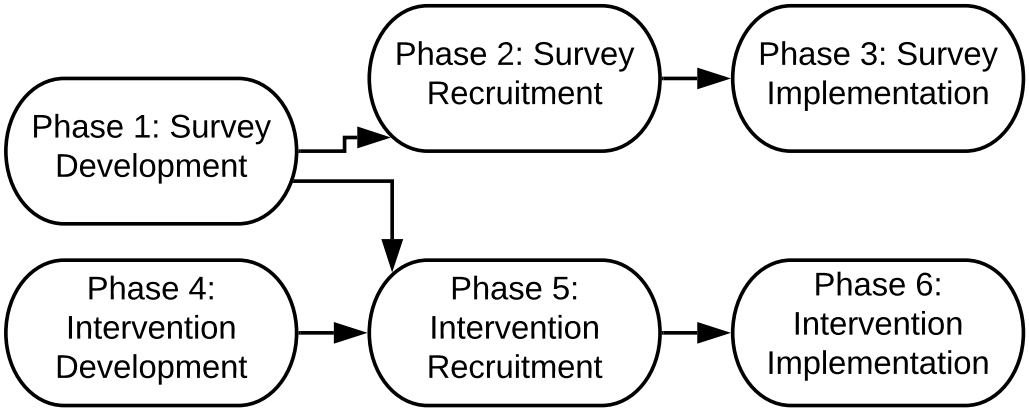

Figure 4. Research Procedures. The figure illustrates the 6 phases of the research procedures.

Phase 1: Survey Development

The survey was developed through an iterative process and uploaded to Qualtrics. Questions in all sections were developed using Ponto (2015) as a reference for survey development. First, questions were developed for Section I to seek demographic information following the procedures of van den Bosch et al. (2017), Lane et al. (2015), and Johl et al. (2016). Second, questions were developed in Section II to evaluate teacher confidence, willingness, and perceived usefulness and followed the procedures of Lane et al. (2015). Third, questions were developed in Section III to measure teacher ability to interpret graphed behavioral data and apply data to inform decisions. Questions were developed following the procedures of Kratchowill et al. (2010), Lane et al. (2015), Maffei-Almodovar et al. (2017), and Zeuch et al. (2017). Next, the questions were reviewed by my dissertation committee for accuracy and feasibility. Specifically, questions were revised to address ethnicity and gender terminology and options, wording of questions, additional answer choices for the scenarios, and grammar. Next, a panel of four experts on Applied Behavior Analysis were asked to review the

survey for accuracy and feasibility and provide critical feedback. The survey was again revised according to the feedback provided by the experts to add setting of classroom and provide additional answer choices for the scenarios. Next, a small sample (n = 4) of pre-service and in-service teachers were asked to complete the survey and provide feedback on the questions. Finally, the survey was revised according to the feedback provided by the pre-service and in-service teachers by including population of students.

Measure. The Teacher Interpretation and Application of Graphed Behavioral Data (TIA-GBD; see Appendix A) survey is the only measure included in this study. The survey was developed by the researcher following the procedures described above and comprised of three sections: (a) Section I: Demographic Information, (b) Section II: Confidence, Usefulness, and Willingness and (c) Section III: Interpretation and Application of Behavioral Graphs. The overall time to complete the survey was approximately 20-30 minutes. Survey development procedures are described in the following paragraphs.

Section I (i.e., Demographic Information) included 16 questions about demographic information, including type of teacher (i.e., general education, special education), highest degree earned, year of highest degree earned, professional certifications, years of teaching experience, professional development around data collection and analysis, and experience with behavioral data.

Responses to the three demographic questions used as predictors from Section I were coded as follows. The first question queried respondents about the type of setting in which they taught. Responses were coded as: general education classroom, inclusion classroom, special education resource room, language and/or learning disabilities classroom, autism classroom, or multiply disabled classroom. I aggregated responses from this question into three precise codes:

(a) general education setting, (b) special education setting (i.e., inclusion, special education resource room, language and/or learning disabilities classroom), (c) special education setting with more intensive behavioral support (i.e., autism classroom, multiply disabled classroom).

The second question queried respondents about their expectations to collect and interpret data in their school district. Responses were coded as: yes or no.

The third question queried respondents about whether they were taught to interpret behavioral data in college courses and/or in workshops within their district or outside of their district. I aggregated responses from those three questions querying respondents about their training in interpreting and applying graphed behavior data into three codes: yes, no, or I do not remember. The data were aggregated into one precise predictor (i.e, training).

Section II (i.e., Confidence, Willingness, & Usefulness) was a 7-question 4-point likert scale (e.g. 1 = not confident at all, 2 = not very confident, 3 = somewhat confident, 4 = very confident) that included questions regarding participant perceived confidence and willingness to interpret behavioral graphs, to provide information to others (e.g., parents, intervention teams), and to apply data in graphs to inform instruction and select student interventions. Similarly, questions were asked regarding participant perception of the usefulness of graphed behavioral data to (a) inform their instruction, (b) select interventions to address problem behaviors, and (c) use the data during the Intervention and Referral Services (I&RS) process.

Confidence was represented by responses to survey items 17-18 in section II. Responses were coded as (1) if not confident at all, (2) if not very confident, (3) if confident, and (4) if very confident.

Willingness was represented by responses to survey item 19-20 in section II. Responses were coded as (1) if not willing at all, (2) if not very willing, (3) if willing, and (4) if very

willing.

Usefulness was represented by responses to survey item 21-23 in section II. Responses were coded as (1) if not useful at all, (2) if not very useful, (3) if useful, and (4) if very useful.

Section III (i.e., Interpretation and Application of Behavioral Graphs) included three scenarios with graphs of student behaviors (see Appendix A).

The first scenario described a student who exhibited off task and defiant behaviors, including talking to others and playing with objects during a lesson, walking around the room during independent work, and refusal to complete assignments. The graph included days on the x-axis and number of off-task behaviors on the y-axis. Student behavior during baseline was increasing and demonstrated high numbers of off-task behaviors. Student behavior during intervention was stable and the behavior remained approximately the same as baseline, demonstrating a change in intervention was warranted.

The second scenario described a student who exhibited off-task behaviors, including difficulty completing assignments. The graph included days on the x-axis and percentage of on-task behaviors on the y-axis. Student behavior during baseline was stable and demonstrated the student was on task approximately 50% of the time. Student behavior during intervention was stable; however, the student's on task behavior decreased, demonstrating the intervention should be changed.

The third scenario described a student who was a selective mute and did not communicate verbally in class. The graph included days on the x-axis and number of initiated verbal interactions on the y-axis. Student behavior during baseline was stable and demonstrated low numbers of initiated verbal interactions. Student behavior during intervention was increasing, demonstrating the intervention should remain the same as it was improving the student's verbal

initiations.

The first and third scenarios include 3 multiple-choice questions. Questions required participants to: (a) select the description that best fits the trend of the data during (reading between) intervention (i.e., behavior got better, behavior got worse, behavior remained approximately the same) and (b) to determine if the current intervention should be continued, discontinued, or changed (reading beyond). The second scenario included 6 multiple-choice questions that follow the same procedures as scenarios one and three with the addition of asking participants to read the data (i.e, mean and level). Participants were given a selection of potential descriptions (reading the data) of the graphed data and asked to select the description that best fits the data. For example, differences in mean/levels between the baseline and intervention.

Data from section III were coded as follows (see Table 3). First, data was dichotomously coded as 0 if incorrect and 1 if correct. Second, the total score was calculated with possible scores ranging from 0 to 12 with 0 representing not able, 1 to 3 minimally able, 4 to 7 somewhat able, 8 to 11 almost able, and 12 entirely able for each participant. Third, domain scores (i.e., read the data, read between the data, read beyond the data, read behind the data) were calculated for each participant with possible scores ranging from 0 to 3 for each domain with 0 indicating not able, 1 indicating minimally able, 2 somewhat able, and 3 entirely able. Fourth, a total score was calculated for the domain scores for survey respondents as a whole per condition (i.e., survey only, survey and workshop; see Table 8) as the mean (standard deviation) in each category. This information was gleaned from survey items 24-35. Specifically, survey items 27, 28, and 29 measured respondent ability to read the data by selecting the correct percent of student behavior (e.g., on-task percent on the last data point) during baseline and intervention phases on the graph associated with the questions. Survey items 24, 27, and 33

measured respondent ability to read between the data (i.e., determine if the behavior improved, did not improve, or stayed the same). Survey items 25, 30, and 34 measured respondent ability to read beyond the data (i.e., determine if the intervention should be continued, discontinued, or changed). Survey items 26, 32, and 35 measured respondent ability to read behind the data (i.e., need to select an intervention). Finally, responses were qualitatively described as either not able, minimally able, somewhat able, almost able, and entirely able for overall score and not able, minimally able, somewhat able, and entirely able for reading the data, between, beyond, and behind, which are reported based on the number of questions answered correctly (see Table 3) based on the percent of respondents in each category.

Table 3
Scores per dependent variable

Dependent Variable	Survey Section #	Survey Question #	Range of raw scores	Qualitative Interpretation of Scores
Teacher overall ability to interpret graphed behavioral data	III	24-35	0 1-3 4-7 8-11 12	Not able Minimally Able Somewhat able Almost able Entirely able
Teacher ability to read the data	III	27-29	0 1 2 3	Not able Minimally Able Somewhat able Entirely able
Teacher ability to read between the data	III	24, 30, 33	0 1 2 3	Not able Minimally Able Somewhat able Entirely able
Teacher ability to read beyond the data	III	25, 31, 34	0 1 2 3	Not able Minimally Able Somewhat able Entirely able
Teacher ability to read behind the data	III	26, 32, 35	0 1 2 3	Not able Minimally Able Somewhat able Entirely able
Teacher confidence to interpret and utilize graphed behavioral data	II	17-18	2 4 6 8	Not confident Somewhat confident Confident Very Confident
Teacher willingness to interpret and utilize graphed behavioral data	II	19-20	2 4 6 8	Not willing Somewhat willing Willing Very Willing
Teacher perceived usefulness of behavioral graph	II	21-23	3 6 9 12	Not useful Somewhat useful Useful Very Useful

Note. This table illustrates the dependent variables and the section of the survey and research questions that correlate with each dependent variable. In addition, the range of scores are included along with the qualitative labels of the scores.

Phase 2: Survey Recruitment

All contact with potential universities and the local school district was approved by the Rutgers Institutional Review Board (IRB). To recruit survey participants, I emailed Teacher Education Partnership Leaders at Rutgers and I researched New Jersey universities with four-year education programs to compile a list of universities to contact (see Appendix B). Further, I asked Rutgers Partnership Leaders to provide an introduction to the pre-service teachers currently in the field and discussed timing and setting for the intervention.

After compiling the university list consisting of 19 universities and receiving the contact information from Partnership Leaders, I contacted 19 University deans/professors responsible for research at the University. In addition, I contacted 10 building administrators in the participating school district. After receiving approval from deans/professors at two universities and eight administrators in the participating district, the survey was disseminated to pre-service and in-service teachers in the participating universities and district, including the researcher disseminating the survey to graduate students in her Assessment and Measurement course. The researcher minimized risk of coercion by making participation in the study optional and was in no way required or a part of their grade. However, the researcher offered a small amount of points of extra credit. In order to deal with undue influence, the researcher provided other opportunities for extra credit to ensure this was not their only option for extra credit. Further, an announcement was made at two classes at Rutgers University for pre-service teachers, one meeting at the participating school district for pre-service teachers, and a faculty meeting at one participating school for in-service teachers. A follow-up email was sent to professors and

administrators that included a brief description of the purpose of the study, a URL link to the study, and contact information for the principal investigator and the dissertation committee chair. Five professors at the two universities and eight administrators in the participating district were asked to share the email with their pre-service teachers in University education programs and in-service teachers in school districts. The survey was sent to 81 pre-service teachers and 300 in-service teachers. One hundred ninety-seven teachers (51.7%) began the survey and 125 teachers (32.8%) completed the survey.

Once the recipient received the email, if the person chose to participate in the study, the participant clicked the URL link. The URL link immediately took the participant to the consent form (see Appendix C). The consent form described the purpose and procedures of the study. In addition, the consent form described voluntary participation, confidentiality, approximate completion time, and IRB contact information. If the participant consented to take the survey, he/she clicked the following boxes: "I voluntarily agree to take this study" and "I certify that I am at least 18 years of age."

Approximately one week after the initial email was delivered, a follow-up email was sent with another link to the survey. A second follow-up email was sent approximately three weeks after the original email. The due date for completed surveys was approximately one and a half months after the initial survey was sent out. An incentive of a fifty-dollar gift card was provided to two survey participants in the form of a raffle. In accordance with federal regulations, all data will be maintained for three years after the completion of the study.

Phase 3: Survey Implementation

For the 101 participants who completed the survey only, the participants consented to participate in the study and began the survey on Qualtrics. The survey took approximately 20-30

minutes to complete. Although 381 individuals received the survey, 197 began taking the survey, resulting in 125 complete responses (i.e., survey only group and survey and workshop group) and 72 incomplete responses (see Figure 5). Those 72 incomplete responses were not used in data analysis.

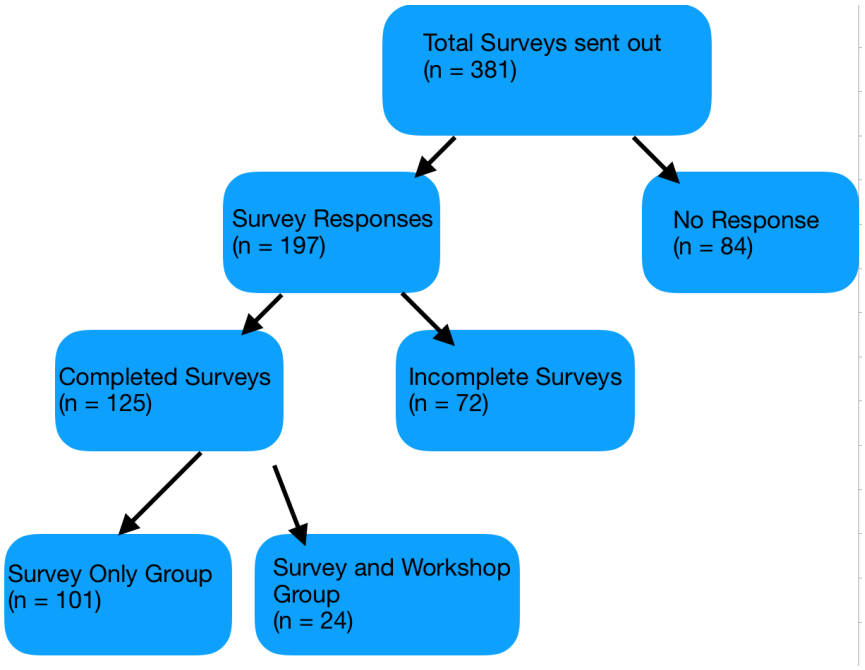

Figure 5. Survey Distribution and Responses. This figure illustrates the number of surveys sent to possible participants, number of respondents and non-respondents, complete and incomplete surveys, and number of participants with completed surveys per group.

Phase 4: Intervention development

When developing the intervention for participants in the survey and workshop group, I followed the procedures of Wight, Wimbush, Jepson, and Doi (2016) (See Figure 6). First, I identified the problem from the prior literature to be addressed by the training. Specifically, I determined that training was needed in: (a) how to collect behavioral data, (b) interpret the data, and (c) apply the data to inform decisions. However, it should be noted that minimal research was available to guide this process.

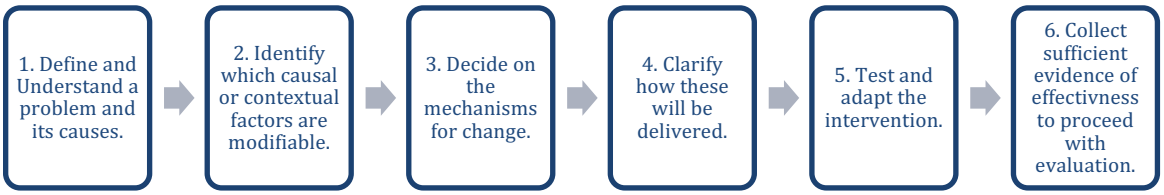

Figure 6. Wight, Wimbush, Jepson, and Doi (2015)'s Six Steps in Quality Intervention Development.

Second, to address this problem, I developed a brief behavior analytic training (3 sessions) for pre-service and in-service teachers. The intervention (i.e., training) was designed as a Behavioral Skills Training (Maffei-Almodovar, Feliciano, Fienup, and Sturmey, 2017), including instructions, modeling, rehearsal, and feedback and incorporated a consistent set of rules (see Appendix D; slide 81-82) to be applied when interpreting graphed behavioral data and applying the data to inform decisions according to Kratchowill et al. (2010), Lane et al. (2015), and Maffei-Almodovar et al. (2017).

Phase 5: Intervention recruitment

Pre-service and in-service teachers were recruited to participate in a pre-intervention survey, CIA-GBD intervention, and a post-intervention survey. Two methods of recruiting were followed. First, pre-service teachers were recruited through collaboration with Partnership Leaders at Rutgers University and the participating school district. Second, in-service teachers were recruited through collaboration with the participating school district.

Pre-service Recruitment. First, the researcher and the researcher's advisor held a meeting with one Partnership Leader from Rutgers University to discuss the logistics of the training. At the meeting, it was decided that pre-service teachers would be recruited from Phase 3 of their program at Rutgers University. These students (n = 3) were enrolled in 532 Clinical

Practice Seminar and were completing their clinical practice. Second, the researcher emailed the administrator in the participating school district, provided information regarding the study, and the logistics of the study. From the email correspondence, the administrator agreed to allow the researcher to recruit from students at a local university that were completing their practicum at the local school district (n = 9). The researcher sent an email with detailed information about the study to the administrator to recruit participants from these settings. Interested participants notified the researcher, which lead to the researcher making a more detailed announcement face-to-face at their seminar course and the participating school district. From this process, pre-service (n = 3) teachers from Rutgers University and pre-service (n = 9) teachers from the participating school district agreed to participate in the study. All completed the training with the exception of one student from Rutgers University.

Interested participants from Rutgers University picked up a number from a randomly organized stack of cards during the university course and interested participants in their practicum from the local school district picked up a number in their assigned participating school district. On the card, participants were provided with a random, unique ID number to be entered when completing the pre-intervention and post-intervention survey. Their name and number were never connected together in any document. The researcher did not have knowledge of the ID number for each participant. After the announcement was made, a reminder email was sent out with instructions and a link to the survey. Participants agreed to participate via the consent form in the survey.

In-service Recruitment. In-service teachers were recruited from a local suburban school district where I am employed. Although I am employed in the district, I had no direct supervisory responsibilities or authority over any of the potential participants. In-service teachers were

initially recruited through an announcement made by the researcher at a faculty meeting at one of the elementary schools in the local suburban school district (described above). Interested participants picked up a number from a randomly organized stack of cards at the end of the faculty meeting. On the card, participants were provided with a random, unique ID number to complete the pre-intervention and post-intervention survey. Their name and number were never connected together in any document. The researcher did not have knowledge of the ID numbers. After the faculty meeting, a reminder email was sent out with instructions and a link to the survey. Participants agreed to participate via the consent form in the survey.

Phase 6: Intervention Implementation

The participants in the survey and intervention group took the pre-intervention survey (20-30 minutes), participated in the intervention (three 30- minute sessions), and completed the post-intervention survey (20-30 minutes). The following workshop procedures were identical for the pre-service and in-service teacher participants. The workshop was guided by a PowerPoint presentation (see Appendix D) and included the following procedures and information.

The first session included instructions and modeling on data collection procedures. Teachers learned (a) the importance of collecting data, (b) challenges with data collection, (c) how to operationally define a behavior, (d) the importance of baseline data, and (e) types of behavioral data to collect. Content was selected based on Behavioral Skills Training and Applied Behavior Analysis procedures (Cooper, Heron, & Heward, 2006; Lane et al., 2015; Maffei-Almodovar et al., 2017). The teachers role-played and rehearsed how to collect data and feedback from the instruction (i.e., the researcher) was provided by the researcher. Following that role play, teachers were asked to choose one target student, identify and operationally define the target behavior, identify the data collection method to be used, and collect baseline data in

the week following the first training session.

The second session occurred the following week and included instructions and modeling on interpreting baseline data and beginning an intervention. Specifically, training included methods to interpret baseline data based on (a) trend, (b) variability, and (c) level. In addition, participants learned when to begin an intervention based on a consistent set of rules (See Appendix D) when interpreting graphed behavioral data. Content was selected based on Behavioral Skills Training and Applied Behavior Analysis procedures (Cooper, Heron, & Heward, 2006; Kamphaus & Reynolds, 2015; Lane et al., 2015; Maffei-Almodovar et al., 2017). During this session, teachers rehearsed how to interpret data and critical feedback was provided by the researcher. Participants were asked to define a replacement behavior for the target behavior, implement a token economy system reinforcing the student when the replacement behavior occurs, collect data, and bring the data to the next session.

The third session included instructions and modeling on interpreting data and determining the effectiveness of an intervention. Participants learned how to interpret baseline and intervention data based on (a) trend, (b) variability, (c) level, (d) immediacy of effect, and (e) overlap. In addition, participants learned how to determine if an intervention was effective or ineffective based on a consistent set of rules (see Appendix D; slides 81-82). Content was selected based on Behavioral Skills Training and Applied Behavior Analysis procedures (Cooper, Heron, & Heward, 2006; Lane et al., 2015; Maffei-Almodovar et al., 2017). Participants role-played how to interpret the data and determined the effectiveness of an intervention. The researcher provided critical feedback.

At the end of training (third session), participants completed a post-intervention survey (identical to the first survey) to assess their knowledge to use, interpret, and apply graphed

behavioral data. In addition, the post-intervention survey assessed their perceived confidence, usefulness, and willingness to use, interpret, and apply graphed behavioral data in practice.

Data Analysis

Data analysis procedures are listed below by research question. Table 4 illustrates the section of the survey that pertains to the data analyses per research question and the type of analyses to measure each dependent variable. Table 4 illustrates the section of the survey, survey questions, and type of analyses per research question.

Table 4
Measures and analyses per research question

Research Question	Section I Demographics	Section II Confidence, Willingness, Usefulness	Section III Teacher Ability	Type of Analyses
1. To what extent do teachers (i.e., pre-service and in-service) interpret and apply data to inform decisions (e.g. read the data, read between, behind, and beyond the data) using behavioral graphs prior to the "Collecting, Interpreting, and Applying- Graphed Behavioral Data (CIA-GBD) intervention?"			X	Descriptive statistics
2. What malleable factors (i.e., prior training, type of setting, expectation to collect data) predict teacher ability to interpret and apply graphed behavioral data prior to the CIA-GBD intervention?	X		X	Multiple Regression Analysis
3. What is the effect of the CIA-GBD intervention on pre-service and in-service teacher (a) overall ability to interpret and apply graphed behavioral data; (b) to read the data; (c) read beyond the data; and (d) read behind the data?			X	Paired Samples T-test/Analysis of Variance (ANOVA)

Was there a difference of effects between pre-service and in-service teachers?			
4. What factors influence pre-service and in-service teacher confidence to interpret and apply graphed behavioral data in classrooms prior to the CIA-GBD intervention?	X	X	Multiple Regression Analysis
5. What factors influence pre-service and in-service teacher willingness to interpret and apply graphed behavioral data in classrooms prior to the CIA-GBD intervention?	X	X	Multiple Regression Analysis
6. What factors influence pre-service and in-service teacher perceived usefulness of interpreting and applying graphed behavioral data in classrooms prior to the CIA-GBD intervention?	X	X	Multiple Regression Analysis
7. Does the CIA-GBD intervention increase teacher confidence, willingness, and perceived usefulness in interpreting and applying graphed behavioral data to make decisions? Was there a difference of effects between pre-service and in-service teachers?		X	Paired Samples T-test/ ANOVA

Note. This table illustrates the seven research questions and the section of the survey that correlates with the question. In addition, the type of analyses are included per research question.

Consistent with my quantitative design, survey data were analyzed through statistical procedures utilizing SPSS, a statistical software program. Specifically, to answer research question 1 (To what extent do pre-service and in-service teachers interpret and apply data to inform decisions (e.g. read the data, read between, beyond, and behind the data) using behavioral graphs prior to CIA-GBD intervention?), I calculated the percent of teachers who were considered not able, minimally able, somewhat able, almost able, and entirely able on questions

from section III of the survey (e.g. reading the data, reading between, beyond, and behind the data).

To answer research question 2 (What malleable factors predict pre-service and in-service teacher ability to interpret and apply graphed behavioral data prior to the CIA-GBD intervention?), I conducted a multiple regression analysis to determine which, if any variables, predicted the teacher's ability to interpret and apply graphed behavioral data (i.e., total raw score for questions 1 to 12 in section III of the survey). Variables considered as predictors were setting, expectation to collect behavioral data, and training (e.g. college courses, in and out of district training).

To answer research question 3 (What is the effect of the CIA-GBD intervention on pre-service and in-service teacher: (a) overall ability to interpret and apply graphed behavioral data; (b) to read the data; (c) read between the data; (d) read beyond the data; and (e) read behind the data? Was there a difference of effects between pre-service and in-service teachers?), I conducted a paired samples t-test to determine the within-group mean difference between responses on the pre-intervention survey and post-intervention survey with overall scores for the combined group (i.e., pre-service and in-service).

Second, I conducted a 2 (groups) x 2 (time) repeated measures ANOVA to determine the between-group effect of the independent variable (e.g. workshop/intervention) on the dependent variables (e.g. pre-intervention survey results, post-intervention survey results). Groups included pre-service and in-service teachers and time included pre- and post-survey for five outcomes (i.e., overall ability, read the data, read between the data, read beyond the data, read behind the data).

To answer research question 4 (What factors influence pre-service and in-service teacher confidence to interpret and apply graphed behavioral data in classrooms prior to the CIA-GBD intervention?), I used the same procedures in research question 2 and conducted a multiple regression analysis to determine which, if any variables (from section I), predicted the total raw score for questions 17-18 in section II of the survey.

To answer research question 5 (What factors influence pre-service and in-service teacher willingness to interpret and apply graphed behavioral data in classrooms prior to the CIA-GBD intervention?), I used the same procedures in research question 2 and conducted a multiple regression analysis to determine which, if any variables (from section I), predicted the total raw score for questions 19-20 in section II of the survey.

To answer research question 6 (What factors influence pre-service and in-service teacher perceived usefulness of interpreting and applying graphed behavioral data in classrooms prior to the CIA-GBD intervention?), I used the same procedures in research question 2 and conducted a multiple regression analysis to determine which, if any variables (from section I), predicted the total raw score for questions 21-23 in section II of the survey.

To answer research question 7 (Does the CIA-GBD intervention increase teacher confidence, willingness, and perceived usefulness in interpreting and applying graphed behavioral data to make decisions? Was there a difference of effects between pre-service and in-service teachers?), I conducted a paired samples t-test to determine the within-group mean difference between responses on the pre-intervention survey and post-intervention survey with overall confidence, willingness, and perceived usefulness scores for the combined group (i.e., pre-service and in-service).

Second, I conducted three separate 2 (groups) x 2 (time) repeated measures ANOVAs to determine the between-group effect of the independent variable (e.g. workshop/intervention) on the dependent variables (e.g. pre-intervention survey results, post-intervention survey results). Groups included pre-service and in-service teachers and time included pre- and post-survey for three outcomes (i.e., confidence, willingness, and perceived usefulness). The outcomes were measured as indicated in research question 3 (from Section II of the survey).

CHAPTER IV

RESULTS

Results of this dissertation examined the following: (a) teacher expectation to collect behavioral data, frequency of data collection, and previous training, (b) teacher ability to interpret and apply graphed behavioral data to inform instruction and student interventions, (c) demographic factors that may influence teachers' ability, teacher perceived confidence, willingness, and usefulness of graphed behavioral data, and (d) the effect of a 3-series workshop on teachers' ability, confidence, willingness, and usefulness and will be described in this chapter. The results of the analyses in this dissertation will be described and presented from the demographic section and per research question. The chapter concludes with a summary.

Demographic Results

Within the demographic section, participants were asked to report on their expectations for behavioral data collection, interpretation, and application in their current district, frequency of data collection, previous training in behavioral data in undergraduate or graduate courses, how many courses incorporated behavioral data, and previous training to collect, interpret, and/or apply behavioral data in a workshop with a presenter within their district or outside of their district (see Table 5, 6, & 7). Sixty-four participants reported having an expectation to collect, interpret, and/or apply behavioral data in their district while 41 participants reported having no expectation and 20 participants reporting they were unsure. Twenty-seven participants reported collecting behavioral data daily, nine participants reported 2-3 times a week, six reported once a week, five reported every other week, ten reported once a month, 36 reported never collecting data, and 32 participants reported another frequency of data collection. The majority of participants reported having no prior training in undergraduate or graduate course(s) teaching

them to interpret and apply behavioral data to inform their instruction and student interventions (n = 60) while 12 participants said they were unsure and 53 participants reported they had no prior training in an undergraduate or graduate course. Of the participants that reported having prior training to interpret and apply behavioral data in an undergraduate or graduate course, one reported taking 0 courses, 35 reported taking 1-2 courses, and 14 participants reported taking 3-5 courses. One hundred and two participants reported having never attended a workshop outside of their district on behavioral data interpretation and application, 18 participants reported having attended a workshop, and 5 participants reported that they didn't remember. Finally, ninety-one participants reported having never attended a workshop in their district on behavioral data interpretation and application, 26 participants reported having attended an in-district workshop, and 8 participants reported that they didn't remember.

Table 5
Demographics by Condition

	Total		Survey Only		Survey and Workshop	
Demographics	N	%	N	%	N	%
Participants	125	100	101	80.8	24	19.2
Gender						
Female	107	85.6	83	82.2	24	100
Male	16	12.8	16	15.8	0	0
Prefer Not to Answer	2	1.6	2	2	0	0
Ethnicity/Race						
African American/Black	1	.8	1	1	0	0
Latino/Latina	4	3.2	4	4	0	0
Caucasian/White	111	88.8	90	89.1	21	87.5
Native American	0	0	0	0	0	0
Asian/Pacific Islander	5	4	2	2	3	12.5
Other	0	0	0	0	0	0
Multi-Racial	2	1.6	2	2	0	0
Prefer Not to Answer	2	1.6	2	2	0	0
Age						
20-25	50	38.8	37	36.6	13	54.2
26-30	17	13.2	15	14.9	2	8.3

31-40	31	24	26	25.7	5	20.8
41-50	16	12.4	15	14.9	1	4.2
51-60	8	6.2	5	5	3	12.5
61+	3	2.3	3	3	0	0
Level of Education						
High School	40	32	31	30.7	9	37.5
Bachelor's	52	41.6	42	41.6	10	41.7
Master's	32	25.6	27	26.7	5	20.8
Doctorate	1	.8	1	1	0	0
Year of Highest Degree						
2015-2019	67	53.6	54	53.5	13	54.2
2010-2014	19	15.2	15	14.9	4	16.7
2005-2010	12	9.6	9	8.9	3	12.5
2000-2005	11	8.8	11	10.9	0	0
1995-2000	4	3.2	2	2	2	8.3
1990-1995	7	5.6	5	5	2	8.3
1985-1990	0	0	0	0	0	0
1980-1985	2	1.6	2	2	0	0
1980 or earlier	3	2.4	3	3	0	0
Type of Teacher 1						
In-service	75	60	63	62.4	12	50
Pre-service	45	36	33	32.7	12	50
Other	5	4	5	5	0	0
Type of Teacher 2						
Elementary	44	34.9	32	31.7	12	50
Secondary	19	15.1	19	18.8	0	0
Student	45	36.5	33	32.7	12	50
Other	5	4	5	5	0	0
Both (Elem & Sec)	12	9.5	12	11.9	0	0
Type of Teacher 3						
General Ed.	43	34.1	36	35.6	7	29.2
Special Ed.	16	12.7	14	13.9	2	8.3
Student	45	36.5	33	32.7	12	50
Other	5	4	5	5	0	0
Both (Gen & Spec)	16	12.7	13	12.9	3	12.5
Years in Profession						
0-5	68	54.4	54	53.5	14	58.3
6-10	26	20.8	23	22.8	3	12.5
11-15	12	9.6	9	8.9	3	12.5
16-20	9	7.2	9	8.9	0	0

21-30	8	6.4	4	4	4	16.7
31+	2	1.6	2	2	0	0
Population						
General Ed.	5	4	4	4	1	4.2
Gen Ed+Mild Spec Ed	12	9.6	11	10.9	1	4.2
Gen Ed+Severe Spec Ed	37	29.6	31	30.7	6	25
Special EdOnly-Mild	0	0	0	0	0	0
Special Ed Only-Intensive	15	12	9	8.9	6	25
All of the Above	56	44.8	46	45.5	10	41.7
Setting						
Gen Ed.	21	16.8	15	14.9	6	25
Special Ed	56	44.8	47	46.5	9	37.5
Special Ed. 2	41	32.8	32	31.7	9	37.5
Other	7	5.6	7	6.9	0	0
Expectation to Collect data						
Yes	64	51.2	48	47.5	16	66.7
No	41	32.8	37	36.6	4	16.7
I'm not sure	20	16	16	15.8	4	16.7
Frequency of Data Collection						
Daily	27	21.6	23	22.8	4	16.7
2-3 times a week	9	7.2	6	5.9	3	12.5
Once a week	6	4.8	4	4	2	8.3
Every other week	5	4	3	3	2	8.3
Once a month	10	8	10	9.9	0	0
Never	36	28.8	32	31.7	4	16.7
Other	32	25.6	23	22.8	9	37.5
College Course Training						
Yes	53	42.4	40	39.6	13	54.2
No	60	48	51	50.5	9	37.5
I don't remember	12	9.6	10	9.9	2	8.3
Number of Courses						
0	1	2	1	2.7	0	0
1-2	35	70	28	75.7	7	53.8
3-5	14	28	8	21.6	6	46.2
6+	0	0	0	0	0	0
Out of District Training						
Yes	18	14.4	15	14.9	3	12.5
No	102	81.6	82	81.2	20	83.3
I don't remember	5	4	4	4	1	4.2

In District Training						
Yes	26	4.8	18	17.8	8	33.3
No	91	72.8	77	76.2	14	58.3
I don't remember	8	6.4	6	5.9	2	8.3

Note. This table illustrates the demographic information compiled from 125 participants per condition. It is important to note that only 50 participants responded to the number of courses taken. The remainder of respondents did not take any college courses in reference to behavioral data collection, interpretation, or application. In addition, setting Special Ed. 2 = with more intensive behavioral support (e.g. autism classroom, multiply disabled classroom).

Table 6
Demographics in Survey Only per Type of Teacher

	Survey Only							
	Total		In-service		Pre-service		Other	
Demographics	N	%	N	%	N	%	N	%
Participants	101	100	63	62.4	33	32.6	5	5
Gender								
Female	83	82.2	48	76.2	31	93.9	4	80
Male	16	15.8	13	20.6	2	6.1	1	20
Prefer Not to Answer	2	2	2	3.2	0	0	0	0
Ethnicity/Race								
African American/Black	1	1	0	0	1	3	0	0
Latino/Latina	4	4	1	1.6	3	9.1	0	0
Caucasian/White	90	89.1	59	93.7	26	78.8	5	100
Native American	0	0	0	0	0	0	0	0
Asian/Pacific Islander	2	2	0	0	2	6.1	0	0
Other	0	0	0	0	0	0	0	0
Multi-Racial	2	2	1	1.6	1	3	0	0
Prefer Not to Answer	2	2	2	3.2	0	0	0	0
Age								
20-25	37	36.6	4	6.3	32	97	1	20
26-30	15	14.9	15	23.8	0	0	0	0
31-40	26	25.7	24	38.1	1	3	1	20
41-50	15	14.9	14	22.2	0	0	1	20
51-60	5	5	4	6.3	0	0	1	20
61+	3	3	2	3.2	0	0	1	20
Level of Education								
High School	31	30.7	3	30.7	28	84.8	0	0
Bachelor's	42	41.6	34	41.6	4	12.1	4	80
Master's	27	26.7	26	26.7	1	3	0	0
Doctorate	1	1	0	0	0	0	1	20
Year of Highest Degree								
2015-2019	54	53.5	22	34.9	31	93.9	1	20
2010-2014	15	14.9	14	22.2	1	3	0	0
2005-2010	9	8.9	7	11.1	1	3	1	20
2000-2005	11	10.9	10	15.9	0	0	1	20
1995-2000	2	2	2	3.2	0	0	0	0
1990-1995	5	5	4	6.3	0	0	1	20
1985-1990	0	0	0	0	0	0	0	0
1980-1985	2	2	2	3.2	0	0	0	0
1980 or earlier	3	3	2	3.2	0	0	1	20

Type of Teacher 1								
In-service	63	62.4	63	100	33	100	0	0
Pre-service	33	32.7	0	0	0	0	0	0
Other	5	5	0	0	0	0	5	100
Type of Teacher 2								
Elementary	32	31.7	32	50.8	0	0	0	0
Secondary	19	18.8	19	30.2	0	0	0	0
Student	33	32.7	0	0	33	100	0	0
Other	5	5	0	0	0	0	5	100
Both (Elem & Sec)	12	11.9	12	19	0	0	0	0
Type of Teacher 3								
General Ed.	36	35.6	36	57.1	0	0	0	0
Special Ed.	14	13.9	14	22.2	0	0	0	0
Student	33	32.7	0	0	33	100	0	0
Other	5	5	0	0	0	0	5	100
Both (Gen & Spec)	13	12.9	13	20.6	0	0	0	0
Years in Profession								
0-5	54	53.5	20	31.7	33	100	1	20
6-10	23	22.8	23	36.5	0	0	0	0
11-15	9	8.9	8	12.7	0	0	1	20
16-20	9	8.9	8	12.7	0	0	1	20
21-30	4	4	3	4.8	0	0	1	20
31+	2	2	1	1.6	0	0	1	20
Population								
General Ed	4	4	3	4.8	1	3	0	0
Gen Ed+Mild Spec Ed	11	10.9	6	9.5	5	15.2	0	0
Gen Ed+Severe Spec Ed	31	30.7	17	27	14	42.4	0	0
Special Ed Only-Mild	0	0	0	0	0	0	0	0
Special Ed Only-Severe	9	8.9	8	12.7	1	3	0	0
All of the Above	46	45.5	29	46	12	36.4	5	100
Setting								
Gen Ed	15	14.9	11	17.5	3	9.1	1	20
Special Ed	47	46.5	34	54	13	39.4	0	0
Special Ed 2	32	31.7	17	27	14	42.4	1	20
Other	7	6.9	1	1.6	3	9.1	3	60
Expectation to Collect data								
Yes	48	47.5	33	52.4	13	39.4	2	40
No	37	36.6	22	34.9	13	39.4	2	40
I'm not sure	16	15.8	8	12.7	7	21.2	1	20

Frequency of Data Collection								
Daily	23	22.8	19	30.2	2	6.1	2	40
2-3 times a week	6	5.9	5	7.9	1	3	0	0
Once a week	4	4	1	1.6	3	9.1	0	0
Every other week	3	3	2	3.2	1	3	0	0
Once a month	10	9.9	6	9.5	4	12.1	0	0
Never	32	31.7	16	25.4	16	48.5	0	0
Other	23	22.8	14	22.2	6	18.2	3	60
College Course Training								
Yes	40	39.6	17	27	22	66.7	1	20
No	51	50.5	40	63.5	7	21.2	4	80
I don't remember	10	9.9	6	9.5	4	12.1	0	0
Number of Courses								
0	1	2.7	0	0	1	3	0	0
1-2	28	75.7	12	19	16	48.5	0	0
3-5	8	21.6	4	6.3	4	12.1	0	0
6+	0	0	0	0	0	0	0	0
Out of District Training								
Yes	15	14.9	12	19	2	6.1	1	20
No	82	81.2	48	76.2	30	90.9	4	80
I don't remember	4	4	3	4.8	1	3	0	0
In District Training								
Yes	18	17.8	14	22.2	2	6.1	2	40
No	77	76.2	46	73	28	84.8	3	60
I don't remember	6	5.9	3	4.8	3	9.1	0	0

Table 7
Demographics in Survey and Workshop Group per Type of Teacher

	Survey and Workshop							
	Total		In-service		Pre-service		Other	
Demographics	N	%	N	%	N	%	N	%
Participants	24	100	12	50	12	50	0	0
Gender								
Female	24	100	12	100	12	100		
Male	0	0	0	0	0	0		
Prefer Not to Answer	0	0	0	0	0	0		
Ethnicity/Race								
African American/Black	0	0	0	0	0	0		
Latino/Latina	0	0	0	0	0	0		
Caucasian/White	21	87.5	11	91.7	10	83.3		
Native American	0	0	0	0	0	0		
Asian/Pacific Islander	3	12.5	1	8.3	2	16.7		
Other	0	0	0	0	0	0		
Multi-Racial	0	0	0	0	0	0		
Prefer Not to Answer	0	0	0	0	0	0		
Age								
20-25	13	54.2	1	8.3	12	100		
26-30	2	8.3	2	16.7	0	0		
31-40	5	20.8	5	41.7	0	0		
41-50	1	4.2	1	8.3	0	0		
51-60	3	12.5	3	25	0	0		
61+	0	0	0	0	0	0		
Level of Education								
High School	9	37.5	0	0	9	75		
Bachelor's	10	41.7	7	58.3	3	25		
Master's	5	20.8	5	41.7	0	0		
Doctorate	0	0	0	0	0	0		
Year of Highest Degree								
2015-2019	13	54.2	2	16.7	11	91.7		
2010-2014	4	16.7	3	25	1	8.3		
2005-2010	3	12.5	3	25	0	0		
2000-2005	0	0	0	0	0	0		
1995-2000	2	8.3	2	16.7	0	0		
1990-1995	2	8.3	2	16.7	0	0		
1985-1990	0	0	0	0	0	0		
1980-1985	0	0	0	0	0	0		
1980 or earlier	0	0	0	0	0	0		

Type of Teacher 1						
In-service	12	50	12	100	0	0
Pre-service	12	50	0	0	12	100
Other	0	0	0	0	0	0
Type of Teacher 2						
Elementary	12	50	12	100	0	0
Secondary	0	0	0	0	0	0
Student	12	50	0	0	12	100
Other	0	0	0	0	0	0
Both (Elem & Sec)	0	0	0	0	0	0
Type of Teacher 3						
General Ed.	7	29.2	7	58.3	0	0
Special Ed.	2	8.3	2	16.7	0	0
Student	12	50	0	0	12	100
Other	0	0	0	0	0	0
Both (Gen & Spec)	3	12.5	3	25	0	0
Years in Profession						
0-5	14	58.3	2	16.7	12	100
6-10	3	12.5	3	25	0	0
11-15	3	12.5	3	25	0	0
16-20	0	0	0	0	0	0
21-30	4	16.7	4	33.3	0	0
31+	0	0	0	0	0	0
Population						
General Ed	1	4.2	0	0	1	8.3
Gen Ed+Mild Spec Ed	1	4.2	1	8.3	0	0
Gen Ed+Severe Spec Ed	6	25	3	25	3	25
Special EdOnly-Mild	0	0	0	0	0	0
Special Ed Only-Severe	6	25	2	16.7	4	33.3
All of the Above	10	41.7	6	50	4	33.3
Setting						
Gen Ed	6	25	4	33.3	2	16.7
Special Ed	9	37.5	6	50	3	25
Special Ed 2	9	37.5	2	16.7	7	58.3
Other	0	0	0	0	0	0
Expectation to Collect data						
Yes	16	66.7	11	91.7	5	41.7
No	4	16.7	0	0	4	33.3
I'm not sure	4	16.7	1	8.3	3	25

Frequency of Data Collection						
Daily	4	16.7	4	33.3	0	0
2-3 times a week	3	12.5	3	25	0	0
Once a week	2	8.3	0	0	2	16.7
Every other week	2	8.3	1	8.3	1	8.3
Once a month	0	0	0	0	0	0
Never	4	16.7	0	0	4	33.3
Other	9	37.5	4	33.3	5	41.7
College Course Training						
Yes	13	54.2	4	33.3	9	75
No	9	37.5	6	50	3	25
I don't remember	2	8.3	2	16.7	0	0
Number of Courses						
0	0	0	0	0	0	0
1-2	7	53.8	2	16.7	5	41.7
3-5	6	46.2	2	16.7	4	33.3
6+	0	0	0	0	0	0
Out of District Training						
Yes	3	12.5	1	8.3	2	16.7
No	20	83.3	11	91.7	9	75
I don't remember	1	4.2	0	0	1	8.3
In District Training						
Yes	8	33.3	6	50	2	16.7
No	14	58.3	5	41.7	9	75
I don't remember	2	8.3	1	8.3	1	8.3

Results by Research Question

Research Question 1

"To what extent do teachers (i.e., pre-service and in-service) interpret and apply data to inform decisions (e.g. read the data, read between, behind, and beyond the data) using behavioral graphs prior to the CIA-GBD intervention?" Means, standard deviations, and qualitative labels overall and for each of the domains (Read the Data, Read Between the Data, Read Beyond the Data, Read Behind the Data) can be found in Tables 8 & 9.

Total mean scores indicated that respondents were *somewhat able* (*M* = 7.2, *SD* = 1.88) to read, interpret, and apply the data without additional training although there was variance in the data. None of the 125 participants were *unable* to read, interpret, and apply the data, 3 participants (2.4%) were *minimally able*, 62 participants (49.6%) were *somewhat able*, 60 participants (48%) were *almost able*, and 0 participants (0%) were *entirely able* to read, interpret, and apply the data.

Mean scores from the Read the Data domain indicated that respondents in both the survey only and survey and workshop groups were *somewhat able* (*M* = 2.02, *SD* = 0.58) to read the data with all scores being fairly close to the mean. Specifically, 2 participants (1.6%) were *unable* to read the data, 14 participants (11.2%) were *minimally able*, 89 participants (71.2%) were *somewhat able*, and 20 participants (15.5%) were *entirely able*.

Mean scores from the Read Between the Data domain indicated that respondents in both the survey only and survey and workshop groups were between *minimally able* and *somewhat able* (*M* = 1.54, *SD* = 0.72) to read between the data with all scores being fairly close to the mean. Specifically, 10 participants (8%) were *unable* to read between the data, 44 participants (35.2%) were *minimally able*, 64 participants (51.2%) were *somewhat able*, and 7 participants (5.6%) were *entirely able*.

Mean scores from the Read Beyond the Data domain indicated that respondents were *somewhat able* (*M* = 2.26, *SD* = 0.82) to read beyond the data although there was some variance in the data. Specifically, 2 participants (1.6%) were *unable* to read beyond the data, 24 participants (19.2%) were *minimally able*, 39 participants (31.2%) were *somewhat able*, and 60 participants (48%) were *entirely able*.

Mean scores from the Read Behind the Data domain indicated that respondents were

minimally able (*M* = 1.41, *SD* = 0.61) to read behind the data with all scores being fairly close to the mean. Specifically, 8 participants (6.4%) were *unable* to read behind the data, 58 participants (46.4%) were *minimally able*, 59 participants (47.2%) were *somewhat able*, and 0 participants (0%) were *entirely able*.

Table 8
Means and SDs by Group per Outcome

	Total	Survey Only	Survey and Workshop Group	
Variables	Pre-Survey	Pre-Survey	Pre-Survey	Post-Survey
Total	7.22 (1.88)	7.29 (1.91)	6.96 (1.71)	7.91 (1.59)
Read the Data	2.02 (0.58)	2.05 (0.62)	1.88 (0.34)	2.17 (0.49)
Read Between	1.54 (0.72)	1.57 (0.74)	1.42 (0.65)	2.00 (0.74)
Read Beyond	2.26 (0.82)	2.26 (0.82)	2.25 (0.85)	2.39 (0.72)
Read Behind	1.41 (0.61)	1.41 (0.60)	1.42 (0.65)	1.35 (0.57)

Note. The ranges of the means represent the following qualitative labels for total score: 0 = Not able, 1-3 = Minimally Able, 4-7 = Somewhat able, 8-11= Almost able, and 12 = Entirely able. The ranges of the means represent the following qualitative labels for read the data, read between the data, beyond the data, and behind the data: 0 = Not able, 1 = Minimally Able, 2 = Somewhat able, and 3 = Entirely able.

Table 9
Qualitative Scores on Teacher ability to Interpret and Apply Behavioral Data per dependent variable

Dependent Variable	Qualitative Scores	Total	Survey Only	Survey and Workshop
Teacher overall ability to interpret graphed behavioral data	Not able	0%	0%	0%
	Minimally able	2.4%	3%	0%
	Somewhat able	49.6%	48.5%	54.2%
	Almost able	48%	48.5%	45.8%
	Entirely able	0%	0%	0%
Teacher ability to read the data	Not able	1.6%	2%	0%
	Somewhat able	11.2%	10.9%	12.5%
	Almost able	71.2%	67.3%	87.5%
	Entirely able	15.5%	19.8%	0%
Teacher ability to read between the data	Not able	8%	8.9%	4.2%
	Somewhat able	35.2%	35.2%	54.2%
	Almost able	51.2%	54.5%	37.5%
	Entirely able	5.6%	5.9%	4.2%
Teacher ability to read beyond the data	Not able	1.6%	2%	0%
	Somewhat able	19.2%	17.8%	25%
	Almost able	31.2%	32.7%	25%
	Entirely able	48%	47.5%	50%
Teacher ability to read behind the data	Not able	6.4%	5.9%	8.3%
	Somewhat able	46.4%	47.5%	41.7%
	Almost able	47.2%	46.5%	50%
	Entirely able	0%	0%	0%

Note. This table illustrates the percentage of participants in each group (i.e. overall, survey only, survey and workshop group) scoring in the various qualitative categories for each behavioral graph interpretation skill (i.e., overall ability, read the data, read between the data, read beyond the data, and read behind the data).

Research Question 2

"What malleable factors (i.e., prior training, setting, expectation to collect data) predict pre-service and in-service teacher ability to interpret and apply graphed behavioral data prior to the CIA-GBD intervention?"

Results of the multiple regression analysis (see Table 10) indicated that the model with three predictors (i.e., [1] training; [2] expectation to collect data; [3] setting) was not statistically

significant and explained 8.1% of the variance (R^2 = .081, $F(6,96) = 1.411$, p = .218).

Table 10
Multiple Regression Analysis of Predictors on Total Score

	Unstandardized Coefficients(β)	*SE*	*t*	*p*	95.0% CI	
					Lower	Upper
Training						
Some	1.446	.955	1.514	.133	-.450	3.342
Minimal	.002	.832	.002	.998	-1.650	1.654
None	.692	.865	.801	.425	-1.024	2.409
Setting						
Gen Ed.	.035	.526	.066	.948	-1.010	1.079
Min Spec Ed.	.406	.463	.877	.383	-.513	1.326
Expectation to Collect and Interpret Behavioral Data	.011	.272	.039	.969	-.530	.551

Note. (R^2 = .081, $F(6,96) = 1.411$, p = .218). Levels of predictors not entered (e.g. maximum amount of training, maximum intensity special education setting).

Research Question 3

"What is the effect of the CIA-GBD intervention on pre-service and in-service teacher: (a) overall ability to interpret and apply graphed behavioral data; (b) to read the data; (c) read between the data; (d) read beyond the data; and (e) read behind the data? Was there a difference of effects between pre-service and in-service teachers?"

Total Score. Results of the paired samples t-test (see Table 11) comparing pre (M = 7.00, SD = 1.73) and post (M = 7.91, SD = 1.59) scores for all CIA-GBD participants (i.e., pre-service and in-service teachers) indicated a statistically significant difference with a moderate effect, $t(22) = -2.29$, p = .031, d = -0 .55, indicating that the training increased teacher ability to interpret and apply behavioral graphed data and demonstrated a decrease in variance in the data after intervention.

Results of the repeated measures ANOVA (see Table 12) comparing the differential effect of time x group for CIA-GBD on pre-service and in-service teacher ability to interpret and apply graphed behavioral data (i.e., total score) did not indicate a statistically significant interaction effect, Wilks' Lambda = .964 $F(1, 21) = .777$, $p = .388$, $\eta_p^2 = .036$.

Read the data. Results of the paired samples t-test comparing pre-survey ($M = 1.87$, $SD = 0.34$) and post-survey ($M = 2.17$, $SD = 0.49$) scores for all CIA-GBD participants (i.e., pre-service and in-service teachers) with an increase in variance after intervention indicated a statistically significant difference with a large effect, $t(22) = -2.61$, $p = .016$, $d = 3.48$.

Results of the repeated measures ANOVA comparing the differential effect of time x group for CIA-GBD on pre-service and in-service teacher ability to read the data did not indicate a statistically significant interaction effect, Wilks' Lambda = .931 $F(1, 21) = 1.562$, $p = .225$, $\eta_p^2 = .069$.

Read between the data. Results of the paired samples t-test comparing pre-survey ($M = 1.43$, $SD = 0.66$) and post-survey ($M = 2.00$, $SD = 0.74$) scores for all CIA-GBD participants (i.e., pre-service and in-service teachers) with an increase in variance after intervention indicated a statistically significant difference with a large effect, $t(22) = 2.87$, $p = .009$, $d = 3.93$.

Results of the repeated measures ANOVA comparing the differential effect of time x group for CIA-GBD on pre-service and in-service teacher ability to read between the data did not indicate a statistically significant interaction effect, Wilks' Lambda = .842 $F(1, 21) = 3.932$, $p = .061$, $\eta_p^2 = .158$.

Read beyond. Results of the paired samples t-test comparing pre ($M = 2.30$, $SD = 0.82$) and post ($M = 2.39$, $SD = 0.72$) scores for all CIA-GBD participants (i.e., pre-service and in-

service teachers) with a decrease in variance after intervention did not indicate a statistically significant difference, $t(22) = -5.26$, $p = 0.604$, $d = -0.56$.

Results of the repeated measures ANOVA comparing the differential effect of time x group for CIA-GBD on pre-service and in-service teacher ability to read beyond the data did not indicate a statistically significant interaction effect, Wilks' Lambda = .988 $F(1, 21) = .245$, $p = .626$, $\eta_p^2 = .012$.

Read behind the data. Results of the paired samples t-test comparing pre ($M = 1.39$, $SD = 0.66$) and post ($M = 1.35$, $SD = 0.57$) scores for all CIA-GBD participants (i.e., pre-service and in-service teachers) with a decrease in variance after intervention did not indicate a statistically significant difference with a small effect, $t(22) = 0.295$, $p = .770$, $d = 0.31$.

Table 11
Paired Samples T-Test on Total Score of Teacher Ability

		Pre-workshop Survey		*Post-Workshop Survey*				
Variable	*n*	*M*	*SD*	*M*	*SD*	*Mean difference*	*t*	*p*
Total score	23	7.00	1.73	7.91	1.59	-.913	-2.299	.031*
Read the Data	23	1.87	0.34	2.17	0.49	-.304	-2.61	.016*
Read Between the Data	23	1.43	0.66	2.00	0.74	-.565	-2.87	.009*
Read Beyond the Data	23	2.30	0.82	2.39	0.72	-.087	-5.26	.604
Read Behind the Data	23	1.39	0.66	1.35	0.57	.043	.295	.770

Note. * represents a statistically significant difference with p value ≤ 0.05.

Results of the repeated measures ANOVA comparing the differential effect of time x group for CIA-GBD on pre-service and in-service teacher ability to read behind the data did not indicate a statistically significant interaction effect, Wilks' Lambda = .996 $F(1, 21) = .091$, $p =$

.765, $\eta_p^2 = .004$.

Table 12
ANOVA on Total scores of Teacher Ability

Variable	*F (df)*	*p*	η_p^2
Total score	.777 (1, 21)	.388	.036
Read the Data	1.562 (1, 21)	.225	.069
Read Between the data	3.932 (1, 21)	.061	.158
Read Beyond the data	.245 (1, 21)	.626	.012
Read Behind the data	.091 (1, 21)	.765	.004

Research Question 4

"What factors influence pre-service and in-service teacher confidence to interpret and apply graphed behavioral data in classrooms prior to the CIA-GBD intervention?"

Confidence. Results of the multiple regression analysis (see Table 13) indicated that the model was statistically significant and explained 22.5% of the variance ($R^2 = .225$, $F(6,96) = 4.643$, $p < .001$). Specifically, results indicated that teachers who received no prior training (i.e., college courses, district training, and/or out of district training) in interpreting behavioral data ($M = 4.64$, $SD = 1.28$) with some variance in the data was a statistically significant predictor ($\beta = -1.40$, $p = .014$) of confidence when compared with teachers receiving the maximum training in college courses, district trainings, and out of district trainings ($M = 6.33$, $SD = 1.51$) with some variance in the data.

Table 13
Multiple Regression Analysis of Predictors on Teacher Confidence to Interpret and Apply Behavioral Data

	Unstandardized Coefficients(β)	*SE*	*t*	*p*	95.0% CI	
					Lower	Upper
Training						
Some	-.018	.618	-.029	.977	-1.244	1.209
Minimal	-.800	.539	-1.486	.141	-1.869	.269
None	-1.404	.560	-2.510	.014*	-2.515	-.294
Setting						
Gen Ed.	-.298	.340	-.874	.384	-.974	.378
Min Spec Ed.	-.028	.300	-.094	.925	-.623	.567
Expectation to Collect and Interpret Behavioral Data	-.363	.176	-2.059	.042*	-.713	-.013

Note. (R^2 = .225, $F(6,96) = 4.643$, $p < .001$). * represents a statistically significant difference with p value <_0.05. Levels of predictors not entered (e.g. maximum amount of training, maximum intensity special education setting).

Research Question 5

"What factors influence pre-service and in-service teacher willingness to interpret and apply graphed behavioral data in classrooms prior to the CIA-GBD intervention?"

Willingness. Results of the multiple regression analysis (see Table 14) indicated that the model and individual predictors were not statistically significant and explained 7.1% of the variance (R^2 = .071, $F(6,96) = 1.219$, p = .303).

Table 14
Multiple Regression Analysis of Predictors on Teacher Willingness to Interpret and Apply Behavioral Data

	Unstandardized Coefficients(β)	*SE*	*t*	*p*	95.0% CI	
					Lower	Upper
Training						
Some	-.054	.898	-.060	.952	-1.836	1.728
Minimal	-.612	.782	-.782	.436	-2.165	.941
None	-.577	.813	-.709	.480	-2.190	1.037
Setting						
Gen Ed.	.565	.495	1.143	.256	-.417	1.547
Min Spec Ed.	-.084	.436	-.194	.847	-.949	.780
Expectation to Collect and Interpret Behavioral Data	-.487	.256	-1.900	.060	-.995	.022

Note. (R^2 = .071, F(6,96) = 1.219, p = .303). Levels of predictors not entered (e.g. maximum amount of training, maximum intensity special education setting).

Research Question 6

"What factors influence pre-service and in-service teacher perceived usefulness of interpreting and applying graphed behavioral data in classrooms prior to the CIA-GBD intervention?"

Usefulness. Results of the multiple regression analysis (see Table 15) indicated that the model was not statistically significant and explained 1.9% of the variance (R^2 = .019, F(6, 96) = .303, p = .934).

Table 15
Multiple Regression Analysis of Predictors on Teacher Perceived Usefulness in Interpreting and Applying Behavioral Data

	Unstandardized Coefficients(β)	*SE*	*t*	*p*	95.0% CI	
					Lower	Upper
Training						
Some	-.269	.836	-.321	.749	-1.928	1.391
Minimal	.311	.729	.427	.670	-1.135	1.758
None	.239	.757	.316	.752	-1.263	1.742
Setting						
Gen Ed.	.097	.461	.210	.835	-.818	1.011
Min Spec Ed.	-.223	.406	-.550	.583	-1.028	.582
Expectation to Collect and Interpret Behavioral Data	.000	.238	.002	.999	-.473	.474

Note. (R^2 = .019, $F(6, 96)$ = .303, p = .934). Levels of predictors not entered (e.g. maximum amount of training, maximum intensity special education setting).

Research Question 7

"Does the CIA-GBD intervention increase teacher confidence, willingness, and perceived usefulness in interpreting and applying graphed behavioral data to make decisions? Was there a difference of effects between in-service and pre-service teachers?" (See Table 16).

Table 16
Means and SDs by Group per Outcome

	Total	Survey Only	Survey and Workshop Group	
Variables	Pre-Survey	Pre-Survey	Pre-Survey	Post-Survey
Confidence	5.22 (1.36)	5.29 (1.40)	4.92 (1.14)	6.50 (1.67)
Willingness	5.71 (1.75)	5.80 (1.73)	5.33 (1.83)	6.88 (1.78)
Usefulness	10.15 (1.60)	10.01 (1.66)	10.75 (1.11)	10.58 (2.54)

Confidence. Results of the paired samples t-test (see Table 17) comparing pre (M = 4.92, SD = 1.14) and post (M = 6.50, SD = 1.67) scores for all CIA-GBD participants (i.e., pre-service and in-service teachers) with an increase in variance after intervention indicated a statistically significant difference with a large effect, $t(23) = -4.452$, $p < .001$, $d = -1.11$.

Results of the repeated measures ANOVA (see Table 18) comparing the differential effect of time x group for CIA-GBD on pre-service and in-service teacher perceived confidence to interpret and apply graphed behavioral data (i.e., total confidence score) did not indicate a statistically significant interaction effect, Wilks' Lambda = .990 $F(1, 22) = .212$, $p = .650$, $\eta_p^2 = .010$.

Willingness. Results of the paired samples t-test (see Table 17) comparing pre (M = 5.33, SD = 1.83) and post (M = 6.88, SD = 1.78) scores for all CIA-GBD participants (i.e., pre-service and in-service teachers) with a decrease in variance after intervention did not indicate a statistically significant difference with a large effect, $t(23) = -2.998$, $p = .901$, $d = -0.86$.

Results of the repeated measures ANOVA (see Table 18) comparing the differential effect of time x group for CIA-GBD on pre-service and in-service teacher perceived willingness to interpret and apply graphed behavioral data (i.e., total willingness score) indicated a statistically significant interaction effect, Wilks' Lambda = .792 $F(1, 22) = 5.782$, $p = .025$, $\eta_p^2 = .208$ with pre-service teachers rating more willingness and less variance in responses (M = 7.08, SD = 1.08) than in-service teachers rating less willingness and more variances in responses (M = 6.67, SD = 2.31).

Usefulness. Results of the paired samples t-test (see Table 17) comparing pre (M = 10.75, SD = 1.11) and post (M = 10.58, SD =2.54) scores for all CIA-GBD participants (i.e., pre-service

and in-service teachers) with an increase in variance after intervention did not indicate a statistically significant difference with a small effect, $t(23)=.306$, $p = .762$, $d = 0.09$.

Results of the repeated measures ANOVA (see Table 18) comparing the differential effect of time x group for CIA-GBD on pre-service and in-service teacher perceived usefulness to interpret and apply graphed behavioral data (i.e., total usefulness score) did not indicate a statistically significant interaction effect, Wilks' Lambda = .950 $F(1, 22) = 1.158$, $p = .294$, $\eta_p^2 = .050$.

Table 17
Paired Samples T-test on Total Score of Confidence, Willingness, and Usefulness

		Pre-workshop Survey		*Post-Workshop Survey*		*Mean difference*		
Variable	*n*	*M*	*SD*	*M*	*SD*		*t*	*p*
Confidence	23	4.92	1.14	6.50	1.67	-1.58	-4.452	<.001*
Willingness	23	5.33	1.83	6.88	1.78	-1.54	-2.998	.006*
Usefulness	23	10.75	1.11	10.58	2.54	.166	.306	.762

Note. * represents a statistically significant difference with p value < 0.05.

Table 18
ANOVA on Total Scores of Confidence, Willingness, and Perceived Usefulness

Variable	*F (df)*	*p*	η_p^2
Confidence	0.212 (1, 22)	.650	.010
Willingness	5.782 (1, 22)	.025*	.208
Usefulness	1.158 (1, 22)	.294	.050

Note. * represents a statistically significant difference with p value < 0.05.

CHAPTER V

DISCUSSION

Behavioral data interpretation and application is an important first step in interrupting the negative trajectory of students with and at risk of HID. Teachers must utilize data, especially throughout the RTI process, in order to determine student progress and adjust classroom decisions, instruction, and interventions accordingly. Very limited research has evaluated teacher ability, confidence, willingness, and perceived usefulness of data interpretation in typical classroom settings. The current study contributes to that body of literature as the aim was to explore teachers' ability to visually inspect behavioral graphs, interpret, and apply their knowledge of data to inform decisions regarding instruction and student interventions before and after training. In addition to the primary goal, factors influencing teacher ability, confidence, willingness, and perceived usefulness to interpret and apply graphed behavioral data to decisions was explored. This chapter reviews the hypotheses and results per research question with reference to prior literature. Finally, this chapter concludes with limitations, future research suggestions, and implications.

Ability Prior to Intervention

Results support my original hypothesis that teachers would have difficulty interpreting the graphed behavioral data and applying that information to intervention selection without the CIA-GBD intervention. Similar to the findings of Van den Bosch et al. (2017), in-service teachers were able to read the data somewhat accurately. However, similar to the findings of studies focusing on teacher use of graphed academic data (Fuchs et al., 1994; Fuchs et al., 1991; Van den Bosch et al., 2017; Zeuch et al., 2017) and behavioral data (Fisher et al., 2003; Hagopian et al., 1997; Keohane & Greer, 2005; Maffei-Almodovar et al., 2017), teachers in this

dissertation study struggled to interpret and use graphed behavioral data to make decisions. They were particularly challenged when asked to read between the data to determine if the behavior was improving or getting worse and to read behind the data to select an intervention. Further, when provided with insufficient information, teachers attempted to make a decision instead of indicating that they needed more information. As such, it is clear that teachers are able to extract very basic information from a graph, such as the number of disruptive behaviors demonstrated on each day; however, they do not know what to do with this information.

This is an important finding as teachers must be able to use behavioral information to make decisions. For example, within the context of RTI, teachers need to be able to interpret daily behavioral data in order to make decisions to either continue with similar instruction or make changes to their instruction, based on student behavioral data. More specifically, if the target behavior for a student was on-task and the teacher noticed that the student was on-task for approximately 80% of the time one day in comparison to 20% on a typical day, the teacher should identify factors that may have contributed to the increase in on-task behavior. The teacher may investigate the type of instruction, prompting, grouping, or type of tasks that were utilized the day when the student was on-task in order to plan similar instruction. If the teacher realized that she prompted the student with visuals prior to the lesson, she would make a decision to add visual prompting and monitor student progress. The benefits of these daily decisions within RTI are numerous and cannot be overstated as they can prevent an unnecessary referral to special education.

This was the first study to attempt to uncover factors that influence teacher ability to interpret and apply graphed behavioral data. Understanding these factors is important when developing a training to increase ability. Unfortunately, the model of predictors selected in this

dissertation did not influence teacher ability. Prior to the study, I hypothesized that teachers in special education settings who were trained and were expected to collect behavioral data by district administrators would be more able to interpret and apply graphed behavioral data to decisions. I formed this hypothesis as teachers in more intensive special education settings would be expected to have specialized training and college courses designed to teach them skills needed to work with students with HID. Special education teachers in these settings are taught a variety of evidence-based interventions for individuals with particular academic and behavioral challenges. It is possible that my hypothesis was incorrect, due to the time between the prior training and their completion of this survey. If teachers were taught to use data accurately, but were not using the skill appropriately within the RTI process, then it is likely that they became less able. Another explanation might be related to the current state of education. More and more discussion and emphasis are being placed on data, for all teachers and not just those who teach students who are struggling. As such, it is possible that my hypothesis is becoming outdated with this shift in practice.

Regardless, it is important for universities and school districts to incorporate more intensive training within college courses and district workshops with particular focus on application and in vivo coaching support. For example, training should focus on the use of behavioral skills training, which was utilized in this study because the results demonstrated an increase in behavioral data interpretation skills; however, due to the continued struggle with applying the data to inform decisions, results from this study reveal that a longer training with one-on-one support may be warranted.

Ability after Intervention

Teachers who participated in the CIA-GBD intervention were more able to read the data, read between the data, and read beyond the data after the training. Teachers in the intervention learned to determine if a behavior was improving or getting worse and to decide when an intervention should remain the same or be changed based on visual inspection of the graph. These results demonstrate that my hypothesis was correct as teachers improved in all aspects of behavioral data interpretation and application except for reading behind the data. This was fortunate as these decisions are vital within the RTI process. These results are the first to evaluate teacher ability to interpret and apply graphed behavioral data. Results are similar to findings found with academic data (Van den Bosch et al., 2017) and behavioral data collected within the context of FABI (Johl et al., 2016; Lane et al., 2015) and ABA intensive settings (Keohane and Greer, 2005; Maffei-Almodovar et al., 2017).

Unfortunately, similar to struggles teachers had before the CIA-GBD training, they continued to be challenged to read behind the data after the training. This finding is similar to the findings of Van den Bosch et al. (2017), Fuchs, et al. (1994), and Förster, Kawohl, and Souvignier (2018). As such, it is clear that teachers find it difficult to determine if they have sufficient information to make a decision and which intervention should be selected to meet the students' needs. It is possible that this is caused by a lack of knowledge outside of graph interpretation. It requires specialized knowledge of appropriate behavioral interventions that are not always taught to a wide range of teachers. Within the context of RTI, this is an important skill and effort should be made to help teachers acquire this skill to prevent the probability of impacting the negative outcomes described in chapter one of this dissertation. One possible cause of this is insufficient training. Training here was only provided on three occasions for 30 minutes

each. It is possible that this indicates the need for longer training. In addition, it is possible that teachers need continued coaching after the initial training. However, decisions made about selecting the intensity of interventions and thus moving through tiers is often a decision made by a team of individuals. As such, it would be beneficial for teachers to have this knowledge, but may not be necessary.

In addition, results here indicated no difference in the benefits of the training between pre-service and in-service teachers. As in studies with academic data (Zeuch et al., 2017), both pre-service and in-service teachers learned equally well.

Confidence, Willingness, and Perceived Usefulness Prior to Training

Prior to training, teachers reported moderate rates of confidence in their ability to interpret and apply graphed behavioral data and willingness to use behavioral data. In addition, they reported that behavioral data was useful. It is doubtful that this finding would have occurred prior to the passage of legal mandates and the current educational climate that has placed emphasis on data-based decision making.

Confidence in ability is important as it can potentially lead to overall effectiveness. As such, it was important to understand factors that influence teacher confidence in this area. As I hypothesized, teachers who had no prior training were less confident than teachers who had prior training. However, I was surprised that this was the only factor that influenced teacher confidence. It is confusing that special education teachers in more intensive behavioral settings with an expectation to collect behavioral data did not report more confidence as it would be assumed that they utilized behavioral data more frequently.

I was equally surprised that none of the variables predicted teacher willingness. For example, I was initially surprised that there was not a statistically significant difference in reports

of willingness by special education teachers working in more intensive behavioral settings with students with disabilities than those working in general education settings. I would expect them to be more willing to utilize behavioral data to inform their classroom decisions. However, on the contrary, it may be that teachers who work with students with disabilities in intensive behavioral settings understand all of the challenges that are encountered when collecting, interpreting, and analyzing behavioral data to inform their decisions. Therefore, their understanding of the challenges may have influenced their willingness.

Similarly, no factors influenced perceived usefulness. Again, I hypothesized that special education teachers working in more intensive behavioral settings with students with disabilities than those working in general education settings with an expectation to collect data would find behavioral data more useful. However, my hypothesis was incorrect. This may be due to high ratings across all individuals for perceived usefulness.

Confidence, Willingness, and Perceived Usefulness after Training

In addition to findings in this dissertation that indicated the CIA-GBD intervention increased teacher ability to interpret and apply behavioral data, the intervention also resulted in increases in teacher confidence in their ability to use behavioral data. This result was similar to findings of Lane et al. (2015) and Johl et al. (2016) as teacher confidence increased after training in both studies.

Further, in the current dissertation, I found that teacher willingness to use data increased after training. This result is important, and encouraging, as willingness is an important factor in implementation of these behavioral data interpretation and decision-making skills. Although both confidence and willingness increased after the intervention, training did not impact teacher

perception of usefulness. It is probable that this is a result of teachers' perceiving behavioral data use as very high prior to the intervention.

In summary, confidence, willingness, and usefulness are essential to effective RTI practices and student outcomes. Similar to findings of Lane et al. (2015) and Johl et al. (2016), participants demonstrated larger increases in their confidence when compared to willingness and usefulness and the smallest difference in in the area of perceived usefulness. Teachers may be confident in their abilities and find behavioral data useful; however, if they are unwilling to utilize these skills it is unlikely that they will use behavioral data effectively.

Limitations to the Study

There were several variables that may limit the generalizability and interpretation of this study. The first limitation is that participants who chose to participate in the survey and/or workshop may be biased due to their interest level in the topic and may have more knowledge than the typical teacher population. In addition, response bias may have been an issue as participants may have responded in a way that was viewed as favorable and socially acceptable. Furthermore, the results from the survey may not generalize as respondents were all from New Jersey and Pennsylvania. Similarly, participants included in the intervention were from limited settings, which may limit the generalizability. For example, the in-service teachers were all from one participating school district and the pre-service teachers were from universities in New Jersey in their field experience.

Future Research

As a result of information gleaned from this study and the increasing demand on teachers to collect, interpret, and apply behavioral data to inform decisions within the RTI process, it is essential that future research continues to investigate this area of study. As this is one of the first

studies to explore teacher interpretation and application of behavioral data, future studies should further explore the findings here. In addition, studies should explore methods of increasing teacher ability to interpret and apply graphed behavioral data to decisions potentially through the use of individual coaching/consulting in vivo in addition to the 3-series workshop. Further, providing hints on the survey similar to studies in the academic component of the literature review should be explored. Considering social validity of any study is important and determining teacher beliefs and opinions about the intervention could be beneficial in making appropriate adjustments/revisions to the intervention. Lastly, procedural fidelity is essential when collecting behavioral data and implementing student interventions and should be explored in future studies to ensure teachers are effectively implementing the procedures in the classroom.

Implications

Results from this dissertation have implications that could be of interest to teachers, administrators, superintendents, and university professors. It is important to note teacher ability to interpret and apply behavioral data prior to the intervention in this study as demonstrated on the pre-intervention survey. The results on the pre-intervention survey demonstrated that teachers can read the data and read beyond the data somewhat accurately prior to training, but they struggled to read between the data and read behind the data. The main conclusion that can be drawn from the results of this study is that after a 3-series behavior analytic training, teachers improved in their ability to identify percentages of data points, determine if a behavior is improving or getting worse, and if an intervention should be continued or discontinued by visual inspection of graphed data; however, teachers continued to struggle to select an appropriate intervention with the information given even after the training, indicating that more intensive training needs to be implemented and possible in vivo coaching into individual cases. In

addition, training was a significant predictor of teacher confidence to interpret and apply graphed behavioral data to inform decisions, which may be an important consideration for university education programs and school districts to include these topics more in depth in education courses and workshops as teachers who are more confident in their abilities may be more willing to put behavioral interpretation and application skills into practice. Another main conclusion is that training increased teacher confidence and willingness to interpret and apply behavioral data to inform decisions in the classroom; however, teachers maintained their belief that use of behavioral data to inform instruction and student intervention was useful. It is important to note that although these findings are important to the field of education, it is essential to acknowledge that teacher ability, confidence, willingness, and perceived usefulness is only one component to a larger and more complex process, including administrator buy in, procedural fidelity, and student outcomes. Without administrator buy in there may not be a push for teachers to utilize these skills. Without procedural fidelity teachers may collect data, but may not be effective in making necessary decisions because they are not following proper procedures. Lastly, and most importantly, the ultimate purpose for collecting, interpreting, and applying graphed behavioral data to inform decisions is to increase positive student outcomes, which will be an important consideration as a follow up study.

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Appendix A

Teacher Interpretation and Application of Graphed Behavioral Data (TIA-GBD) Survey

1. Please indicate the type of participation (e.g. survey only or workshop and survey) you will be engaged in for this study. (This will be indicated in the email you received regarding the study).
    a. Survey Only
    b. Survey and Workshop
2. Gender:
    a. Male
    b. Female
    c. Other (please specify)
    d. Prefer not to answer
3. Age
    a. 20 to 25 years old
    b. 26 to 30 years old
    c. 31 to 40 years old
    d. 41 to 50 years old
    e. 51 to 60 years old
    f. 61+ years old
4. Race/Ethnicity (Select all that apply):
    a. Black/African American
    b. Latino/Latina
    c. White/Caucasian
    d. Native American
    e. Asian/Pacific Islander
    f. Other (please specify)
    g. Prefer not to answer
5. What is your highest level of education?
    a. High school diploma
    b. Bachelor's Degree
    c. Master's Degree
    d. Doctorate
6. What is the year of your highest degree earned?
    a. 2015-2019
    b. 2010-2014
    c. 2005-2010
    d. 2000-2005
    e. 1995-2000
    f. 1990-1995
    g. 1985-1990
    h. 1980-1985
    i. 1980 or earlier
7. What position(s) have you held? (Select all that apply):
    a. General education elementary teacher (PK-5)

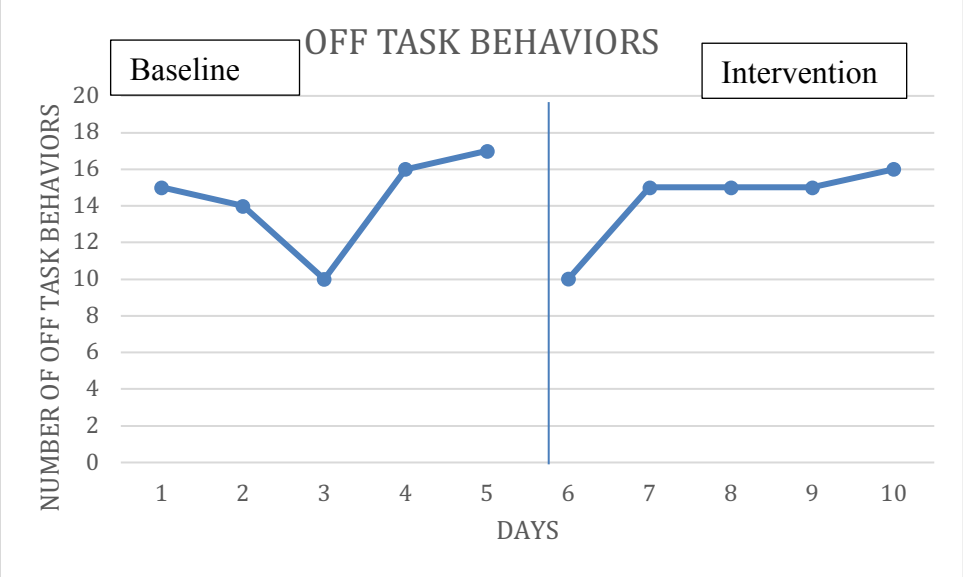
   b. General education secondary teacher (6-12)
   c. Special education elementary teacher (PK-5)
   d. Special education secondary teacher (6-12)
   e. School Counselor
   f. School Psychologist
   g. School Social Worker
   h. Learning Consultant
   i. Behaviorist/BCBA
   j. Administrator
   k. Student
   l. Other (please specify)
8. What subject(s) have you taught? (Select all that apply):
   a. Art
   b. Language Arts
   c. Mathematics
   d. Music
   e. Physical Education
   f. Science
   g. Social Studies
   h. Spanish
   i. Other (please specify)
9. Are you currently working in education?
   a. Yes
   b. No
10. Years in profession
   a. 0-5 years
   b. 6-10 years
   c. 11-15 years
   d. 16-20 years
   e. 21-30 years
   f. 31+ years
11. List your certificates or licenses below.
12. What state are you working in?
13. Select the population of students you have worked with. (Select all that apply):
   a. Students in general education only
   b. Students with Learning Disabilities
   c. Students with ADHD
   d. Students with Emotional and Behavioral Disorders (EBD)
   e. Students with Autism
   f. All of the above
   g. None of the above
   h. Other (please specify)
14. Select the settings in which you have taught (Select all that apply):
   a. General education classroom
   b. Inclusion classroom
   c. Special Education Resource Room

   d. Language Learning Disabled Classroom
   e. Autism Classroom
   f. Multiply Disabled Classroom
   g. Other (Please specify):
15. How would you define behavioral data?
16. Are you expected to collect, interpret, and apply behavioral data to inform your instruction and student interventions in your current position?
   a. Yes
   b. No
   c. I'm not sure
17. How frequently do you collect/use behavioral data?
   a. Daily
   b. 2-3 times a week
   c. Once a week
   d. Every other week
   e. Once a month
   f. Never
   g. Other (please specify)
18. Were you taught to interpret and apply behavioral data to inform your instruction and student interventions in your undergraduate or graduate studies?
   a. Yes
   b. No
   c. I don't remember
19. If selected yes → What college/university did you attend?
   a. Bloomfield College
   b. Caldwell University
   c. Centenary University
   d. College of Saint Elizabeth
   e. Fairleigh Dickinson University
   f. Felician University
   g. Georgian Court University
   h. Kean University
   i. Monmouth University
   j. Montclair State University
   k. New Jersey City University
   l. Rider University
   m. Rutgers University
   n. Saint Peter's University
   o. Seton Hall University
   p. Stockton University
   q. The College of New Jersey
   r. William Paterson University
   s. Other (please specify)
20. Approximately how many courses taught you how to collect, interpret, and apply behavioral data?
   a. 0

b. 1-2
c. 3-5
d. 6+

21. Name the course(s) that you were taught how to collect, interpret, and apply behavioral data to your instruction and student interventions.
22. Were you taught to interpret and apply behavioral data to inform your instruction and student interventions in a workshop outside of your district?
    a. Yes
    b. No
    c. I don't remember
23. Have you had professional development in behavioral data interpretation and application provided by someone in your school district?
    a. Yes
    b. No
    c. I don't remember
24. On a scale of 1-4 (1-being not confident at all and 4- being very confident), rate your *confidence* in your ability to interpret behavioral data to provide information about your students.
25. On a scale of 1-4 (1-being not confident at all and 4- being very confident), rate your *confidence* in your ability to apply behavioral data to inform your instruction and student interventions.
26. On a scale of 1-4 (1-being not willing at all and 4- being very willing), rate your *willingness* to interpret behavioral data in the classroom to provide information about your students.
27. On a scale of 1-4 (1-being not willing at all and 4- being very willing), rate your *willingness* to apply behavioral data to inform your instruction and student interventions.
28. On a scale of 1-4 (1-being not useful at all and 4- being very useful), how *useful* do you believe graphed behavioral data is when planning your instruction?
29. On a scale of 1-4 (1-being not useful at all and 4- being very useful), how *useful* do you believe graphed behavioral data is when selecting student interventions to address problem behavior?
30. On a scale of 1-4 (1-being not useful at all and 4- being very useful), how *useful* do you believe graphed behavioral data is during the Intervention & Referral Services (I&RS) process?

Jason is a second-grade student in a general education classroom. He has no formal diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) or Oppositional Defiant Disorder (ODD); however, the classroom teacher believes she has observed symptoms of distractibility, hyperactivity, impulsivity, and defiance. Jason's main struggle is refusing to comply with teacher directives. During a lesson, Jason talks to his classmates and himself, plays with any object he can find, and tells his teacher "no" when she gives directions. During independent work, he walks around the room, talks to his classmates and himself, and refuses to complete his assignments. His classroom teacher decided to give him a break when he begins to demonstrate any of the behaviors listed above. The graph below illustrates data collected by the teacher on the frequency of off task behaviors per day prior to the breaks being given and frequency of off task behaviors per day after breaks have been given. Please answer the following questions in relation to the graph.



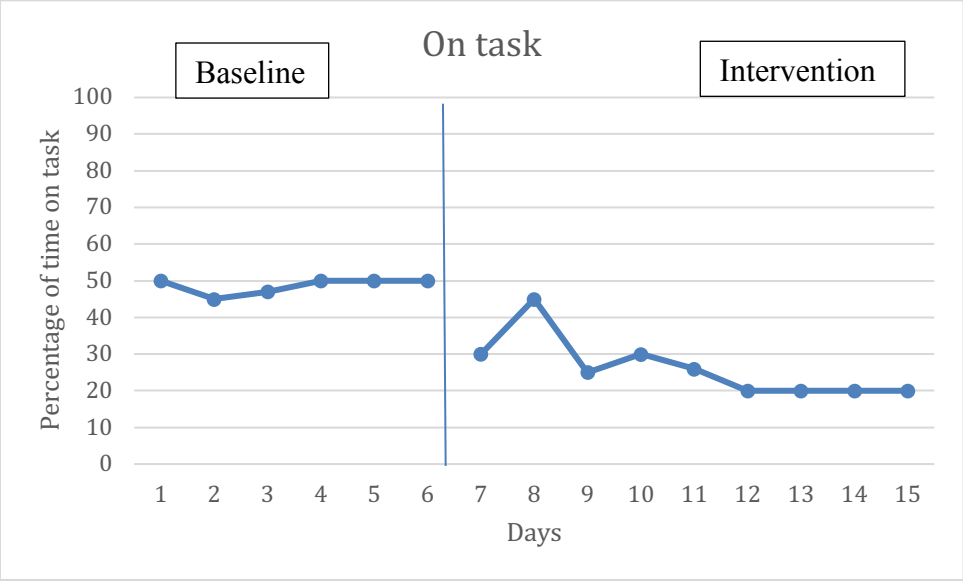
31. Please select the correct response:
a. The behavior got better
b. The behavior instantly improved
c. The behavior got worse
d. The behavior instantly got worse
e. The behavior remained approximately the same

32. Please select the correct response:
a. The intervention should be continued.
b. The intervention should be discontinued because the student made adequate progress.
c. The intervention should be discontinued because the student did not make adequate progress and no further intervention is required.
d. The intervention should be changed and/or another component should be added.

33. What intervention would you select based on this graphed behavioral data?
a. Continue giving him breaks
b. Use a timer to teach him how to self-monitor his compliant behavior
c. Give him extra time to complete his work
d. Do not provide breaks anymore and no further intervention is needed
e. Break the work into smaller chunks
f. Give student time out when he is non-compliant or refuses to complete his work
g. Stay in at recess to complete the work
h. Reward the student for compliant behavior during specific intervals
i. Insufficient information provided (What additional information/assessments should be conducted?).

Maria is a fourth-grade student in a general education classroom. When she is assigned a reading task that involves silently reading and responding in writing to what she read, she remains on task for only a portion of the time and does not complete the assignment. Her teacher decided to give her extra time to complete the task. The graph below illustrates rates of on-task behavior

prior to the extended time and rates of on-task behavior after the extended time was given. Please answer the following questions in relation to the graph.



34. What is the approximate average percent of on task behavior during baseline?
    a. 50%
    b. 49%
    c. 40%

35. What is the approximate average of on task behavior during the intervention phase?
    a. 50%
    b. 40%
    c. 26%

36. Please select the percentage of time on task at the end of the intervention:
a. 50%
b. 30%
c. 20%

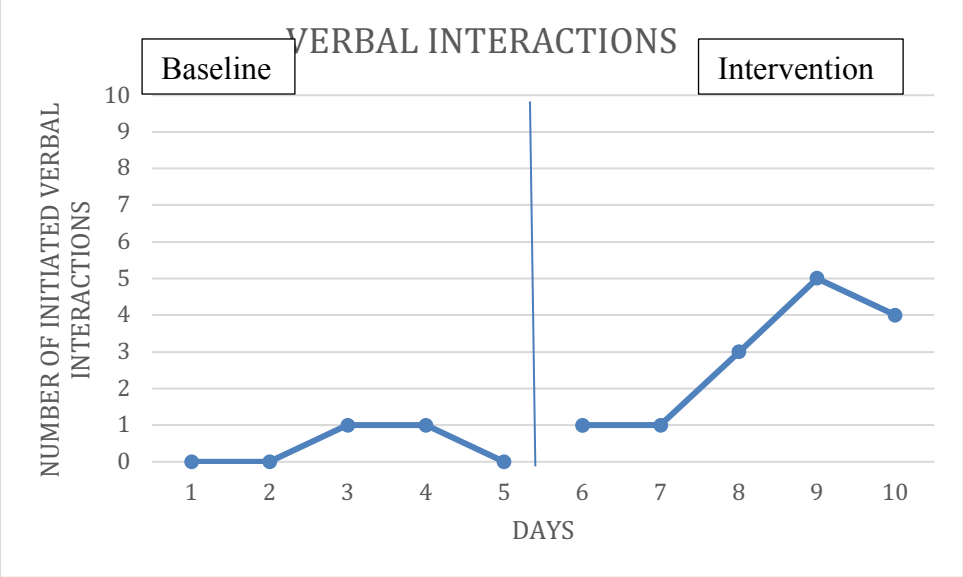
37. Please select the correct response:
a. The behavior got better
b. The behavior instantly improved
c. The behavior got worse
d. The behavior instantly got worse
e. The behavior remained approximately the same

38. Please select the correct response:
a. The intervention should be continued.
b. The intervention should be discontinued because the student made adequate progress.
c. The intervention should be discontinued because the student did not make adequate progress and no further intervention is warranted.

d. The intervention should be changed and/or another component should be added.

39. What intervention would you select based on this graphed behavioral data?
a. Use a timer to teach her how to self-monitor her on task behavior-
b. Provide breaks -
c. Continue with extra time
d. Do not provide extra time anymore and no further intervention is needed
e. Break the writing into smaller chunks
f. Give student time out when she acts out or does not complete her work
g. Stay in at recess to complete the work
h. Reward the student for completed work
i. Insufficient information provided (What additional information/assessments should be conducted?).

Sammy is a 1st grade student in a general education classroom. She has selective mutism. She communicates with her parents at home and sometimes on the playground with her peers, but she will not talk in the classroom. Her classroom teacher decided to give her a token every time she whispered any verbal comment to the teacher or a classmate so she can trade them in for a prize/activity at the end of the day. She began this intervention in hopes that the student would start communicating in the classroom more often. The graph below illustrates the number of verbal interactions prior to the token economy system and number of verbal interactions after the token economy system was implemented. Please answer the following questions in relation to the graph.



40. Please select the correct response:
a. The behavior got better
b. The behavior instantly improved
c. The behavior got worse
d. The behavior instantly got worse
e. The behavior remained approximately the same

41. Please select the correct response:
    a. The intervention should be continued.
    b. The intervention should be discontinued because the student made adequate progress.
    c. The intervention should be discontinued because the student did not make adequate progress.
    d. The intervention should be changed and/or another component should be added.

42. What intervention would you select based on this graphed behavioral data?
    a. Use a timer to self-monitor the frequency of initiated verbal comments
    b. Provide breaks
    c. Continue with the intervention (i.e. token economy)
    d. Do not continue with the intervention and no further intervention is needed
    e. Break the assignment into smaller chunks
    f. Give student time out when she refuses to speak
    g. Stay in at recess to complete the work
    h. Reward the student for initiating verbal interaction during specific intervals
    i. Insufficient information provided (What additional information/assessments should be conducted?).

Appendix B

4 Year New Jersey Universities with Education Programs

Universities Contacted

Bloomfield College

Caldwell University

Centenary University

College of Saint Elizabeth

Fairleigh Dickinson University

Felician University

Georgian Court University

Kean University

Monmouth University

Montclair State University

New Jersey City University

Rider University

Rowan University

Rutgers University

Saint Peter's University

Seton Hall University

Stockton University

The College of NJ

William Paterson University

Appendix C

TITLE OF STUDY: Teacher Interpretation and Application of Graphed Behavioral Data
Principal Investigator: Colleen P. Belmonte, MA, BCBA

PURPOSE:
You are invited to participate in a survey about data interpretation and application of behavioral data. The survey will ask you to interpret behavioral graphs and describe your perceived confidence, usefulness and willingness to use behavioral data to inform your instruction and student interventions. Your answers will help teachers and education researchers further understand the needs of teachers in behavioral data interpretation and application. In addition, your answers will ultimately help develop possible college courses for pre-service teachers and professional development opportunities for in-service teachers. As such, the goal of this survey is to explore teachers' understanding, confidence, and willingness to interpret and apply behavioral data.

PROCEDURES:
Approximately 70 in-service teachers and 70 pre-service teachers will participate in the survey. During this survey, you will be asked a series of questions in the format of multiple choice and open ended. These questions aim to gain knowledge on your perceived knowledge, confidence, usefulness, and willingness to use behavioral data in the classroom. Participation in this survey will take approximately 15-20 minutes.

CONFIDENTIALITY:
You will not provide any identifying information. Your responses will be given a unique participant ID number. Your ID number will be coded and will not be associated with any findings or published results. Information related to your ID will be treated in strict confidence to the extent provided by law.

RISKS AND DISCOMFORTS:
There are no known risks to participating in this study. If for any reason, you feel uncomfortable during the survey please contact Colleen Belmonte at Colleen.Belmonte@gse.rutgers.edu. You can also contact my faculty advisor at Judith.Harrison@gse.rutgers.edu. If you have questions about your rights as a research subject, you can call the IRB Director at: *New Brunswick/Piscataway HealthSci IRB (732)235-9806.* If needed, appropriate professional referrals will be arranged immediately. If you decide you would like to stop taking the survey, you may withdraw your participation at any time.

BENEFITS:
Your responses to this survey, along with those of others, will guide further research and potentially the development of college courses for pre-service teachers and behavioral professional development for in-service teachers. Information gathered from this survey may benefit teachers with students with behavioral difficulties.

COSTS and COMPENSATION:

To participate in this survey, there is no cost; however, there may be compensation. Each participant's email address will be entered into a raffle. Two participants will be randomly selected to win a $50.00 Visa gift card. If you would like to be included in the raffle, email Colleen Belmonte at Colleen.Belmonte@gse.rutgers.edu. In the email, mention that you have completed the survey and provide your email address.

VOLUNTEERING
Your participation is voluntary. Your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw from the interview at any time and all data attributed to you will be withdrawn by the investigator.

SUBJECT STATEMENT:
By clicking on the "I agree" button, I acknowledge that I have read the explanations provided to me. I have had all of my questions answered satisfactorily and I voluntarily agree to participate in this study. Please print out this consent form if you would like a copy of it for your files.

Thank you,
Colleen Belmonte
Doctoral Student
Rutgers, The State University of New Jersey

TITLE OF STUDY: Teacher Interpretation and Application of Graphed Behavioral Data
Principal Investigator: Colleen P. Belmonte, MA, BCBA

PURPOSE:
You are invited to participate in a survey and a workshop about data interpretation of graphed behavioral data. The survey will ask you to interpret behavioral graphs and describe your perceived confidence, usefulness and willingness to use behavioral data to inform your instruction and student interventions. Your answers will help teachers and education researchers further understand the needs of teachers in behavioral data interpretation. In addition, your answers will ultimately help develop possible college courses for pre-service teachers and professional development opportunities for in-service teachers. As such, the goal of this survey is to explore teachers' understanding, confidence, and willingness to interpret and apply behavioral data. In addition, a workshop will be provided that will teach pre-service and in-service teachers how to collect, interpret, and apply behavioral data to inform classroom instruction and student interventions. After the workshop is complete, you will be asked to complete a follow-up survey demonstrating the knowledge that was learned from the workshop. This will help to show the researchers the effectiveness of the workshop on behavioral data collection, interpretation, and application.

PROCEDURES:
Approximately 70 in-service teachers and 70 pre-service teachers will participate in the survey. During this survey, you will be asked a series of questions in the format of multiple choice and open ended. These questions aim to gain knowledge on your perceived understanding, confidence, usefulness, and willingness to use behavioral data in the classroom. Participation in this survey will take approximately 15-20 minutes. In addition, you will be asked to participate in 3 workshop sessions that will be provided to teach educators how to collect, interpret, and apply behavioral data to inform instruction and student intervention. Following the series of workshops, you will complete another survey at the end of the training.

CONFIDENTIALITY:
You will not provide any identifying information. Your responses will be given a unique participant ID number. *PLEASE SAVE THE ID NUMBER YOU HAVE BEEN GIVEN AS YOU WILL NEED IT FOR THE POST-WORKSHOP SURVEY. Your ID number will be coded and will not be associated with any findings or published results. Information related to your ID will be treated in strict confidence to the extent provided by law.

RISKS AND DISCOMFORTS:
There are no known risks to participating in this study. If for any reason, you feel uncomfortable during the survey please contact Colleen Belmonte at Colleen.Belmonte@gse.rutgers.edu. You can also contact my faculty advisor at Judith.Harrison@gse.rutgers.edu. If you have questions about your rights as a research subject, you can call the IRB Director at: *New Brunswick/Piscataway HealthSci IRB (732)235-9806.* If needed, appropriate professional referrals will be arranged immediately. If you decide you would like to stop taking the survey, you may withdraw your participation at any time.

BENEFITS:

Your responses to this survey, along with those of others, will guide further research and potentially the development of college courses for pre-service teachers and behavioral professional development for in-service teachers. Information gathered from this survey may benefit teachers with students with behavioral difficulties.

COSTS and COMPENSATION:
To participate in this survey, there is no cost; however, there may be compensation. Two participants will be randomly selected to win a $50.00 Visa gift card. If you would like to be included in the raffle, email Colleen Belmonte at Colleen.Belmonte@gse.rutgers.edu. In the email, mention that you have completed the survey and provide your email address.

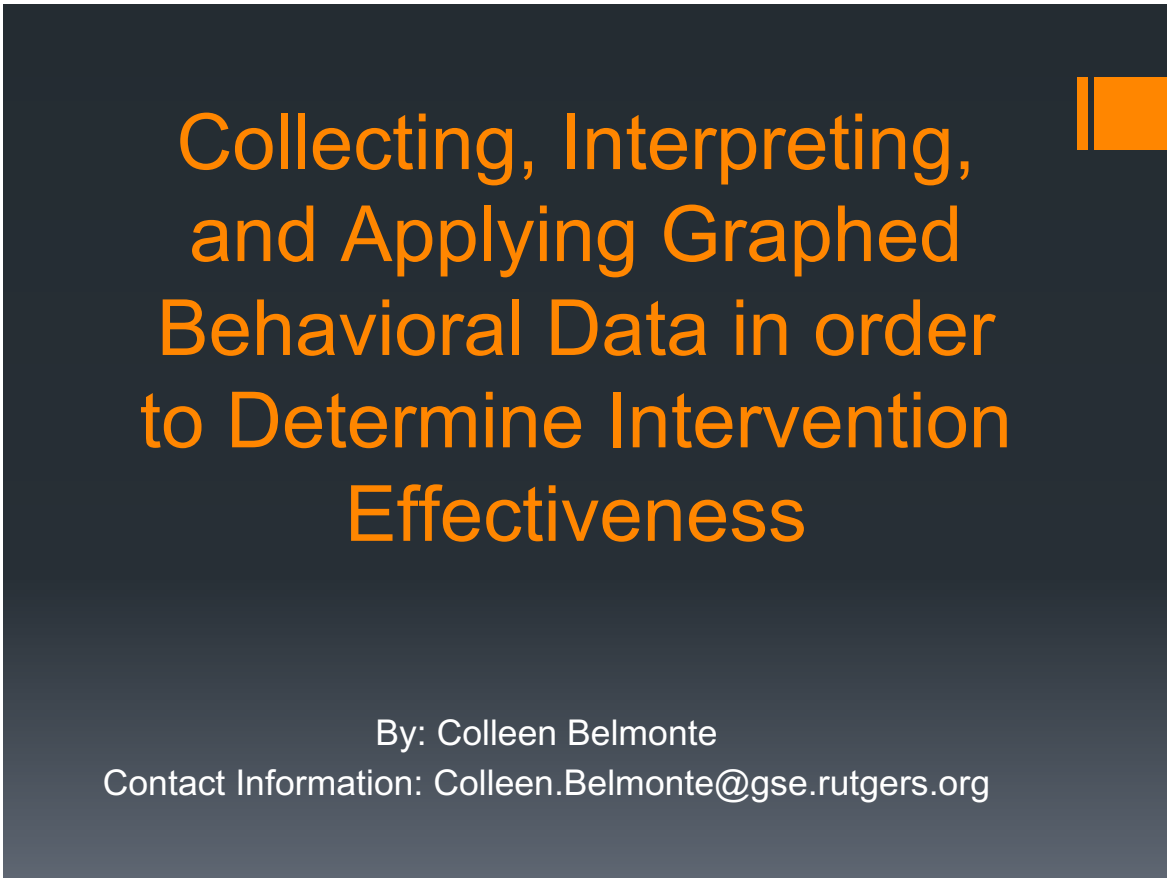
VOLUNTEERING
Your participation is voluntary. Your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw from the study at any time and all data attributed to you will be withdrawn by the investigator.

SUBJECT STATEMENT:
By clicking on the "I agree" button, I acknowledge that I have read the explanations provided to me. I have had all of my questions answered satisfactorily and I voluntarily agree to participate in this study. Please print out this consent form if you would like a copy of it for your files.

Thank you,
Colleen Belmonte
Doctoral Student
Rutgers, The State University of New Jersey

Appendix D.

Collecting, Interpreting, and Applying Graphed Behavioral Data (CIA-GBD) Intervention



Should you continue the intervention?

Decision Making with 3 data points:

1. After 3 consecutive data points in the desired direction (e.g. trend), continue the intervention or change the intervention (e.g. on task interval for 6 minutes instead of 5).
2. After 3 flat data points, a decision should be made to change the intervention (unless meeting your expectations).
3. After 3 data points in the undesired direction, change the intervention.

Decision Making with 5 data points:

1. If 3 out of the 5 data points in a sequence are in the desired direction, continue the intervention.
2. If 3 out of the 5 data points in a sequence are not in the desired direction, change the intervention.

(Maffei-Almodovar, Feliciano, Fienup, & Sturmey, 2017)

Important Indications

"1. A decision to continue an instructional tactic or program indicates that the student is making progress toward mastering the skill and that instruction should continue unchanged.

2. A decision to change an instructional tactic or program indicates that the student is not making progress toward mastering the skill and that an instructional change is necessary (e.g., change to a more intrusive prompt level, change to a different type of prompt, provide instructional materials, reinforce, teach prerequisite skill).

3. A decision to change when criterion for mastery is met indicates that the student has learned the short-term objective and that a new objective should be taught."

(Maffei-Almodovar, Feliciano, Fienup, & Sturmey, 2017)