The Effects of a Technology Delivered Self-Monitoring System and Video Self Modeling on the Disruptive Behavior of Adolescents with Autism

BY

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Abstract

Many students with autism demonstrate a variety of school based challenges, including complex and disruptive behaviors. Given these challenges, and the increases in prevalence widely reported for this population, teachers are in need of effective and efficient interventions to ameliorate the many difficulties faced by students with autism. Self-monitoring and video-based modeling are interventions with empirical support for individuals with ASD to decrease behaviors that are incompatible with successful outcomes. However, there is limited evidence regarding their utility at decreasing these challenging behaviors, when delivered via a mobile technology device. This study evaluated the functional relationship between I-Connect, a technology-delivered self-monitoring application on a smartphone, and decreases in the level of disruptive behavior for three students with ASD in the school setting utilizing a multiple-baseline design with an across participants. It also evaluated the combined effects of a video-self monitoring intervention delivered via the same device on the disruptive behavior of four adolescents with autism in school settings. Results and implications for practice and future research are discussed.

Contents

CHAPTER 1

Introduction

Unique Learning Challenges

Autism Spectrum Disorders (ASD) refers to a broad range of neurological disorders characterized by qualitative impairments in social interactions and communication, and restrictive and repetitive patterns of behavior, interests, and activities (American Psychiatric Association, 2013). It has been well established that students with autism often exhibit a variety of learning challenges (see Simpson, 2005). Learners with autism often demonstrate a variety of unique barriers to learning in school settings. Social difficulties often impact their ability to interact meaningfully with peers and adults (Stitchter & Conroy, 2006). Without adequate social competence, individuals with autism are more likely to have negative social interactions (e.g., bullying, ridicule, loneliness, anxiety, depression) and have fewer interpersonal relationships and positive social experiences than typically developing peers (MacKay, Knott, & Dunlop, 2007). Combined with broad communication deficits that are commonplace for students on the autism spectrum (Tager-Flusberg, Paul, & Lord, 2005), and difficult behavioral responses (i.e., aggression, self-injury, and stereotypic behavior) that are often demonstrated by school age students with autism (Machalicek, O'Reilly, Beretvas, Sigafoos, & Lancioni, 2007), these students are often considered a very challenging group for practitioners to successfully teach (Simpson, McKee, Teeter & Beytien 2007; White, Smith, Smith, & Stodden, 2012).

These challenges are further complicated by unique manifestations of ASD symptomology resulting in a wide variety of demonstrated skills and deficits (Bregman, & Higdon, 2012; Simpson, 2005). Due to these unique challenges, school personnel are in need of a

wide variety of evidence-based intervention strategies to address the needs of these students (Simpson, McKee, Teeter & Beytien 2007; White, Smith, Smith & Stodden, 2012).

The need to develop and implement effective strategies for students with ASD is especially pertinent given the increases in ASD diagnosis. Recent data suggest that autism prevalence rates may be as high as 1 in 68 children, including 1 in 42 males (Center for Disease Control, 2014). These data represent a 30% increase from data published by the Center for Disease Control (CDC) in 2012, and a 120% increase from data collected by the CDC in 2002 (Center for Disease Control, 2014). Predictably, students receiving special education services for an ASD diagnosis are also increasing. In the year 2000, 65,000 students were receiving special education services for an ASD diagnosis; by the year 2010, over 378,000 were receiving these services. This represents a 481% increase in students with ASD receiving services in school settings. This is in sharp contrast to other disability categories (i.e., intellectual disabilities, learning disabilities, and emotional and behavioral disorders), which have demonstrated decreasing trends during the same timeframe (National Center for Educational Statistics, 2011). The unique challenges demonstrated by learners on the autism spectrum, coupled with the increases in ASD prevalence, have created compounded demands on teacher capacity. Interventions that can be implemented without the direct supervision of overburdened teachers appear uniquely situated to produce effective and efficient results for learners with ASD.

One group of interventions that have proved effective in a variety of school settings for students across the autism spectrum is self-monitoring (SM) interventions (Lee, Simpson, & Shogren, 2007). The features of SM systems render them particularly useful in school settings given that they can be maintained without the direct supervision and implementation of an instructor and are often dynamic systems that are adaptable to the specific needs of the student

and the environment (Koegel & Koegel, 1990). Similarly, video modeling has shown promising results addressing a wide variety of outcomes for students across the autism spectrum (Bellini, & Akullian, 2007; Mason, Ganz, Parker, Burke, & Camargo, 2012). Video models have also been identified as efficient teaching tools that deliver consistent instructional representations (Charlop-Christy, Le, & Freeman, 2000).

SM

There are several different intervention paradigms that have been developed under the broad umbrella of self-regulation or self-management including SM, self-evaluation, self-instruction, goal setting, and problem-solving instruction (Mooney, Ryan, Uhing, Reid, & Epstein, 2005). The intervention of SM involves teaching the student to record the frequency or duration of specific behaviors (Maag, 2004; Mooney, Ryan, Uhing, Reid, & Epstein, 2005). This active process often reduces problem behaviors and increases desired behaviors by cueing the student's attention to the presence of the targeted behaviors (Zirpoli, 2008). These behavioral improvements may be directly related to an increase in the student's self-awareness. As students become more self-aware, they begin to recognize the discrepancy between their behavior and other external norms, (e.g., the behavior of others or specific instructor criteria; Polsgrove & Smith, 2004). Self-management skills have also been identified as pivotal skills for students with autism, indicating that successfully demonstrating these skills will likely effect a variety of behaviors/outcomes (Koegel, Koegel, & Mcneary, 2001).

Self-monitoring systems have been used in a variety of ways: paper and pencil routines (Ganz, & Sigafoos, 2005; Koegel, & Koegel, 1990), videotapes/video feedback (Coyle & Cole, 2004; Deitchman, Reeve, Reeve, & Progar, 2010), checklists (Stahmer & Schriebman, 1992) and electronic monitoring devices, (Blood, Johnson, Ridenour, Simmons & Crouch, 2011) to impact

a variety of behaviors including: social skills (Deitchman, Reeve, Reeve, & Progar, 2010; Shearer, Kohlar, Buchan, & McCullough, 1996; Stahmer, & Schreibman, 1992); appropriate behavioral responses (Koegel, Koegel, & Hurley, 1992); daily living skills (Ganz, & Sigafoos, 2005; Pierce, & Shcreibman,1994); and task-related behaviors (Coyle & Cole, 2004) for students across the autism spectrum.

Video Modeling

Video modeling is a strategy or technique that demonstrates a desired behavior being modeled in video format; the individual watching the video then imitates the modeled behavior (Bellini, & Akullian, 2007). Video modeling is based on the social learning theory that was developed by Albert Bandura in the late seventies (Bellini & Akullian, 2007). In this theory, he proposed that children learn a wide range of skills by watching others who are proficient at executing the skills. Bandura considered the relationship between modeling and behavior acquisition and determined three steps that occur in observational learning: attention, retention, and reproduction. He also demonstrated that the reproduction phase of observational learning could be controlled by the application of reinforcement or by an increase in motivation (Zirpoli, 2008).

Video modeling builds on ideas from observational learning by focusing on the attention, retention, and reproduction of specific behaviors being presented to the learner in the form of videos instead of live models. Video models were first used with students on the autism spectrum when Haring and colleagues (1987) used them to teach purchasing skills to 3 20-year-old adults with autism. Video modeling appears to take advantage of the visual learning strengths of students with autism, and recent information demonstrates that students with ASD are more likely to attend to videos than to live presentations (Cardon, & Azuma, 2012).

Since 1987, video modeling has been used to teach a variety of skills (e.g., social interactions, communication, behavioral responses, functional skills) to students across the autism spectrum (Bellini, & Akullian, 2007; Buggey 2005; Charlop-Christy, Le, & Freeman 2000; Haring, Kennedy, Adam, & Pitts-Conway, 1987; Mason, Ganz, Parker, Burke, & Camargo, 2012; Sherer et al., 2001), and has become a more established intervention for students with autism. In 2011, The National Center for Professional Development on Autism Spectrum Disorders (NCPD-ASD), an Office of Special Education Programs (OSEP) funded multi-university center for developing and promoting evidenced-based practices (EBP) for students with autism, listed video-modeling as a an EBP for students with autism. Similarly, recent meta-analyses on video modeling (Bellini, & Akullian, 2007; de Bruin, Deppeler, Moore, & Diamond, 2013; Huaqing Qi, & Lin, 2012; Mason, Ganz, Parker, Burke, & Camargo, 2012) have synthesized the growing body of research surrounding video modeling and have identified it as an effective instructional strategy for students with ASD. Fortunately, developing and implementing video models is now easier than ever before. With increased access to high quality video devices (e.g., iPhones, iPads, and handheld HD camcorders) that capture videos in digital format, recording and editing videos is now accessible to most practitioners.

This current study is an analysis of the effectiveness of a technology delivered SM application (I-connect; Wills, & Mason 2014) on the effects of disruptive classroom behavior for three adolescents with ASD. I-Connect is a SM application, currently operating on the Android™ mobile platform. I-Connect has been utilized to improve academic engagement and decrease inappropriate behavior for high school students with disabilities. This mobile application allows for customizable prompts including type (i.e. tone, vibration, or flash), frequency (e.g., 30 s, 60 s, 90 s), and wording (e.g., “Are you on task?” or “Did you have quiet

hands and mouth?”). Participant responses are automatically synced to an online database that allows school-based staff to access results and monitor progress. I-Connect has been used to successfully reduce the stereotypic behavior of two adolescents with ASD (Crutchfield, Mason, & Chambers, in review). Its effects on other disruptive behaviors or the additional effects of video modeling on behavioral levels is unknown.

Research Questions

This study was an examination of the effects of the I-Connect application on the disruptive behavior of adolescents who have ASD and intellectual disabilities. Additionally, this study was an investigation of the additive effects of a video-self model combined with the aforementioned SM system. This researcher specifically sought to answer the following questions:

1. What is the functional relationship between the electronically delivered SM system and adolescent’s rates of disruptive behavior?
2. What effect does a combined VSM and SM system intervention have on the participant’s rates of disruptive behavior?

Chapter 2

Review of Relevant Literature

The current state of the literature in regards to SM interventions for adolescents with autism and VSM interventions for adolescents with autism is examined below. Similarly, brief summarizations of the literature surrounding repetitive/restrictive behaviors (including stereotypy) are discussed.

SM Interventions for Adolescents with Autism

As explained in Chapter One, SM interventions are developed from the broader framework of self-regulation and self-management (Mooney, Ryan, Uhing, Reid, & Eptsein, 2005). Specifically, SM interventions include discriminating behavioral occurrences, as well as recording and tracking behavior over time (Maag, 2004). Self-monitoring interventions have been utilized to demonstrate positive effects across a wide variety of disciplines and behaviors, including weight loss (Turk, et al., 2013), oral hygiene (Schwarzer, Antoniuk, & Gholami, 2014), physical activity, (Nicklas, Gaukstern, Beavers, Newman, Leng, & Rejeski, 2014), blood glucose levels (Muchmore, & Miller, 1994), and work attendance (Coleltte, & Latham, 1989). The broad effectiveness of SM interventions is likely connected to an increase in the individual's consciousness regarding his/her current behavioral levels. This increase in awareness, coupled with comparisons to external criteria, and self-reinforcement, may, in fact, lead to the effects of SM systems (Ganz, 2008; Zirpoli, 2008).

In school settings, SM interventions have been effectively utilized for students with a variety of learning and behavioral characteristics including: typically developing students (Rock, 2005), students with learning disabilities (Uberti, Mastopieri, & Scruggs, 2004), attention deficits (Harris, Friedlander, Saddler, Frizzelle, & Graham, 2005), cognitive impairments (Ganz, &

Sigafoos, 2005), and autism (Koegel, & Koegel, 1990). Similarly, SM interventions have addressed a wide variety of student behavior, including task-related behaviors (King, Radley, Jenson, Clark, & O'Neill, 2014; Rock, 2005; Stassola, Perilli, & Damiani, 2014), academic accuracy and productivity (Shimabukuro, Prater, Jenkins, & Edelen-Smith, 1999), social skills (Ganz, Heath, Davis, & Vannest, 2013), and problem behaviors (Koegel, Koegel, Hurley, & Frea, 1992).

The National Center for Professional Development on Autism Spectrum Disorders (NCPD-ASD), an Office of Special Education Programs (OSEP) funded, multi-university center for developing and promoting evidenced-based practices (EBP) for students with autism, listed SM interventions an EBP for elementary, middle, and high school students (Nietzel, Busiek, 2009). Table 1 is a summary of key studies connected to secondary students (middle and high school; ages 12-19) with autism and SM interventions.

Table 1.

Secondary Students with ASD and Self-Monitoring

Authors	Research Design	Participant(s)	SM Components	Setting	Target Behavioral Outcome(s)
Agran et al., 2005	MBD across participants	13-year-old male assessed for Asperger Syndrome (IQ: 60)	Task analysis paper/pencil checklists	Self-contained	Following rules
Cihak, Wright, & Ayres, 2010	MBD across participants	Three males (ages: 13) diagnosed with HFA (IQ: 72, 105, 108)	Computer delivered picture prompts; checklists paper/pencil	General education	On-task
Hughes et al., 2002	MBD across participants	One male age 19 diagnosed with ASD and CI	Picture prompts checklists paper/pencil	General education	Functional communication (saying thank you)
Kern et al., 1994	MBD across participants	13-year-old male diagnosed with PDD (IQ: 71)	Checklists	Self-contained	(1) On task, (2) disruptive behaviors
Koegel, & Frea, 1993	MBD across behaviors	Two Males 13, 16 with ASD (IQ: 104, 71)	Wrist watch paper/pencil checklist	Community Settings	Social Behavior (disruptive behavior)
Koegel, & Koegel, 1990	MBD across participants	2 participants within age range (12, 14) ASD Diagnosis (mental age: 2-9 and 5-11)	Timer paper/pencil checklist	Clinical Settings	Stereotypic Behavior
Mancina et al., 2000	MBD across skills	1 female age 12 years with ASD (IQ 42-55)	Timer/watch checklists picture prompts	Self-contained	Rates of Inappropriate verbalizations
Morrison et al., 2001	MBD across participants	1 Male (age 13) diagnosed with ASD	Paper/pencil monitoring sheets	Pullout program	Social interactions, inappropriate behaviors
Newman, et al. 1995	MBD across participants	3 teenage males (ages 14-17); IQ: Mild/moderate CI	Transferring of tokens	Afterschool program	Schedule Following
Newman, Buffington, & Hemmes, 1995	Alternating treatment	Three teenage males (ages not specified) diagnosed with ASD	Self-reinforcement	Self-contained	Levels of appropriate conversation
Stahmer, & Schreibman, 1994	MBD across participants	1 male; 1 female (ages 12, 13) diagnosed with ASD (IQ, 46, 65)	Wrist watch paper/pencil checklist	Clinical/ home	Appropriate play, self-stimulatory behavior
Rock & Thead, 2007	Withdrawal design	One girl (age 14) diagnosed with ASD and moderate ID (IQ of 48-52)	Picture prompts mnemonics paper/pencil	General education	Academic engagement (on-task)
Yakubova, & Taber-Doughty, 2013	Multi-probe across participants	2 participants with ASD (age 16-19) IQ: 50-56	Video models SmartBoard electronic SM	Self-contained SPED	Daily living tasks

The 13 studies listed in Table 1 are representative of the evidence surrounding the use of SM interventions for adolescents with ASD. A total of 23 students with ASD between the ages of 12-19 participated in the studies outlined. Most of the studies provided specific details regarding the IQ of participants, which ranged from 46-104, indicating that SM interventions have demonstrated effectiveness for adolescents with varying levels of ASD symptomology. While these are encouraging results, in many of the studies several participants were utilized who were in elementary school or who did not have an ASD diagnosis to demonstrate a functional relationship between the SM systems and the targeted outcomes. For example, Agran and colleagues increased the rule-following behavior of six middle school students with disabilities in general education classrooms; however, only one of these students had autism (Agran, et al. 2005). This indicates that while 13 studies have been completed with this population, that represents only 23 students, a strikingly limited sample of adolescents with ASD.

Of the 13 studies outlined, 70% (9) took place in school-based environments, indicating that a majority of research on this topic is taking place in general and special education settings. Targets addressed included social behavior, academic tasks, and behavioral responses. Six studies (46%) were investigations of the effects of SM systems on behavioral levels (both appropriate and inappropriate responses), indicating that SM systems are used to address a variety of targets for adolescents with ASD.

In 100% (13) of the studies, multi-component SM systems were utilized that most often included paper/pencil checklists and wristwatches or other timing devices. This is significant in that one of the key features of SM systems is the ability to implement them without the direct supervision of teachers (Koegel, & Koegel, 1990). However, multi-component systems need to

be organized and managed in order for them to be implemented effectively, and researchers are noticeably vague on how materials are managed within these systems. A single component system that automatically delivers interval reminders to students as well as recording and tracking their responses appears to be a unique and a relatively untested system within the SM literature for adolescents with ASD. Similarly, only one study was an investigation of a technology-delivered SM system for students with autism. Technology-delivered systems, such as the I-Connect application, seem uniquely equipped to combine monitoring components into a single cohesive system, allowing students to access the system without the management of teachers or support staff.

Another aspect of the SM intervention's review is that many of them are accompanied by extensive discrimination training (see Agran, 2005; Koegel, & Koegel, 1990; Mancina, 2000). This training is highly variable, from a few minutes (Koegel, & Koegel, 1990), to up to 18 hours of "intensive training" (Mancina, 2000). This training is designed to quantify a student's understanding of behaviors so he/she can accurately monitor the occurrences and non-occurrences of targeted behaviors. It is unclear what role these training routines have on the effects of SM interventions, and whether effects can be achieved without this often-extensive training. Connectedly, it is unclear what role student accuracy of self-record contributes to overall effects, as low-levels of accuracy (e.g., 38% accuracy; Koegel, & Koegel, 1990) have still demonstrated positive effects.

Another common feature of SM interventions for adolescents with ASD is their use of reinforcement, both as part of the treatment package (Koegel, & Koegel, 1990), and for instances of accurate self-record (Mancina et al., 2000). These components (reinforcement, self-record accuracy, and discrimination training) make it difficult to isolate specific variables that may be

contributing to positive outcomes for adolescents with ASD. This researcher will seek to expand the evidence surrounding SM interventions for adolescents with autism in four key ways: 1) by adding to the literature base surrounding adolescents with ASD and SM; 2) by attempting to isolate some of the variables connected to the effects of SM interventions by implementing a SM intervention without a reinforcement schedule or extensive training protocols; 3) by testing the effects of a single component SM system delivered by technology; and 4) by assessing the additive effects of a self-video model combined with the SM system on the target outcomes.

Video Modeling Interventions for Adolescents with ASD

Video modeling is based on the well-known instructional principal of modeling. Modeling is founded largely on the work of Albert Bandura and his enduring social learning theory. Bandura demonstrated that children's learning benefited from observing successful performances of the learning targets, and that this learning not only took place without the presence of direct reinforcement, but also transferred to novel settings (Bandura, 1977; Bellini, & Akullian, 2007). Video modeling extends these principles to brief video demonstrations of desired skills. Video modeling has been a particularly effective instructional method for individuals with ASD (see Bellini & Akullian, 2007; Mason et al., 2012), and both the NCPD-ASD and the National Standards Project list video modeling as an established evidence-based practice for individuals with autism (National Standards Report, 2009; Plavnick, & Hume, 2013). Due in large part to these positive effects and the ever increasing ease at which videos can now be recorded and produced, the interest surrounding video modeling and individuals with autism is at an all-time high (Simpson, & Crutchfield, 2013).

Video modeling interventions appear to have some significant advantages over more traditional types of modeling (often referred to as "in-vivo" or live modeling), specifically, cost

effectiveness, consistency, and efficiency (Charlop-Christy, 2000; Mason et al. 2013; Sigafoos, O'Reilly, & Cruz, 2007). Video models are efficient and consistent in that they can be viewed countless times once they are implemented, ensuring that students can access the same instruction across environments and as many times as necessary until the skills have been mastered (Ayers,Maquire, McClimon 2009; Mason et al., 2013). As video models are moved onto mobile devices, students can access them easily in a variety of settings and re-watch them as needed, essentially summoning consistent instruction, literally in the palm of their hand (Ayers, Mechling, & Sansoti, 2013). In this way, video models are also cost effective. Charlop-Christy and colleagues demonstrated that video models were cheaper and took less time to create and implement than traditional types of teacher modeling (Charlop-Christy et al., 2000). Given the information discussed previously regarding the need for interventions that increase the capacity of teachers who work with students on the autism spectrum, video modeling appears to be an obvious choice to increase student outcomes efficiently and effectively.

VSM Interventions for Adolescents with ASD

VSM is a form of video modeling in which an individual is recorded demonstrating a specific skill or behavior. The individual then watches a video of him/herself performing the desired behaviors and ultimately imitates their own modeled actions (Bellini, & Akullian, 2007). Similar to SM systems, video modeling has been utilized in a variety of disciplines to impact a range of behaviors, including stuttering (Cream et al., 2010), decoding skills (Ayala & O'Connor, 2013), fine motor skills (Mechling, & Swindle, 2013), clinical skills of pre-service physical therapists (Maloney, Storr, Morgan, & Ilic, 2013), and new language learners (Ortiz et al., 2012).

Like other types of video modeling, VSM has also demonstrated effective outcomes for individuals with ASD (see Bellini, & Akullian, 2007; Mason et al., 2012). Often, VSM requires the practitioner or researcher to record long video clips attempting to "catch" the behaviors occurring naturally. This approach is often referred to as "positive self-review" and is designed for behaviors that are already within the students repertoire (Dowrick, 2006). Another VSM option is to coach the student to demonstrate the desired behaviors or skills and then edit out these "hidden prompts." This approach gives students a "view of future mastery," allowing them to view successful completions of skills that they cannot yet demonstrate independently (Dowrick, 2006). Table 2 is a summary of the key studies connected to VSM and adolescents with ASD.

Table 2.

Secondary Students with ASD and VSM

Authors	Research Design	Participant(s)	VSM Components	Setting	Target Behavioral Outcome(s)
Burton, et al. 2013	MBD across subjects	3 participants with ASD; IQ: 61-85	Video feed forward viewed on iPad	Special education	Academic skills completion of story problems
Cihak, & Schrader, 2008	Alternating treatment design	2 participants ages 16-17 IQ: 30-50	Narration feed forward	School	vocational skills
Lassater, Brady, & Michael, 1995	MDB across tasks	2 participants autism and PDD 14-15; IQ: 64-95	Video feedback packaged with self-assessment and disc. training	Home	Task fluency and independence
Cihak, Wright, & Ayres, 2010	MBD across participants	3 males (age 13) diagnosed with HFA (IQs: 72, 105, 108)	Packaged intervention with self-monitoring	General education	On-task
Theimann, & Goldstein, 2001	MBD across participants	1 within target age rang; 12 year old male	Video feedback and self-assessment packaged intervention	Pullout intervention	Peer interactions

These five studies are representative of the evidence surrounding VSM and adolescents with ASD. A total of 11 students with autism between the ages of 12-19 are represented in the studies summarized above. All but one of the studies provided additional information regarding

participant characteristics, revealing that VSM has been effective for students across the autism spectrum. Most of the studies summarized above (3/5) used VSM as part of a packaged intervention; VSM was packaged with reinforcement systems and SM/self-feedback routines to impact target outcomes. The evidence connected to VSM and adolescents with ASD appears to be limited, as it does not meet the threshold identified by the What Works Clearinghouse (WWC) and their recommendations for combining evidence from single case research (SCR; Kratchowill et al., 2010). These recommendations call for at least 5 independent investigations across geographic regions, encompassing at least 20 individuals. The research results summarized above indicates that VSM cannot be considered an evidence-based practice (EBP) for adolescents with ASD, according to these standards.

Video modeling (regardless of model type) does meet these criteria for adolescents with ASD, as outlined by several systemic reviews and meta-analyses (see Bellini & Akkullian, 2007; McCoy, & Hermansen 2007; Mason et al., 2013). Mason and colleagues demonstrated through meta-analysis that no differences were demonstrated in the effect sizes between video modeling with others (VMO) as the model and VSM (Mason, et al 2013). However, there appears to be one noteworthy argument for using VSM instead of VMO for learners with ASD, and that is the contributions that VSM can make to the self-efficacy of the learner. Self-efficacy is an individual's belief about his or her own potential for success. According to Bandura, self-efficacy can be increased through the observation of one's own successes (Akullian, 2007; Bandura, 1994). Video SM has the capability to improve student's perceptions of their own capabilities through watching positive, successful completions of target behaviors. Increases in self-efficacy can increase student's attention to the model and overall motivation for learning (Bellini, & Akullian, 2007).

In general, VSM interventions summarized above included brief (between one to three minutes) positive demonstrations of the target behavior. One of the VSM interventions included adult narration designed to orient students to salient elements of the VSM and to provide encouragement or social reinforcement for demonstrating the target skills (Cihalk, & Schrader, 2008). This supports the findings of Smith and colleagues (2013) who demonstrated more efficient and effective results for video models that included adult narration components compared to video models that did not (Smith, Ayers, Mechling, & Smith, 2013).

Two of the studies summarized above utilized mobile devices (e.g., iPad) to view the VSM (Burton et al., 2013; Cihak, Wright, & Ayres, 2010). Similarly, video modeling interventions have recently been taking advantage of utilizing portable electronic devices to view video models and the positive effects have been maintained even on small screens (see Ayers, Mechling, & Sansoti, 2013; Grosberg, & Charlop, 2014). This is important in that it allows for video models to be easily transported across environments, giving students immediate access to high quality instruction. New technology devices such as smartphones and tablets can also be exciting and motivating for students (Ayers, Mechling, & Sansotti, 2013), and have the potential to increase social capital and decrease stigmatization.

The study discussed in chapters 3-5 advances the literature connected to VSM interventions for students with ASD in three key ways: 1) it provides an investigation of the effects of VSM for four additional adolescents with ASD; 2) it investigates the additive effects of VSM to a SM intervention, and 3) it uses a mobile electronic device to disseminate the video models.

Repetitive and Restrictive Behaviors and Individuals with ASD

Along with qualitative impairments in communication and social interactions, restrictive and repetitive patterns of behavior are considered a defining characteristic of individuals on the autism spectrum (American Psychiatric Association, 2013). This encompasses a wide variety of behavior, including preference for sameness and routine, narrow interests, stereotypic behavior, and self-injurious behavior (Bregman, & Higdon, 2012).

Stereotypic behavior is often associated with individuals with ASD, and individuals with ASD demonstrate higher rates of stereotypic behavior than individuals with other developmental disabilities (DiGennaro Reed, Hirst, & Hyman, 2012). Occurrences of these behaviors has been connected to level of impact and intellectual disabilities, with higher rates of stereotypy occurring in individuals who are more impacted by ASD (DiGennaro Reed, Hirst, & Jenkins, 2014) and who are co-morbid with intellectual disabilities (Bregman, & Higdon, 2012). Stereotypy is frequently heterogeneous, and involves a variety of motor and vocal behavior including brisk arm movements, rigid or odd walking postures, toe-walking, body rocking, non-communicative vocal repetitions, and head shaking (Bregman, & Higdon, 2012; Lanovaz et al., 2014; Lee, Odom, & Loftin, 2007). These behaviors are complex and not fully understood. They are thought to serve a variety of functions including stimulatory and communication (Kennedy, Myers, Knowles & Shukla, 2000). Depending on the rate at which they occur, these behaviors can present barriers to task completion, instructional routines, and social interactions while also contributing to the stigmatization surrounding ASD and disability in general (Lanovaz, et al., 2014; Koegel & Koegel, 1990; Kennedy, Myers, Knowles & Shukla, 2000; Koegel, Koegel, & Hurley, 1992).

Historically, two types of interventions have been utilized to reduce the stereotypic behaviors of students with ASD, function-based treatments and non-function-based treatments (Mulligan, Healy, Lydon, Moran, & Foody, 2014). Function-based treatments attempt to conduct both direct and indirect functional behavioral analysis procedures to determine external stimuli (e.g., social attention, task avoidance, and internal motivation) that were maintaining the behaviors before designing and implementing an intervention. Non-function-based treatments implemented intervention protocol without first conducting a functional analysis (Mulligan, Healy, Lydon, Moran, & Foody, 2014). Functional analysis of behavior has long been a part of treatment procedures addressing the problematic behavior of students with autism, and has informed clinical and school-based practice for nearly three decades (Scott, & Bennett, 2012). However, conducting these analyses, especially in regards to stereotypic behavior, can be tedious and often requires experimental control of the environment that is not always present or, at the very least, difficult to maintain in school settings (DiGennaro Reed, Hirst, & Hyman, 2012).

In their seminal systematic review of interventions that have been developed to address the stereotypic behavior of individuals with ASD, Healy and colleagues indicated that there were few differences in terms of efficacious results connected to the presence of functional analysis, but rather, that interventions that were consequence-based proved to be more effective, regardless of functional analysis (Healy, Lydon, Moran, & Foody, 2014). They also recognized that a majority of the studies included in their review indicated that the function of stereotypic behavior appeared to be maintained by internal, rather than external, contextual factors. However, they cautioned colleagues, as others have (see Digennaro Reed, Hirst, & Jenkins, 2012), not to ignore the function of stereotypic behavior, as it has been demonstrated to serve functions connected to social attention and communication (Healy, Lydon, Moran, & Foody,

2014). In a continued effort to identify interventions that increase teacher capacity, the interventions tested for this investigation utilized only indirect analysis of the behavior function. Indirect analyses identify potential behavioral functions in an efficient teacher survey that can be easily completed and interpreted without large demands on teacher time and resources (specific details in Chapter 3).

I-Connect Pilot Study

In October-December, 2013, a pilot study was conducted to test the effectiveness of the I-Connect device on the stereotypic behavior of two adolescent students with ASD (Crutchfield, Mason, & Chambers, in review). The purpose of the study was twofold: 1) to see if a functional relationship existed between reductions in stereotypy and the introduction of the I-Connect application and 2) to test the feasibility of using the I-Connect application for adolescents with ASD as it is currently configured. What follows is a brief report on that pilot study, as it directly informs the subsequent follow-up studies discussed in chapters 3-5.

Settings and participants. The study took place in a local urban middle school that had high rates of minority populations (85%) and students who qualified for free and reduced lunch (78%). The 2 students who participated in the study were 14 years old at the time of the study and were enrolled in the eighth grade. Both students were diagnosed with ASD and were also co-morbid with intellectual disabilities, as measured by a non-verbal IQ test. Students were included in the study based on: 1) a diagnosis of an ASD, 2) high rates of stereotypy that impacted task completion and social opportunities, and 3) parents provided written consent for participation. The study was completed in a special education classroom, where students were working independently on academic tasks (e.g., writing personal information and completing basic math

tasks). Descriptions of both participants from the manuscript, which is currently under review, are included below:

> Barry is a 14-year-old Caucasian with a diagnosis of autism. In addition, Barry was medically diagnosed with ADD and Down Syndrome and was taking medicine for attention at the time of this study. Barry's most recent IQ test was one year prior to the study. The Universal Nonverbal Intelligence Test (Bracken & McCallum, 1998) assessed his overall Full Scale IQ at 54, falling into the very delayed category. (Crutchfield, Mason, & Chambers, in review p. 6)
>
> Carl is a 14-year-old Caucasian with a medical diagnosis of autism and ADHD. At the time of the study, Carl was not taking any medication for attention. According to school records, Carl met special education eligibility under the category of autism. He also received services in the areas of speech and language. No recent IQ tests had been administered; however, five years earlier, he was assessed as having a nonverbal IQ score of 53 on the *Stanford-Binet Intelligence Scales,* Fifth Edition (Roid, 2003). His overall intelligence was classified as "moderately delayed and ranked at the 0.1 percentile of same-age peers. (Crutchfield, Mason & Chambers, in review p. 7)

Target behaviors. According to the teacher and parent report, stereotypic behavior was said to be an issue for each student, especially when they were completing tasks independently. The operational definitions of stereotypy from the manuscript are included:

> Stereotypic behavior was individually defined for each participant. Operational definitions of stereotypic behaviors for Barry included: 1) non-functional hand gestures (e.g., hand flapping, waving hands in front of face); 2) placing hands in mouth; and 3) vocalizations not directed at another individual (e.g., grunts, repetitive laughing, and

repeating words and phrases). The operational definitions for Carl's stereotypic behaviors included: 1) vocal language not directed to a communication partner and 2) placing hands or objects in mouth. (Crutchfield, Mason, & Chambers, in review p. 9)

Self-monitoring materials. The handheld mobile device used in the study was a Samsung Galaxy 5.0 tablet with a five-inch screen. The I-Connect program is an Android application that provides scheduled prompts for participants to self-evaluate and self-monitor targeted behaviors. The application provides three prompting options (i.e., flash, vibration, and a ringtone) at fixed intervals ranging from 30 seconds to 15 minutes as selected by the teacher. The I-Connect application was loaded onto the Samsung device, connected to school wireless networks to assess for compatibility, and tested to ensure it was functioning as intended prior to intervention (Crutchfield, Mason, & Chambers, in review).

Experimental design. The effect of the intervention was evaluated through the implementation of an ABAB reversal design with an embedded multiple baseline across two participants. Although a full reversal design, in and of itself, is considered a strong experimental design according to the standards established by the WWC (Kratochwill et al., 2010), the inclusion of a staggered baseline strengthens the internal validity of the study (Crutchfield, Mason, & Chambers, in review).

Results. In this study, the researchers demonstrated positive results for participants, and both visual analysis and statistical analysis indicated large effects for the intervention. In Figure 1, the observational data from this study are provided.

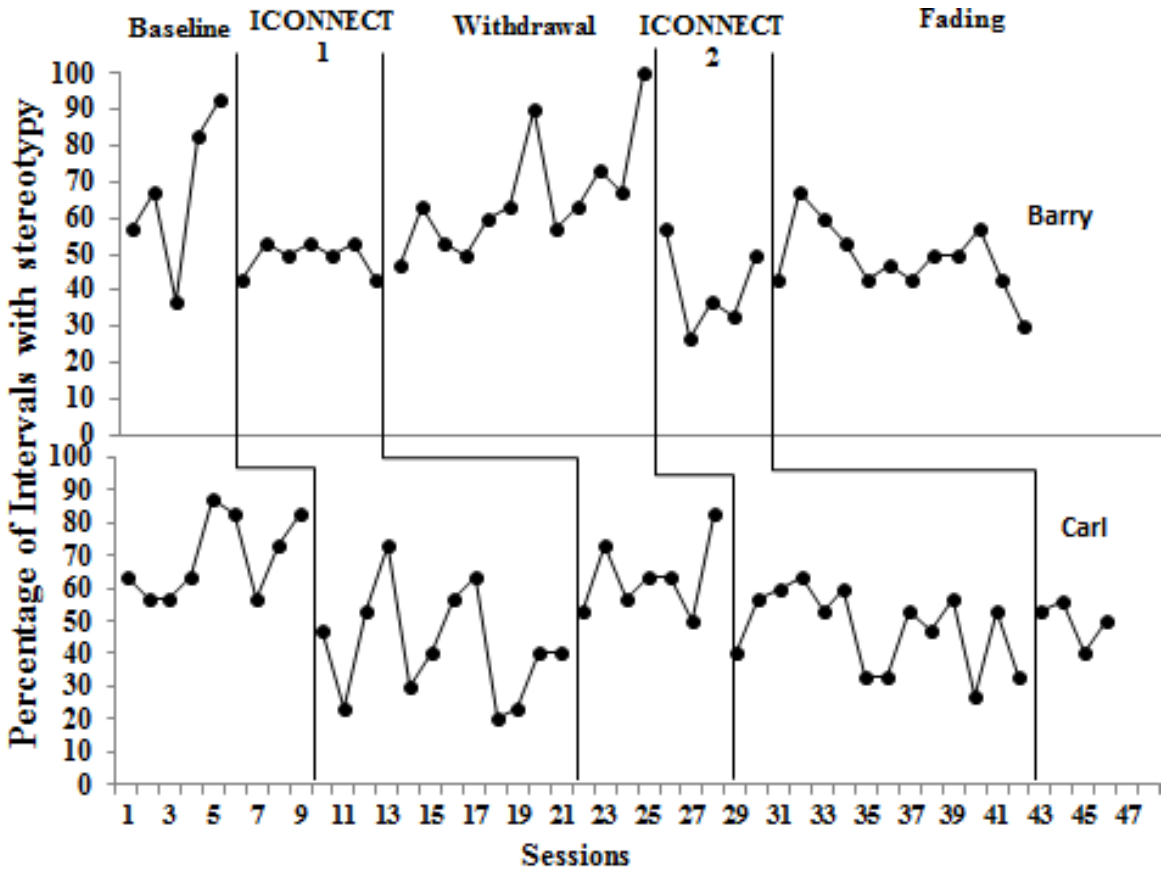

Figure 1. I-Connect pilot study results

Brief discussion. A full description of methodology, procedures, data collection, and results will not be included in this brief report. However, lingering questions in the discussion directly inform the follow-up studies discussed in chapters 3-5. Namely, (a) Could these results be replicated with similar participants? (b) What, if any, student characteristics contributed to the success of the study? and (c) Could an additional technology delivered intervention (i.e., VSM) further reduce levels of this behavior? While the results were effective at reducing stereotypy, the levels were still at a level that was infringing on task completion. These questions directly informed the research questions that were outlined at the end of Chapter 1 and, along with the literature summarized above, provided the rationale for conducting this investigation.

In summary, video SM and video-based modeling interventions have demonstrated effectiveness in ameliorating a wide variety of outcomes for adolescents with ASD. These interventions also appear well situated to increase teacher capacity by nature of their efficiency, consistency, and level of independence in which they can be implemented. While the evidence surrounding these interventions has been well established, little is known about the effects of using them in conjunction to address student behavior. Similarly, limited evidence has extended the effects of SM to technology-based systems or included video models presented via smartphones. Finally, the only evidence to suggest that the I-Connect application is an effective SM system for adolescents with ASD is the pilot study discussed above. The study discussed in the following chapters addresses these deficiencies and extends the current literature surrounding SM and VSM by testing the effectiveness of I-Connect and VSMs on the disruptive behavior of five adolescents with ASD.

Chapter 3

Methods

Two connected studies were conducted to test the effectiveness of I-Connect, and the additional effects of a video self-model (VSM) on the disruptive classroom behaviors of adolescents with autism. Study A attempted to replicate the findings of the initial I-Connect pilot, by investigating the effects of the application on the disruptive classroom behaviors of three adolescents with autism. Two of the students responded positively to the I-Connect device. These students were combined with the students from the I-Connect pilot to see if the addition of a VSM would further reduce their disruptive classroom behavior in Study B. Additionally, training phases and probes were conducted with the student who did not respond to the I-Connect to determine what additional supports were necessary for students with similar characteristics to benefit from the I-Connect application. The specific details of both studies' methodology are discussed below.

Study A: The Effects of I-Connect on the Disruptive Behavior of Three Adolescents with Autism

Participants, Settings, and Materials

Participants. One high school and two middle school students participated in this study. Participants were selected based on the following criteria: (a) attended a local public high school or middle school; (b) chronically demonstrated high frequency behaviors that were disruptive to task completion or general education inclusion; (c) carried an independent diagnosis of ASD based on criteria in the *Diagnostic and Statistical Manual of Mental Disorders DSM-IV* (American Psychiatric Association, 2000); (d) had a full scale IQ of 75 or lower, or other formal and informal assessments suggested that they had a cognitive impairment; and (e) had parental permission to participate in the study.

Calvin (real name withheld) was an 18-year-old African-American male with a diagnosis of autism. Calvin was attending an 18-21-transition program in a local urban high school. Calvin's most recent IQ score was administered two years prior to this study and according to the Leiter-R (Roid, Miller, Pomplun, & Koch, 1997), Calvin had a Full Scale IQ score of 60. Two years prior to participation in this study Calvin was also administered the *Vineland Adaptive Behavior Scale* (Sparrow, Cicchetti, & Balla, 2005). His composite score on the on the Vineland was 60. Teacher information indicated that Calvin has limited spontaneous verbal communication, although he could answer questions verbally and would respond to social initiations when prompted. Calvin was able to read words, phrases, and short books. At the time of the study, Calvin was pursuing a job in the community, and volunteered at three separate community settings to enhance his job placement potential.

June (real name withheld) was a 12-year-old Caucasian female attending a local suburban middle school. June's most recent IQ score was administered more than five years prior to this study, so the results were not included. However, she was administered the *Verbal Behavior Milestones, Assessment and Placement Program* (VB-MAPP; Sundberg, 2008) in 2012. The VB-MAPP is a criterion-referenced test of language, communication, and adaptive behavior that is administered to students with autism. According to the VB-MAPP results, June demonstrated language and learning behavior that fit developmental milestone for individuals 30-48 months. Teacher information indicated June had limited spontaneous verbal speech. She was able to communicate basic wants and needs verbally. June could read words and phrases, and could respond to written questions. At the time of the study, June was attending classes in both general and special education settings.

Joseph (real name withheld) was a 12-year-old Caucasian male who attended the same suburban middle school as June. Joseph did not have a recent IQ test on file with the district. However, he was recently administered a *Vineland Adaptive Behavior Scale* (Sparrow, Cicchetti, & Balla, 2005). The Vineland is a norm-referenced test of adaptive behavior capabilities that is often administered to students with autism and is highly correlated to mental age and autism severity (Wells, Condillac, Perry, & Factor, 2009). Joseph's adaptive behavior composite was 38, placing him nearly 4.5 standard deviations from the mean, which corresponds to a percentile rank less than 1. Teacher information indicated that Joseph rarely demonstrated spontaneous speech, which is limited to only a few words of highly preferred items. Joseph uses an augmented communication device (IPod touch, fourth generation with Proloquo2GO; Sennott, & Bowker, 2009) to communicate with peers and adults. Joseph can identify a few sight words, but cannot read; he responds to a few written prompts with intensive training. Joseph is currently attending classes in a special education setting.

Settings. This study took place at a local middle school and high school. Calvin attended high school in a major metropolitan area in a Midwestern city. At the time of this study, the high school's enrollment consisted of 79% minority populations, with 65% of students qualifying for free or reduced lunch. All data were collected for Calvin in the "transition academy" at his high school. This space consisted of adjoining rooms, containing a work area and a kitchen. Calvin completed daily reflection activities as part of his transition program. These tasks consisted of Calvin writing five reflection statements about his day, including where he had worked and what tasks he had completed. There were other students and staff in the room during this time. Students who were present were completing similar tasks to Calvin. This was considered a

special education environment, as no typically developing peers were present in the space during this time of day.

The middle school that June and Joseph attended is located in a suburban area outside of a Midwestern city. At the time of this study, the middle school's enrollment consisted of 82% Caucasian students, with 7% qualifying for free and reduced lunch. For June, all data were collected in a general education Family and Consumer Sciences (FACS) class that met daily. During this class, June sat at a table with peers and worked on a variety of projects, including note taking, worksheets, sewing activities, and cooking activities. For Joseph, all data were collected in the special education environment during speech and language activities. These activities were conducted by a licensed speech and language pathologist (SLP) and consisted of using his communication device to answer questions, receptively identifying items and icons, and responding to initiations.

Materials. The self-monitoring application (I-Connect) that was used in this study was contained on a Samsung Galaxy 5.0 tablet, which has a five-inch screen. I-Connect is currently an android application that is designed to provide scheduled prompts for participants to self-monitor targeted behaviors (Wills, & Mason, 2014). The prompts, in the form of chimes, vibrations, or flashes, are delivered to the participant in pre-configured intervals currently ranging from 30 seconds to 15 minutes. Each participant in the study utilized monitoring prompts delivered at one-minute intervals. The I-Connect application was loaded onto the Samsung device, and connected to the school's wireless network prior to intervention. Figure 1 demonstrates how the I-Connect looked for Calvin, June, Carl, and Bobby. Slight modifications were made to the I-Connect screen for Joseph. During training, Joseph demonstrated difficulty in

selecting the “Yes/No” buttons on the device so they were enlarged. Figure 2 represents the I-Connect as configured for Joseph.

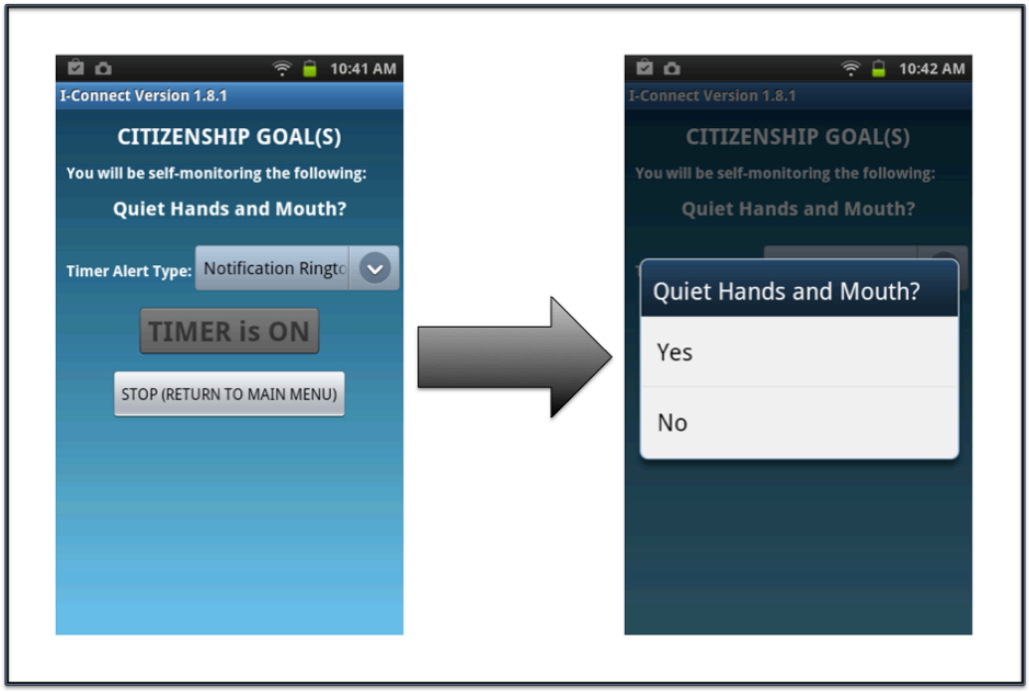

Figure 1: *I-Connect as configured for Calvin and June*

Figure 2: *I-Connect as configured for Joseph*

Experimental Design and Measurement

Design. A concurrent multiple baseline design (MBD; Baer, Wolf, & Risley, 1968) across three participants was used to evaluate the effectiveness of the I-Connect application on disruptive classroom behaviors. This type of MBD involves introducing a series of AB designs with staggered treatment phases (Christ, 2007). This design is considered adequate for demonstrating internal validity with at least three subjects or three separate behavioral targets. Thus, the design offers three demonstrations of change, which meets quality standards as established by the What Works Clearinghouse (WWC; Kractochwill et al., 2010). This study was carried out over the course of 10 weeks with 3 to 4, 5-minute observation sessions per week. Observations and data collection occurred in the same setting across phases for all participants.

Dependent variable. The percentage of intervals in which disruptive behavior occurred was the dependent variable for all subjects. Disruptive behavior was defined individually for each participant. Operational definitions for disruptive behaviors were developed with the assistance of each participant's classroom teacher. For Calvin, disruptive behavior included: 1) swearing, including swearing that was directed at others and swearing that was repeated with no communication partner; 2) repeating words and phrases aloud; and 3) kicking a wall or table. For June, disruptive behavior included: 1) scripting words or phrases from movies or songs aloud; 2) singing songs or notes aloud; 3) audible humming; and 4) audible grunting or growling. For Joseph disruptive behavior included: 1) loud vocalizations or screams of syllables; 2) growling or deep guttural vocalizations; and 3) slapping his hand on a table in conjunction with a vocalization (harder than a normal table pat or just placing his hands on a table).

Measurement. A 10-second partial interval recording was used to measure the frequency of the target behaviors. Partial interval recording is a data collection method that requires the

observer to indicate the occurrences or non-occurrences of targeted behaviors at any point during the interval, regardless of duration or frequency (Cooper, Heron, & Heward, 2007). Observations were recorded on a data collection sheet (Appendix A) that included a grid with columns labeled by minutes (i.e., 1-5) and rows labeled by intervals (i.e., 1-6). Thus, the data collection sheet had 30 recording boxes. The observer circled "Yes" if the behavior occurred and "No" if the behavior did not occur during each measurement interval. Recorders listened for a pre-recorded audio track in one earbud during observations as a means of structuring the recording. The audio track would say, "Observe" at the beginning of each 10-second interval, and "Record" at the end of each interval. Observers were given three seconds to record their responses before the prompt to begin the new interval was initiated. The daily percentage of disruptive behavior was calculated by dividing the number of intervals in which "Yes" was coded by the total number of intervals.

Reliability, Fidelity, and Validity

Reliability. Two coders, who were coached in the data collection procedure simultaneously, but independently, collected data for a minimum of 20% of observations for each participant, in each phase of the study. Observers were in agreement if both coded occurrences or non-occurrences of the behavior were the same within a given interval. Percent of agreement was calculated by dividing the total number of intervals in which agreement occurred by the total number of intervals in the observation. The mean agreement across participants and phases was 87%, with a range between 77%-97%. For Calvin, mean agreement was 95% with a range of 90%-96%. For June, mean agreement was 82% with a range of 77%-87%. For Joseph, mean agreement was 86%, with a range of 77%-96%.

Fidelity of implementation. Treatment fidelity was assessed on 25% of all I-Connect sessions. The fidelity measure that was developed for the I-Connect pilot consisted of five Yes/No questions: (1) Did the student initiate the monitoring session by starting the timer on the device after the teacher or researcher prompted "Start your timer"?; (2) Did the teacher provide reinforcement during the session connected to the targeted outcomes?; (3) Did the teacher only interact with the student if he or she needed help on an assignment?; (4) Student interactions were limited only to discussions of an assignment and not focused on monitoring activities?; and (5) Prompting procedures connected to the device were followed? See procedures for more information on these methods. The percent of treatment fidelity was assessed as the number of "Yes" responses divided by the total possible number of responses. Fidelity of implementation was assessed at 100% for both Calvin and June. Fidelity of implementation for Joseph was 80%, likely because his teachers had to push the "Start timer" button for him due to dexterity issues, thus, affecting the stated implementation protocol. The mean percentage of fidelity was assessed at 96% across all participants.

Social validity. A 10-item satisfaction survey was given to the teachers, para-professionals, and SLPs who worked with the students. The survey included two sections and was designed to gauge teacher/staff opinions concerning the effects of the I-Connect application and the teacher/staff member's assessment of how effective and efficient the I-connect was compared to other interventions that had been used in the past to address the same target behaviors. Results are reported in Chapter 4.

Procedures

Baseline. During the baseline phase, students went about completing tasks and participating in the environment as usual. Data were collected as described above on the number

of intervals in which the students engaged in disruptive behavior. During baseline, Calvin participated in filling out his reflection worksheets. He also completed some addition and subtraction of money amounts, if time allotted. During baseline, June participated in her FACS class, including sewing activities, group activities, and seatwork. During baseline, Joseph completed speech tasks including using his communication device and receptively identifying items and pictures. The classroom teachers and support staff provided assistance to the students per their normal protocol. Following five data points of baseline, during which time there was no decreasing trend, students were systematically introduced to the intervention. The intervention was introduced to one participant at a time. Subsequent participants were introduced to the procedures following a demonstration of improvement from baseline by the first and second participant, respectively.

Training sessions. Training occurred on the I-Connect application before each student entered into the intervention phase of the study. Training was the same for Calvin and June; however, it ultimately had to be altered for Joseph. Calvin sat at his desk with the author of this research as he was completing his reflection worksheet. The device was placed on his desk within reach; the intervals were set to one minute; the monitoring question was chosen as "Quiet hands and mouth?" and the notification was set to "chime." When the device chimed, the researcher prompted Calvin by saying, "Answer your question." At each interval, the researcher would give Calvin three seconds to respond before prompting him to answer his question. It took Calvin two five-minute sessions to respond independently to the device. Also, during this time, the researcher looked for opportunities to provide feedback on the accuracy of his monitoring, such as providing corrective feedback if Calvin indicated he had "quiet hands and mouth" when he did not. Accuracy of self-recording was not part of the criteria to access the intervention

phase. Calvin did demonstrate anecdotal evidence that he was processing the device questions, saying phrases such as, “Yes, I am quiet” when the device would chime.

June’s training proceeded in much the same manner. However, the para-professional who worked with her provided the training while the researcher observed. The device was configured to one-minute intervals, the monitoring question was, “Were you quiet?” and the notification was set to “chime.” The training was done in the speech classroom after her FACS class instead of during her class time with her same-age peers. It took June one 15-minute session to respond to the device independently. During this time, the para-professional provided corrective feedback regarding June’s responses to the device (i.e., correcting her if she said, “Yes” when her behavior had warranted a “No” response) but accuracy of self-record was not a contingency for moving into the intervention phase. Like Calvin, June demonstrated understanding of the monitoring question, on several occasions saying “shhhh,” whenever the device would chime, and looking at the para-professional working with her and saying “Quiet,” after answering with a “Yes.”

Joseph’s training had to be configured differently because his learning traits presented unique challenges relative to using the application as it was originally configured. The application interval was set to one minute, the monitoring question identified for Joseph, was “Nice voice?” and the notification was set to “chime.” Because, teachers and staff were unclear about Joseph’s reading capabilities, the researcher and speech pathologist began by assessing Joseph’s understanding of the phrase “Nice voice?”. The phrase was paired with small icons and large text. Joseph was able to demonstrate 80% accuracy receptively by identifying the “Nice voice” text/icon, with 3 distractors, after approximately 20 trials. These trials, and subsequent training trials, were built into Joseph’s naturally occurring speech schedule. After identifying the icons, Joseph also demonstrated receptive identification of the words “Yes/No” with 80%

accuracy after approximately 20 training trials. Periodically, during these training phases, Joseph was asked to respond to the question “Did you have a nice voice?” using his speech output device. Joseph was able to respond to 80% of these trials independently. Following these trainings, which took approximately 25 minutes of total work time spread out between two days of speech class, the device was introduced to Joseph.

Training for Joseph continued from this point in the same manner described for Calvin and June. Joseph did not respond to the device without prompts. Initially, prompts were given to Joseph as verbal prompts. However, because he did respond to the device following verbal prompts, gestural prompts were used. Joseph responded appropriately to the device following gestural prompts, but was unable to respond independently. During these prompted responses, it was noticed that Joseph had a difficult time pressing the “Yes/No” buttons on the device. These buttons were positioned in close proximity and were relatively small in comparison to the size of the screen. Because of this, the user-interface of the app was reconfigured specifically for Joseph; the Yes/No buttons were increased in size, and also color-coded (i.e., Yes = green; No = red). This reconfiguration is shown in Figure 2. After 3 training sessions of 15 minutes, with prompting and the reconfigured app, the decision was made by the SLP, the researcher, and the teacher to provide high preference reinforcement for responding to the device. A 1:1 reinforcement schedule, with a high preference edible reinforcer was used for two 10-minute training sessions. During that time, the student responded to the device independently on 85% of the monitored intervals. The next day, two training sessions were conducted without reinforcement and Joseph maintained his high rate of independent responses without reinforcement.

Intervention. As participants met the outlined training criteria, the I-Connect intervention commenced. The settings and activities remained the same during intervention as during baseline. That is, the only addition was the self-monitoring application in their workspace. The device was programmed for one-minute intervals for each participant; each participant utilized the "chime" as their notification reminder. Prompting routines for the intervention phase of the study prevented students from missing more than one consecutive interval. If students did not respond to an interval, no prompts were provided. However, on the next interval, if the student did not respond within a few seconds, a prompt was provided to "Answer your question." During all intervention sessions, Calvin and Joseph needed no prompts, and June needed only two prompts.

Discrimination training and video feedback. As Joseph did not respond positively to the original I-Connect intervention protocol (see results in Chapter 4), he was exposed to extended discrimination training through video feedback and then reintroduced to the I-Connect application. The other participants, Calvin and June, went on to participate in Study B. During the discrimination training, Joseph was shown video exemplars of behavior that fit the "nice voice" and "not a nice voice" criteria. Joseph was then asked to use his communication device to tell the speech and language pathologist SLP if he had used a nice voice in a video clip by indicating yes or no. After two 10-trial probes, Joseph demonstrated accuracy levels of 60% and 80%, respectively. Subsequently, Joseph was shown the video clips of his positive and negative behavior in one extended video. During this viewing, the SLP provided qualitative remarks on the video, pointing out features of "nice voice" and "not a nice voice." Immediately following the viewing of this clip, Joseph was exposed to typical speech tasks. The researcher and SLP would look for naturally occurring trials of appropriate and inappropriate behavior and ask

Joseph to evaluate his performance by responding with a yes or no to the question, “Was that a nice voice?” with his communication device. After 20 such naturally occurring trials, Joseph was able to demonstrate accuracy of self-evaluation at 80%.

In hopes that this success could translate to the I-Connect application, the final phase included creating a screen capture of the Yes/No response as presented on the version of I-Connect that Joseph was accessing (see Figure 2). This screen capture allowed the “Yes/No” prompt to remain on the screen, as opposed to being present only at the end of intervals. Joseph was then exposed to the previously described video feedback routine. Again, the researcher and SLP looked for naturally occurring demonstrations of positive and negative behavior. When these occurrences happened, staff would initiate contact with Joseph using the question, “Did you have a nice voice?” and prompt him to respond by touching Yes/No on the I-Connect screen capture. This was continued until Joseph could answer 80% of the trials independently and accurately. This took 3 additional training session, which were 15-minutes each. After this extensive discrimination training through video feedback, Joseph was reintroduced to the I-Connect application in exactly the same manner as described above for June and Calvin.

Data analysis. Both visual analysis and statistical analysis were used to evaluate the relationship between disruptive behavior and the I-Connect application. Visual analysis of graphical displays has long been utilized in single case research (SCR) to determine the nature of the relationship between two variables (Baer, Wolf, & Risley, 1968), and is currently the most widely utilized method for analyzing results of SCR (Davis, 2013). While, visual analysis is a procedure steeped in the tradition of the behavioral sciences, there is significant variability and lack of systematic oversight regarding its implementation, resulting in the limited reliability of visual analysis (Brossart, Parker, Olson, Mahadevan, 2006). More recently, many have argued

(see Parker, Vannest, Davis, & Sauber, 2011; Krotochwill et al. 2010), that the behavioral sciences would benefit from reporting effect size calculations in SCR, in order to provide a clear index of association between contrasted phases (i.e., baseline and intervention; Brossart, Parker, Olson, Mahadevan, 2006). Common among effect size calculations for SCR are non-overlap techniques. These techniques are non-parametric, and attempt to define the magnitude of improvement between phases by analyzing the proportion of data points that overlap with data from prior phases (Davis, 2013). The effect size chosen for use in the study is a non-overlap technique called Tau-U. Tau-U is calculated by comparing data points in baseline to each intervention data point; the resulting Tau-U statistic is the proportion of all pairs that do not overlap (Mason, et. al, 2014; Parker, Vannest, & Davis, 2011). As Tau-U follows the "S" distribution, relevant confidence intervals, and p values are available for this statistic. To be certain, these are imperfect methods, and with very small sample sizes little emphasis should be placed on "statistical significance". However, the purpose of utilizing effect size calculations for SCR is to validate and compliment the visual analysis in order to determine results that are practically significant (Brossart, Parker, Olson, Mahadevan, 2006).

Data were graphed and the differences between the baseline phase and the intervention phase were evaluated based on data trend, mean, and data variability. A statistical analysis for between phase effects was also applied. The Tau-U effects size (Parker, Vannest, Davis, & Sauber, 2012) was calculated to demonstrate the quantitative differences that occurred between phases for each participant. Similarly, all participants' phases were combined to produce an overall effect size for the study. Tau effect sizes were interpreted in the following manner: < .5 = minimal to no effect; .5 to .69 = moderate effects; and .70 to 1.0 = large effects.

Study B: Additional Effects of a VSM Intervention on the Disruptive Behaviors of Adolescents with Autism

Participants, Settings, and Methods

Participants. Calvin and June, who participated in Study A, also participated in Study B. Similarly, two students who participated in the I-Connect pilot study also participated in Study B. These four participants all responded similarly to the implementation of the I-Connect intervention in that their disruptive classroom behaviors decreased when using I-Connect. However, the levels of their disruptive behaviors were still occurring at rates that were affecting task completion and social interaction opportunities (see results of Study A in Chapter 4). The purpose of this follow-up study (Study B) was to investigate whether another efficient technology delivered intervention (VSM), would further reduce the levels of the participants' disruptive classroom behavior when used in combination with the I-Connect application. Criteria for participating in Study B, mirrored that of Study A. However, with additional criteria that students were currently using the I-Connect intervention and still demonstrating disruptive classroom behaviors.

Calvin was an 18-year-old African-American male with a diagnosis of autism. Calvin was attending an 18-21-transition program in a local urban high school. Calvin's most recent IQ score was administered two years prior to this study and according to the Leiter-R (Roid, Miller, Pomplun, & Koch, 1997), Calvin had a Full Scale IQ score of 60. Teacher information indicated that Calvin had limited spontaneous verbal communication, although he could answer questions verbally and would respond to social initiations when prompted. Calvin was able to read words, phrases, and short books. At the time of the study, Calvin was pursuing a job in the community, and volunteered at three separate community settings to enhance his job placement potential.

June was a 12-year-old Caucasian female attending a local suburban middle school. June's most recent IQ score was administered more than five years prior to this study, so the results were not included. However, she was administered the *Verbal Behavior Milestones, Assessment and Placement Program* (VB-MAPP; Sundberg, 2008) in 2012. The VB-MAPP is a criterion-referenced test of language, communication, and adaptive behavior that is administered to students with autism. According to the VB-MAPP results, June demonstrated language and learning behavior that fit the developmental milestone for individuals 30-48 months. Teacher information indicated June had limited spontaneous verbal speech. She was able to communicate basic wants and needs verbally. June could read words and phrases, and could respond to written questions. At the time of the study, June was attending classes in both general and special education settings.

Barry was a 14-year-old Caucasian with a diagnosis of autism. In addition, Barry was medically diagnosed with ADD and Down syndrome and was taking medicine for attention at the time of this study. Barry's most recent IQ test was one year prior to the study. The Universal Nonverbal Intelligence Test (Bracken & McCallum, 1998) assessed his overall Full Scale IQ at 54, falling into the much-delayed category. The *Vineland Adaptive Behavior Scales, Second Edition* (Sparrow, Cicchetti, & Balla, 2005) was also given one year prior to the study. Teacher scores indicated an Adaptive Behavior Composite of 54.

Carl was a 14-year-old Caucasian with a medical diagnosis of autism and ADHD. At the time of the study, Carl was taking medication for attention. According to school records, Carl met special education eligibility under the category of autism. He also received services in the areas of speech and language. No recent IQ tests had been administered; however, five years earlier he was assessed as having a Nonverbal IQ score of 53 on the *Stanford-Binet Intelligence*

Scales, Fifth Edition (Roid, 2003). His overall intelligence was classified as Moderately Delayed and ranked at the 0.1 percentile of same-age peers. The *Vineland Adaptive Behavior Scales, Second Edition* (Sparrow, Cicchetti, & Balla, 2005) was also given to Carl one year prior to the study. Teacher scores indicated that Carl's adaptive behavior skills were in the Low range with scores of 58 on the Adaptive Behavior Composite.

Settings. The settings for Calvin and June remained unchanged from Study A to Study B. Bobby and Carl attended a local urban middle school in the same school district that Calvin attended. The middle school served students from diverse populations (77% minority) who were economically disadvantaged (85% free and reduced lunch). All data were collected for Carl and Bobby in their special education classroom while they were completing independent work activities. These activities consisted of writing personal information, identifying emotions, labeling actions, and math worksheets.

Materials. In addition to the I-Connect application detailed above, each student also received a video modeling intervention (VSM). The VSM treatments were all recorded with the Samsung Galaxy 5.0, and edited with Corel VideoStudio 5.0. The VSM were all between 40 and 48 seconds long and demonstrated the students "working quietly." Each video contained approximately 10 seconds of adult narration highlighting specific features of working quietly. The videos were watched on the Samsung Galaxy 5.0 tablet immediately prior to the student participating in the setting where data were collected.

Experimental Design and Measurement

Design. A concurrent multiple baseline design (MBD; Baer, Wolf, & Risley, 1968) across the four participants was used to evaluate the effectiveness of the I-Connect application and a VSM treatment on disruptive classroom behaviors. This type of MB design also involved a

series of AB designs with staggered treatment phases (Christ, 2007). This research design was adequate for demonstrating internal validity with at least three subjects; three demonstrations of effect meets quality standards as established by the What Works Clearinghouse (WWC; Kractochwill et al. 2010). This study was carried out over the course of three weeks with three to four, five-minute observation sessions per week. Observations and data collection occurred in the same setting across phases for all participants.

Dependent variable and measurement. Calvin and June retained the same targets as described in Study A. Bobby and Carl had the same targets as described in the I-Connect pilot. Operational definitions of stereotypic behaviors for Barry included: 1) non-functional hand gestures (e.g., hand flapping, waving hands in front of face); 2) placing hands in mouth; and 3) vocalizations not directed at another individual (e.g., grunts, repetitive laughing, and repeating words and phrases). The operational definitions for Carl's stereotypic behaviors included: 1) vocal language not directed to a communication partner and 2) placing hands or objects in the mouth. The measurement procedures were identical to those used in the Study A outline above.

Reliability and Fidelity

Reliability. Inter-observer agreement was measured in exactly the same manner as described in Study A. Overall reliability for all phases and all participants was 87.33% with a range of 77%-100%. Overall reliability for Calvin was 98% with a range of 96%-100%. Overall reliability for June was 82% with a range of 77%-87%; reliability for Carl was 85.5% with a range of 79%-90%. Finally, overall reliability for Bobby was 87.67% with a range of 80%-93%.

Fidelity of implementation. Treatment fidelity was assessed on 25% of all VSM sessions. Treatment fidelity was assessed using a three-question fidelity assessment, consisting of the following "Yes/No" questions: (1) Did students watch the video model immediately

before the target task? (2) Did students attend to the video model without prompts? (3) Did students begin self-monitoring intervals immediately after watching the video model? The number of "Yes" responses was divided by the total number of questions for an overall percentage of treatment fidelity. Treatment fidelity was assessed at 100% for all participants.

Procedures

I-Connect. During the I-Connect phase, students accessed the I-Connect device as described above in Study A. Data were collected on the percentage of intervals where the target behaviors occurred. Once the third student in Study A began the I-Connect intervention phase, data collection commenced for Bobby Carl. Data collection continued for five additional data points and then students were systematically introduced to the I-Connect plus VSM phase of the study.

I-Connect and video self-modeling. In this phase of the study, students had access to the I-Connect application in exactly the same manner as described in Study A and the I-Connect pilot. However, immediately prior to initiating the self-monitoring application, students watched a VSM that showed them completing tasks in the target environment. The video segments showed the students demonstrating appropriate behaviors, that is, alternatives to the targeted disruptive behaviors. All disruptive behavior or prompts were edited out of the video in order to provide students with a view of "future mastery" (Dowrick et al., 2006). This procedure allowed them to view successful completion of tasks without any demonstrations of disruptive behavior. Students viewed the VSM immediately prior to participating in the activities described above, after viewing the video, the researcher or teacher logged into the SM application (which usually took about 15-20 seconds) and students began the SM routine by pressing "Start timer." Videos were viewed on the same device where the SM application was functioning.

Data analysis. Both visual analysis and statistical analysis were used to evaluate the relationship between disruptive behavior and the two intervention treatment phases (I-Connect and I-Connect plus VSM). The evaluation methods were exactly the same as discussed in Study A.

Chapter 4

Results

Study A

I-Connect intervention. Results for the baseline and intervention phases are graphically displayed in Figure 1. The x-axis of the figure represents the observational data collection sessions, and the y-axis represents the percentage of intervals in which disruptive behaviors occurred. Data are represented for all participants of Study A; Calvin is in the top pane of the graph, June is in the middle pane, and Joseph is in the final pane. The phase change lines represent the introduction of the I-Connect intervention, which was systematically introduced and staggered across participants. A phase mean line is also graphically displayed for each participant and phase.

Visual analysis of baseline data indicates high rates of disruptive behavior, with some level of variability for both Calvin and June. During baseline, percentage of intervals with disruptive behaviors for Calvin was usually above 50%; for June, baseline levels were usually above 60%. Joseph demonstrated lower levels of disruptive behavior during baseline, with percentage of disruptive behaviors approximately 30%. Introduction of the I-Connect intervention caused an immediate decrease in levels of disruptive behavior for Calvin, with only one data point returning to baseline mean. June demonstrated a less dramatic response to the I-Connect intervention, though a majority of intervention data points were below that of baseline. Joseph demonstrated a minimal response to the I-Connect intervention via visual analysis.

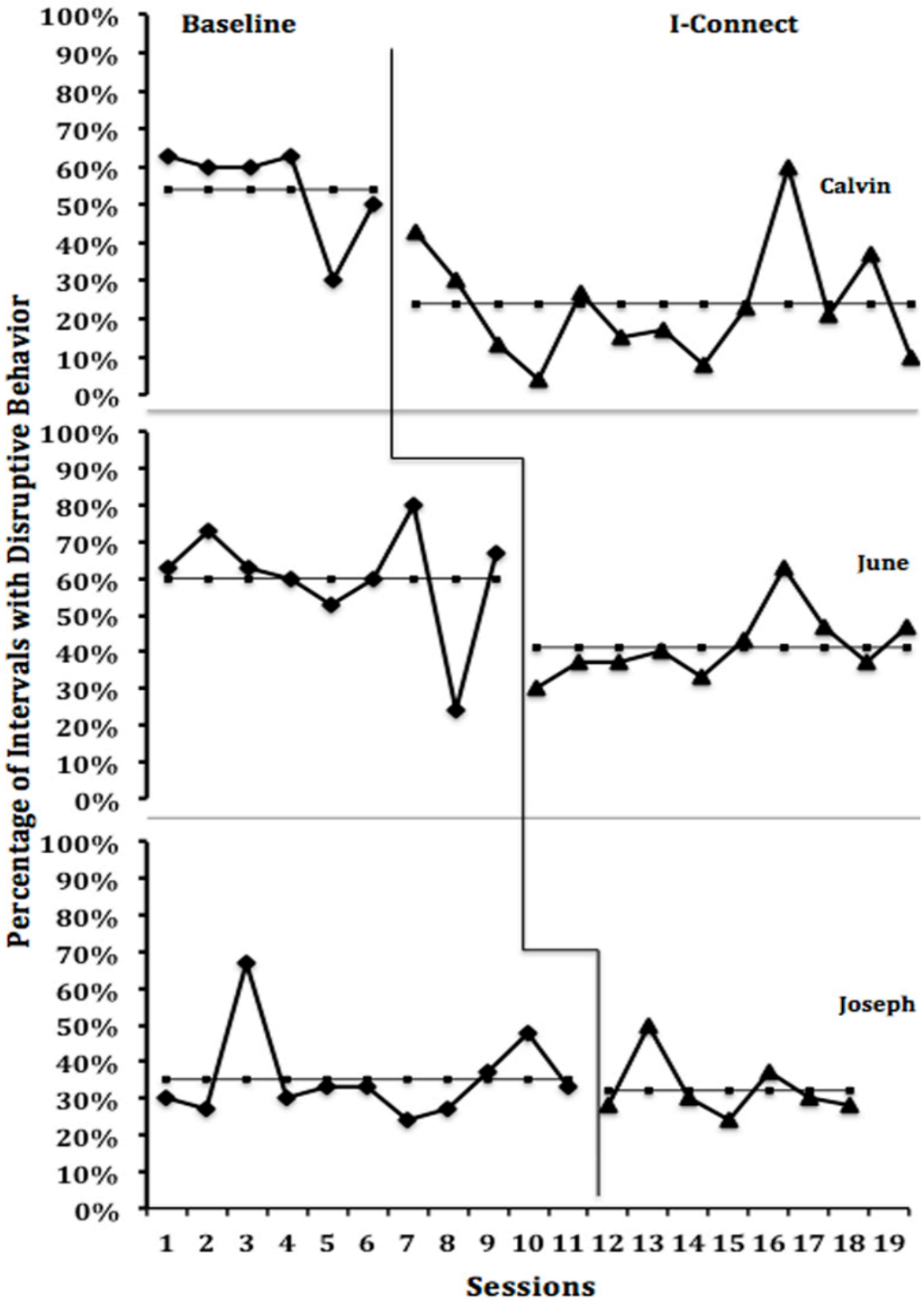

Figure 1. Graphical display of percentages of disruptive behavior

Statistical analysis indicated mixed results for the I-Connect intervention (see Table 1). The mean level of disruptive behavior in baseline for Calvin was 54%; this dropped to 24% with

the introduction of the I-Connect intervention, a decrease of 30%. Tau effect size calculations for Calvin also indicated a large magnitude of change with a Tau of .859. Contrast between baseline and I-Connect phases for June demonstrated results that are more moderate. She demonstrated a mean level of disruptive behavior of 60% in baseline; this fell to an average of 41% with the introduction of I-Connect, a decrease of 19%. Effect size calculations for June revealed a moderate magnitude of change with a Tau of .688. In regards to Joseph, statistical analysis of the contrast between baseline and the I-Connect intervention showed far weaker effects. Joseph's disruptive behavior averaged approximately 35% of intervals in baseline; this fell to 32% of intervals during the I-Connect intervention, a decrease of only 3%. Contrast between the baseline phase and the I-Connect phase indicated a Tau of .114. Statistically, this minimal difference is interpreted as no change between the two phases.

Table 1.

Tau Effect Sizes and Relevant Confidence Intervals

			90% CI	
	Tau Effect Size	P Value	Lower Limit	Upper Limit
Calvin				
Baseline vs. I-Connect	.859	.003	.378	1
June				
Baseline vs. I-Connect	.688	.011	.241	1
Joseph				
Baseline vs. I-Connect	.142	.618	−.652	.329
Combined	.569	.006	.295	.834

Social validity. A 10-item satisfaction survey was given to the teachers, para-professionals, and SLPs who worked with the students. The survey included two sections, and it gauged teacher's overall opinion on the effects of the I-Connect application and the teacher's assessment of how effective and efficient the I-connect was compared to other interventions that had been used in the past to address the same target behaviors. The results of this measure are

reported in Table 2 and 3. Results for each participant were averaged if more than one rater was utilized.

Table 2

Teacher Ratings of the I-Connect Intervention

	Section I: Impact of I-Connect Intervention 1 = No Improvement		5 = Great Improvement	
Student:	Productivity	Work Completion	Accuracy	Grade
Calvin	4	5	3	N/A
June	4	4	4	N/A
Joseph	N/A	N/A	N/A	N/A

Table 3

Teacher Ratings of the I-Connect Compared to Other Interventions

	Section 2: Comparisons to Other Interventions 1 = A lot less than other interventions		5 = A lot more than other interventions	
Student:	Desired change	Efficiency – time	Efficiency – resources	Participant enjoyment
Calvin	5	5	5	5
June	4	5	5	4
Joseph	3.5	4	4	3

Results indicate that raters found the intervention to be useful and efficient. Perhaps most important, the raters believed the intervention to be more effective than other interventions that have been utilized to address these behaviors in the past. The intervention was also perceived to be more efficient in both time and resources than prior interventions. All raters indicated that they would be interested in future use of the I-Connect intervention.

Functional assessment. As discussed in Chapter 3, the motivation assessment scale (MAS; Delaney, & Duran, 1986) was administered to teachers and support staff to identify potential underlying motivators linked to the target behaviors. The motivational categories receiving the highest and second highest raw scores on the MAS are summarized in Table 4.

These results indicate that the I-Connect device was successful in reducing behaviors that had a variety of underlying motivators.

Table 4.

Participant MAS Results

Student	1st MAS Result	2nd MAS Result
Calvin	Obtain Tangible	Obtain Attention
June	Sensory	Attention
Joseph	Sensory	Obtain Tangible

Study B

I-Connect and VSM intervention. Results for the I-Connect and intervention phases are graphically displayed in Figure 2. The x-axis of the figure represents the observational data collection sessions, and the y-axis represents the percentage of intervals in which disruptive behaviors occurred. Data are represented for all participants of Study B, with Calvin in the top pane of the graph, Barry in the second pane, Carl in the third pane, and June in the final pane. The phase change lines represent the introduction of the I-Connect and VSM intervention, which was systematically introduced and staggered across participants. A phase mean line is also graphically displayed for each participant and phase.

Visual analysis of the I-Connect-only phase indicates moderate rates of disruptive behavior with some level of variability for all participants. During I-Connect-only, the percentage of intervals with disruptive behavior for Calvin was approximately 25%; Barry demonstrated slightly higher levels with I-Connect only (40%). Carl and June both demonstrated I-Connect-only levels above 40%. Introduction of the I-Connect and VSM intervention caused an immediate decrease in levels of disruptive behavior for Calvin, with zero data points returning to I-Connect-only mean levels. Carl and June demonstrated less dramatic responses to the I-Connect intervention, although a majority of intervention data points were below that of

baseline. Barry initially demonstrated an increase in levels of disruptive behavior immediately following the introduction of the I-Connect VSM intervention. This steadily decreased and was below I-Connect-only levels by the third session.

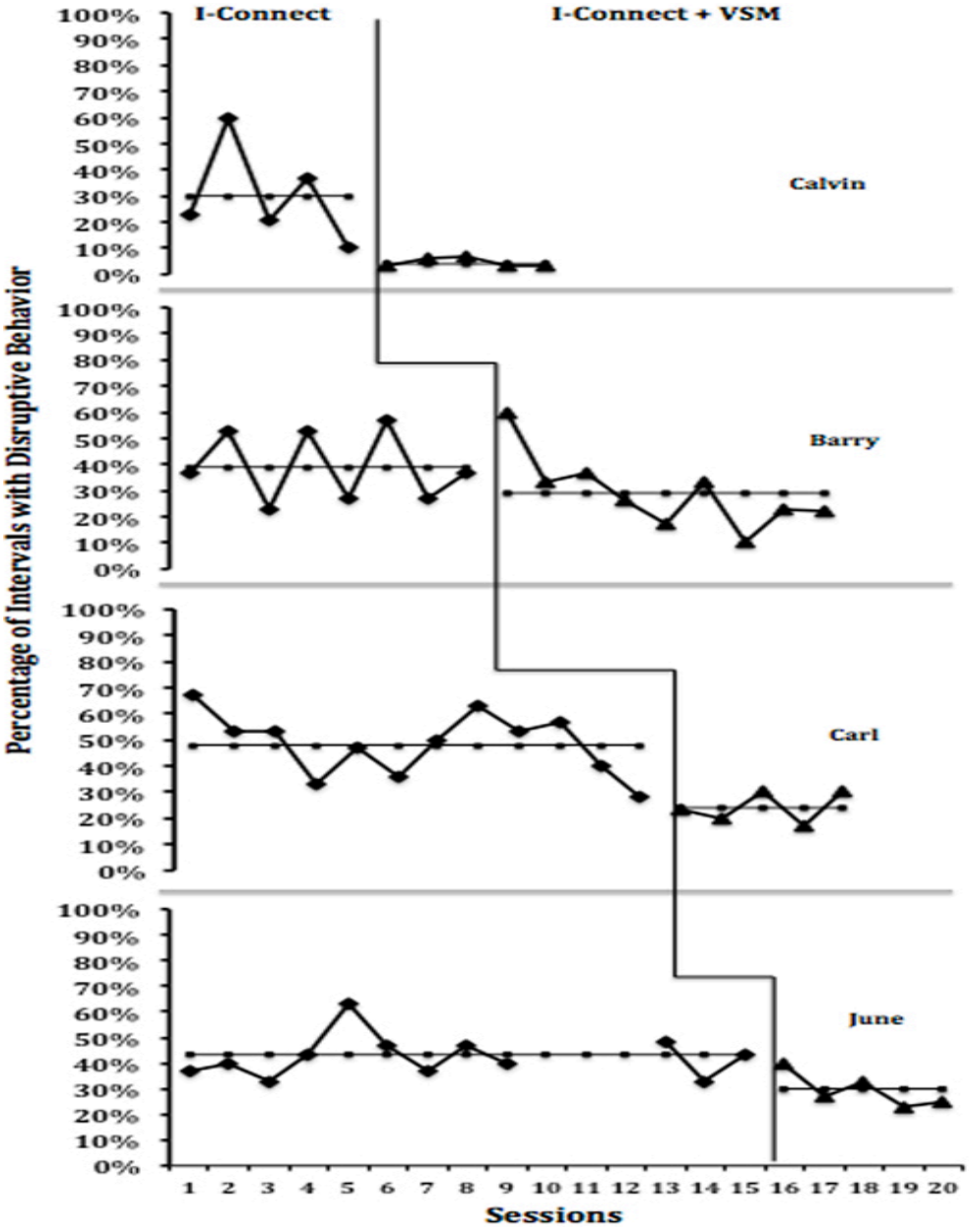

Figure 2. Graphical display of percentages of disruptive behavior

Statistical analysis indicated mixed results for the I-Connect and VSM intervention (see Table 5). The mean level of disruptive behavior in the I-Connect-only phase for Calvin was 30%;

this dropped to a mean of 4% during the I-Connect and VSM intervention, a decrease of 26%. Tau effect size calculations for Calvin also indicated a large magnitude of change, with a Tau of 1.0. Contrasts between baseline and I-Connect phases for Barry revealed limited results. He demonstrated a mean level of disruptive behavior of 39% in the I-Connect-only phase; this fell to an average of 29% during the I-Connect and VSM phase, a decrease of 10%. Effect size calculations for Barry showed little to no change, with a Tau of .458. In regards to Carl, statistical analysis of the contrast between baseline and the I-Connect intervention revealed moderate effects. Carl's mean level of disruptive behavior in the I-Connect-only phase was 48%. This fell to 24% of intervals during the I-Connect and VSM phase, a decrease of 24%. Contrast between the baseline phase and the I-Connect phase for Carl indicated a Tau of .683, which is interpreted as a moderate magnitude of change between the two phases. Additionally, because Carl's I-Connect-only phase demonstrated a rapidly decreasing trend, the effect size calculation was completed after controlling for the baseline trend. During the I-connect-only phase, June's mean percentage of disruptive behavior was 43%; this was reduced to 30% in the I-Connect and VSM phase. This change represents a large magnitude of change between the I-Connect-only-phase and the I-connect and VSM phase, as validated by the calculated Tau of .800

Table 5

Tau Effect Sizes and Relevant Confidence Intervals

	Tau Effect Size	P Value	90% CI Lower Limit	Upper Limit
Calvin				
I-Connect vs. IC + VSM	1.0	.009	.370	1
Barry				
I-Connect vs. IC + VSM	.458	.112	-.017	.933
Carl				
I-Connect vs. IC + VSM	.683	.030	.163	1
June				
I-Connect vs. IC + VSM	.800	.011	.413	1
Combined	.671	.000	.407	.935

Extended training with Joseph. As discussed in Chapter 3, additional training in the form of video feedback was provided to Joseph. These results are graphically displayed in Figure 3. The visual analysis of these results indicates that Joseph responded positively to the additional training sessions. When the I-Connect intervention was reintroduced, Joseph's behavior remained stable for one session and then began a decreasing trend.

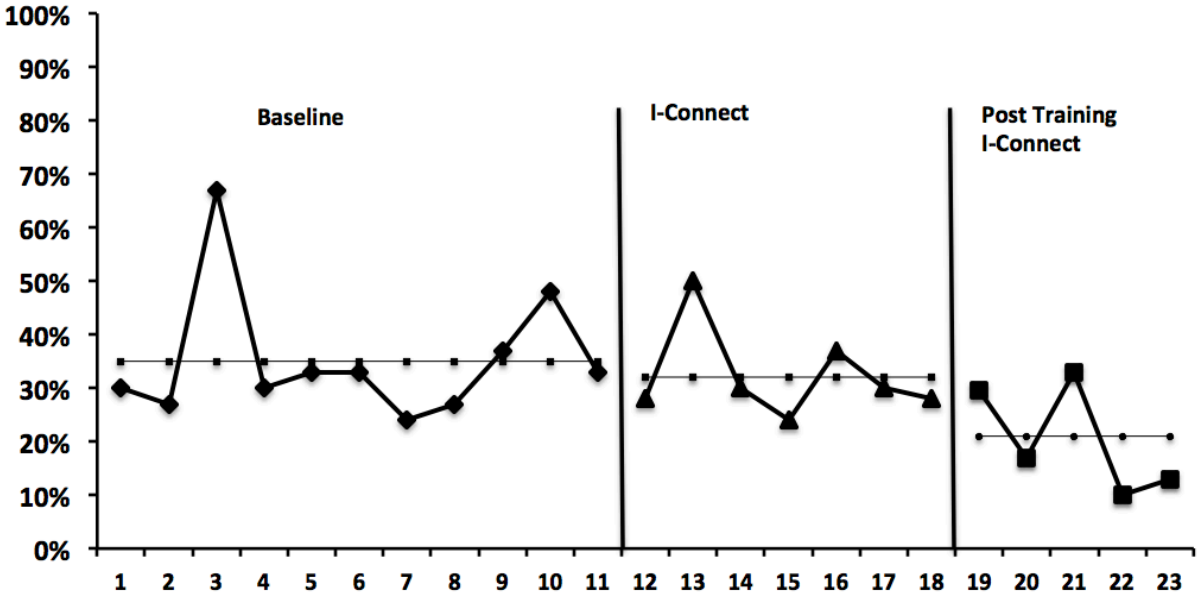

Figure 3. *Graphical display of Joseph's percentage of disruptive behavior*

Statistical analysis indicated that during the baseline phase Joseph's average percentage of disruptive behavior was 35%; it dropped just 3% with the first I-Connect phase. However,

after the video feedback training sessions, Joseph's average percentage of disruptive behavior was 21%, a decrease of 14% from the initial baseline phase. Effect sizes between the initial I-Connect phase and the post-training I-Connect phase were still small (.458), indicating little change between the two phases of I-Connect, though the combination of the two interventions nearly cut percentages of Joseph's disruptive behavior in half. Table 6 summarizes the effect sizes and relevant confidence intervals for Joseph's extended training sessions.

Table 6

Tau Effect Sizes and Confidence Intervals

			90% CI	
	Tau Effect Size	P Value	Lower Limit	Upper Limit
Joseph				
Baseline Vs. I-Connect	.142	.618	.437	1
1st I-Connect vs. 2nd I-Connect	.458	.165	.378	1

In summary, the two studies revealed mixed, yet promising results. All participants in study A demonstrated reduced levels of disruptive behaviors, although Joseph needed some scaffolding procedures in order to demonstrate significant reductions in his disruptive behavior levels. Study B was largely successful in further reducing these levels for Calvin and June, as well as for Barry and Carl from the I-Connect pilot. These results are discussed at length in Chapter 5.

Chapter 5

Discussion

As outlined in Chapter One, the purpose of this research project was to (1) determine whether the promising results of the I-Connect pilot could be replicated with students with similar classroom behaviors; and (2) evaluate the effects of implementing a VSM intervention in combination with the I-Connect intervention.

Though the results of Study A were positive, the functional relationship demonstrated by the I-Connect pilot was not fully replicated with all participants. Additional training sessions and video feedback routines were necessary for Joseph to demonstrate a significant reduction in disruptive behaviors. The results of Study B indicated that the combination of the I-Connect intervention and a VSM intervention into one treatment package further reduced the levels of disruptive behavior for all four participants demonstrating a functional relationship between the bundled interventions and decreased levels of the target behaviors. A detailed analysis of these results follows, including strengths, limitations and directions for future investigations.

Discussion of Study A

Strengths. Though ultimately inconclusive, Study A offered promising results as a follow-up to the I-Connect pilot. Two students demonstrated significant decreases in disruptive classroom behavior that had been resistive to prior treatments. The third student required additional training procedures to demonstrate similar results, but nonetheless eventually responded to the intervention, demonstrating a moderate magnitude of change in disruptive behaviors. Combined with the results of the I-Connect pilot study, which showed a clear functional relationship between the I-Connect intervention and levels of disruptive behaviors, these results present a compelling case that the I-Connect application may be a useful tool for

certain adolescents with autism. This outcome resonates in five key ways: (1) it provides additional experimental evidence regarding the effects of SM interventions to decrease stereotypic and disruptive classroom behaviors for adolescents with autism in a school setting; (2) it expands the current empirical literature regarding SM interventions to include an innovative, technology-delivered SM application; (3) it provides preliminary information on the features of SM interventions that contribute to this intervention's overall effectiveness; (4) it provides guidelines on how to successfully scaffold SM interventions for non-responders; and (5) it offers social validity information, indicating the I-Connect intervention was more efficient than previous interventions utilized to address the same behaviors.

As discussed in Chapter Two, SM interventions have demonstrated broad effectiveness for adolescents with autism (Lee, Shogren, & Simpson, 2007, Mancina et al., 2001. However, the current state of the literature supporting the use of self-monitoring for adolescents with autism in school settings includes only 9 studies, with 13 total participants. While promising, this literature base is still developing, and it benefits greatly from this current research. Namely, 5 adolescents with autism demonstrated decreases in problem behaviors as a result of Study A and the I-Connect pilot, which increases the total number of students with autism who have demonstrated positive effects connected to SM interventions, thus further establishing this practice as evidenced-based.

Similarly, only 1 study (Yakubova, Taber-Doughty, 2013) to date has utilized a technology delivered self-monitoring system to target outcomes for adolescents with autism. While offering promising results, the researchers used SmartBoards™ (large, interactive whiteboards that are generally stationary) to provide prompts and allow students to monitor the number of steps completed in a daily living routine. No current research has utilized mobile

technology systems to provide ongoing self-monitoring for adolescents with autism in school settings. The results of Study A and the I-Connect pilot thus contribute significantly to the research surrounding SM interventions by extending self-monitoring to include mobile technology devices. Mobile devices can be used consistently across environments, are easily portable, and contain all components of the self-monitoring system (e.g., timing mechanisms, prompts to record behavior, and student responses). Also, mobile phones are embedded within the culture of adolescents and are therefore more socially acceptable and less stigmatizing than more traditional SM systems (i.e., timers, checklists, charts, and so forth), especially in general education settings. Anecdotally, students who participated in this study appeared highly interested and motivated in using the devices, evidenced by students requesting "to use the phone," looking for the device if it was not present, independently getting the phone and placing it in their workspaces, and/or re-positioning the devices in their workspace for easier referencing.

SM interventions often include a variety of components (see review in Chapter 3 and Lee, Shogren, & Simpson, 2007). These features include explicit discrimination training, the ongoing self-monitoring or self-recording of behavior, and reinforcement packages. It is currently unclear what value discrimination training and reinforcement add in terms of overall treatment and intervention effects. In their 2007 meta-analysis on self-monitoring interventions for students with autism, Lee and colleagues argued that studies, which included sessions of explicit discrimination training, did not produce superior results to studies that did not include this training. They posit that this is likely due to contextual factors that make this type of training redundant, though they urged researchers to investigate the usefulness of this type of training. Each student in the I-Connect pilot study and 2 of the 3 students in Study A demonstrated decreases in the targeted behaviors without sessions of discrimination training,

indicating that discrimination training may not be necessary for some students, which makes implementation of SM interventions more time and labor efficient. This inference bodes positively relative to teacher resources. Similarly, specific reinforcement of appropriate behavioral levels was not used in any way during the I-Connect treatment. The existence of student improvement despite the lack of discrimination training and reinforcement indicates that SM alone, and particularly the I-Connect application, was sufficient to address inappropriate classroom behaviors for some students. To be clear, these results are preliminary, and additional component analysis of SM interventions seems warranted; however, these results are clearly encouraging.

Another strength of this study is the information it provides on how to successfully scaffold SM interventions, should students not respond. Joseph did not immediately respond to the I-Connect intervention. He needed additional training (and ultimately reinforcement) to respond to the monitoring prompts. In addition, once the I-Connect intervention was implemented and he responded to the monitoring prompts, his behavior decreased only marginally. In an effort to determine what procedures would be necessary to elicit positive results, this study looked at a specific scaffolding procedure in the form of extensive discrimination training. The discrimination training included sessions of video feedback (see Chapter 3 for specific details) and accuracy criteria before the I-Connect device was re-introduced. The success of this system may inform future protocol scaffolding of SM interventions. Perhaps, students who do not initially respond to SM interventions will need to be introduced to more specific, targeted iterations of the intervention, much in the same way that a tiered intervention framework (i.e., Response to Intervention (RTI) supports increasingly targeted interventions for non-responders. In this way, practitioners could initially implement

SM interventions without time-consuming discrimination training, if students do not initially respond to the SM intervention. That is, efforts may need to include discrimination training and ultimately reinforcement for some students. This is likely to create not only more efficient implementations of SM interventions, but also increased access to more specialized interventions for non-responders. Additional research on this and other scaffolding systems will greatly benefit practitioners seeking to implement maximally efficient and effective interventions.

Finally, data collected from teachers in both the I-Connect Pilot and Study A indicated that the intervention was more efficient and more effective than previous interventions implemented to address the same behaviors. This is important in that one of the supposed benefits of the I-Connect application was the ability to manage and organize all of the monitoring materials in one self-contained system that need not be controlled by teachers. Similarly, treatment fidelity measures indicated that teachers were not providing prompts to students regarding the monitoring materials. One premier advantage of the I-Connect application appears to be its ability to independently manage the monitoring system. This advantage will likely free teachers to attend to other matters and offer students the opportunity to independently engage in the intervention.

Limitations. As with any study, Study A has certain limitations. Foremost, is the inability to establish a functional relationship between the I-Connect application and corresponding decreases in the target behaviors for all study participants. While two of the students (Calvin and June) demonstrated decreases in the targeted behaviors after the implementation of the I-Connect intervention, Joseph needed additional training sessions to accomplish results similar to the other participants. This additional training included specific discrimination training and a slightly modified user interface (see Chapter 3 for details) to

accomplish results similar to the other participants. Accordingly, it is unclear what component was most responsible for the demonstrated outcomes for Joseph: the I-Connect application, the discrimination training, or the altered user interface. Quality standards for single case research (see Kratochwill et al. 2010) require three separate demonstrations of change in order to demonstrate a functional relationship. Study A had only two demonstrations of change with the introduction of the I-Connect only intervention as additional components as discussed above were needed to produce overall changes for the third participant. Several factors may have impacted Joseph's response to the I-Connect, including (1) relatively low levels of the targeted behavior during baseline and (2) specific person characteristics of Joseph that differed from other participants in the study.

Prior to baseline data collection, Joseph began a new medication for attention, which prompted discussion between stakeholders regarding Joseph's continued participation. Ultimately, the stakeholders decided to proceed, as it was unclear what effect the medication would have on his behavior. At this point in the study, no data points had been collected while Joseph was receiving medication. Anecdotally, both from teacher reports and from pre-baseline observations made by the researcher, the medication likely had an effect on Joseph's baseline levels of disruptive behavior. Though the extent of these effects is not known, Joseph did demonstrate a relatively low rate of the disruptive behavior during baseline, averaging disruptive behavior in 35% of intervals. It this thought that this level would have been higher had Joseph not been on medication. This relatively low level of disruptive behavior for the student offered little room for improvement compared to baseline levels of the other participants (i.e., 55% for Calvin and 63% for June). The target behaviors were still disruptive to the classroom environment and the medication did not seem to impact the intensity of the behavior, as Joseph's

screaming behavior made instruction difficult at times. Connectedly, behaviors that occur infrequently may not be as sensitive to treatment via SM, compared to behaviors that occur more frequently.

More importantly, specific person characteristics were possible factors in the results achieved by Joseph, particularly when combined with the current configuration of the I-Connect application. These factors may have prohibited Joseph from accessing maximum benefit from the intervention. Of the five students who participated in the I-Connect Pilot and Study A, four of them (Calvin, Carl, Barry, and Joseph) had been assessed using the Vineland *Adaptive Behavior Scales, Second Edition* (Sparrow, Cicchetti, and Balla 2005) within the past three years; three of the students (Calvin, Carl and Barry) had received IQ scores within the last five years (see table 1). The Vineland was the only assessment that at least four of the participants had received as a part of their school programming As school protocol required formal procedures (e.g., parental consent, assessments conducted by a multidisciplinary team, etc.) to conduct assessments, this study relied on existing assessment results to describe participant characteristics. Therefore, no additional assessments were administered, and comparisons between student characteristics relied on the Vineland results and teacher observations.

Table 1: Participants Vineland Results

Student	**Adaptive Behavior Composite Score**	**Full Scale IQ Score**
Calvin	60	60 (Lieter-R)
Carl	54	53 (TONI)
Barry	58	54 (UNIT)
Joseph	38	-
June	-	-

The Vineland is a measure of adaptive behavior that is widely used for students with autism; the Adaptive Behavior Composite (ABC) on the Vineland is a standard score that reflects

the overall level of adaptive behavior. It is highly correlated (r =.82) with mental age and moderately correlated with level of autism severity as measured by the Childhood Autism Rating Scale CARS (r -.53; Wells, Condillac, Perry, & Factor, 2009). In this connection, the ABC is a good predictor of cognitive capabilities and autism severity. Given this assessment-based relationship, it appears that when compared to the other three students with ABC scores, Joseph was functioning at a much lower level in terms of cognitive capabilities and autism severity. Joseph's ABC was more than one standard deviation lower than the other three students, indicating that the other participants may have had significantly higher cognitive and/or adaptive behavior assets. These abilities may have prevented Joseph from benefiting from the I-connect application, at least as configured.

June did not have an ABC score to shore up this argument; nevertheless, she appeared to be performing at a much higher level than Joseph. June and Joseph had the same case manager, who indicated that June demonstrated spontaneous language, some grade level reading, and the ability to respond to interactions from peers and adults without prompting. Joseph, on the other hand, demonstrated no spontaneous language besides verbal approximations for wants and needs; he could read only a few select sight words; and he would only respond to others if prompted. Therefore, anecdotal information strongly suggests that Joseph possesses characteristics that prevented him from benefiting from the device without discrimination training and the adjustment of the user interface, especially relative to the traits of other participants in this study. This information is valuable relative to future research because it suggests certain students may need equipment adaptations and individualization. That is, the I-Connect application may need to include features to make it more accessible (e.g., icons and pictures) for students with characteristics similar to those of Joseph.

Another weakness surrounding this study is the lack of generalization trials or fading procedures. Students with autism have well-documented deficits in skill transfer and generalization of learning effects across environments (Simpson, & Myles, 2008). Interventions that can demonstrate effects across multiple environments are uniquely positioned to offer maximum benefit for individuals with autism. Similarly, interventions that can demonstrate effects following systematic fading procedures (as was accomplished in the I-Connect pilot) are advantageous in that they provide for greater independence and reduce reliance on instructor-driven interventions for successful outcomes.

Directions for Future Research. Several suggestions for future investigations are apparent based on the outcomes of Study A. A component analysis of SM systems could identify the features that produce the greatest effects, which would inform not only further investigations of the I-Connect application but also practice and research associated with SM interventions as a whole. With this information, practitioners and researchers could develop streamlined self-monitoring systems that contained contained only components that contributed to desired outcomes. Similarly, identifying student characteristics that could connect and effectively link to these components seems another logical step in creating SM interventions that are both maximally efficient and effective.

Another future research question relative to SM monitoring systems, and more specifically the I-Connect application, is the role that student accuracy of self-recording contributes to the overall effects of self-monitoring systems. As discussed in Chapter 2, the contributions of accuracy of self-record are not fully understood, as foundational studies of self-monitoring demonstrated that accuracy of self-record was not correlated with positive outcomes (O'Leary, & Dubay, 1979; Zirpoli, 2008). Similarly, more recent studies have validated this by

demonstrating effects despite low levels of accuracy (Koegel, & Koegel, 1990). Other studies (Morrison, Kamp, Garcia, & Parker, 2001;Coyle, & Cole, 2004) similar to this investigation, simply have not addressed the accuracy of self-recording, and instead measure the effects of the SM system without considering this variable. A formal investigation of the relationship between student accuracy of self-recording and overall outcomes would likely contribute to a more complete understanding of SM interventions by informing more fully the current theories of change surrounding SM. Multiple theories of change are currently discussed within the SM literature; however, they generally center on a subject-driven model of behavioral evaluation (Kanfer, 1997). If future research for adolescents with autism routinely connects low levels of accuracy to positive effects of SM, then perhaps the primary change agent is actually a response to environmental cues to self-monitor or self-record, either from the teacher or the cueing system (i.e, the I-Connect application), as others have suggested (Nelson, & Hayes, 1981). In actuality, the change agent may differ based on student characteristics, intervention implementation protocols, and environmental factors. Developing such an understandings relative to adolescents with autism in school settings seems particularly advantageous, given the difficulties faced by these individuals across school, home and community environments.

Discussion of Study B

Strengths. Four students (Calvin, Carl, Barry, and June), all of whom responded similarly to the I-Connect application, were included in Study B. Study B demonstrated a functional relationship between the use of the I-Connect application plus a VSM intervention and decreasing levels of disruptive classroom behavior. Study B extends the current literature surrounding VSM in four key ways: (1) it extends the VSM literature to include more adolescents with autism in a school setting; (2) it demonstrates positive effects of a VSM

intervention in combination with a SM intervention; (3) it demonstrates VSM effectiveness when applied on a mobile device; and (4) the VSM intervention essentially extinguished the target behavior for one participant. The specific results and directions for future research are discussed below.

As discussed in Chapter 2, video-based modeling interventions have been used extensively to improve a variety of outcomes for individuals with autism. However, relatively few studies have included VSM as an intervention for adolescents with autism. In this connection, Study B contributes four additional participants to the literature base. Results for all students demonstrated decreased levels of disruptive behavior. Three participants (Calvin, Carl, and June) all demonstrated a large magnitude of change in behavioral levels: Calvin Tau = 1.0 Carl Tau = .683, June Tau = .80. Only Barry demonstrated decreases that were quantified as little change (Tau = .458). The combined effect for all four participants was an overall effect size of .671. This study resulted in three independent demonstrations of change across participants, thus meeting quality criteria standards (Kratochwill, 2010).

These results demonstrate the additive effect of VSM on the target behaviors beyond the effects participants demonstrated when the I-Connect application was used alone. This is significant because VSM interventions are relatively easy to create and implement, generally non-intrusive to participants or classroom routines, and capable of multiple viewings by the students with consistent instruction. VSM and other video based models have been increasingly used as enhancements to other evidenced based practices (Simpson, & Crutchfield, 2013), and this study contributes to the theme of using these flexible interventions to provide additional instruction to students with autism. The results of Study B also support the use of VSM interventions in combination with SM. Such an effect has only been explored in one other

intervention study on adolescents with autism (Yakuobva, & Taber-Doughty, 2013). This is encouraging in that both interventions (VSM and SM) are efficient treatments that can be maintained without direct or only minimal teacher support once implemented. Further research in this relationship, including what implementation order (e.g., SM then VSM, or VSM then SM) garners the most desired outcomes, will better support and inform practitioners looking to implement these interventions in combination.

The fact that this study demonstrated the positive effects of a VSM intervention viewed on a mobile device for adolescents in school settings is of particular importance. As discussed above, mobile devices are ubiquitously embedded in adolescent and popular culture. Leveraging these technology devices as learning tools for adolescents with autism should be of primary concern for practitioners and researchers alike. The indication that VSM can be transferred to smaller screens while still demonstrating the desired effects is especially encouraging. While some have suggested (Ayers, & Mechling, 2013) smaller screens are less effective than larger screens, relatively little is known about the effect of screen size, including the possible benefits of portability and optimal outcomes and user preferences. Investigations of the effects of differing screen sizes and how VSM interventions can be implemented most effectively via mobile devices is an area that is ripe for future analysis.

Finally, a particular strength of study B was the effect of the intervention on Calvin's disruptive behavior levels. Calvin was demonstrating high levels of disruptive behavior during baseline, including behaviors that were highly averse to students, teachers, and staff. These behaviors included screaming, swearing, kicking the wall, and repeating inappropriate and offensive words and phrases, some of which were threatening in nature (e.g., "I kill you", "you dead"). The I-Connect device improved these behaviors, but they still occurred on an average of

25% of intervals. The VSM intervention, however, reduced these behaviors considerably. Calvin averaged only 4% of intervals for disruptive behavior when the VSM intervention was applied. What is not encapsulated in these data is the fact that the intensity of the behavior changed as well. Anecdotally, Calvin was no longer swearing or repeating threatening phrases and instances of the target behavior after the VSM intervention were reduced to mumblings or whispers to himself. The teachers and support staff who worked with Calvin were in awe of his transformation and curretly seek to expand the use of I-Connect and VSM to additional environments. This is very meaningful in terms of adult outcomes for Calvin. He is currently interviewing for jobs and hopes to find employment in the next few months. The disruptive behavior that Calvin demonstrated would likely obstruct employment in most community settings. Thus, these positive results could potentially affect Calvin's post-secondary trajectory, adult outcomes, and quality of life.

Limitations. The results of study B are promising and inform not only current practice but also future research. Yet they contain flaws. A primary weakness is that one subjects demonstrated a decreasing baseline trend prior to the introduction of the VSM intervention. Standards for high quality single case research indicates that studies with baseline trend in the direction of desired behavior change prior to the introduction of the intervention does not demonstrate experimental control (Kractochwill et al. 2010). In single case research, prior data points are expected to correlate with future data points, and decreasing trends may continue to decrease. If interventions are implemented before the data stabilizes, intervention effects are difficult to interpret because data would be expected to decrease with or without the introduction of the independent variable. Two primary factors contributed to the introduction of the independent variable for Carl, despite a decreasing baseline trend. Carl was a participant in the

I-Connect Pilot study. As a result of this participation, nearly 30 points of observational data across the two phases of the I-Connect Pilot and the I-Connect baseline in Study A were available for analysis. These data had a high rate of variability and routinely demonstrated periodic dips and increases. However, no data points had ever been below 25% or above 65% of intervals. Based on these extensive data and related timeline issues connected with changes in Carl's schedule as a result of state assessments, the decision was made to implement the VSM intervention despite the decreasing trend of the I-Connect baseline.

Another possible limitation of Study B is that Barry only demonstrated small decreases in levels of disruptive behavior with the introduction of VSM. Immediately after implementing the VSM intervention, Barry's behavior spiked to 60% of intervals. He then demonstrated a decreasing trend across the next six data sessions, with only one other data point falling above baseline levels. This potentially speaks to a dosage issue surrounding video based modeling and, VSM in particular. Relative to this occurrence little is known about how frequently students should view models and the impact of additional viewing time. It may be that with continued exposure to the visual model Barry would have demonstrated significant decreases in the target behavior. Future investigation on issues related to viewing dosage surrounding video based models would be advantageous to practitioners looking to implement this type of intervention.

Conclusion

Treatment practices for individuals with autism have notoriously featured a variety of un-vetted methods, many of which are commercially available and often make exaggerated claims of effectiveness and utility (see Biklen, 1993; Simpson, 2005). The often desperate search for effective treatments has often exposed individuals with an ASD to more un-validated practices than other developmental disabilities (Heflin, & Simpson, 1998a; Simpson, 2005; White, Smith,

Smith, & Stodden, 2012; Metz,Mulick, & Butter, 2005). We are currently witnessing a continuation of this theme in connection with mobile devices and technology delivered interventions in general. A brief search of the mobile application marketplace on the ios platform (iPhone, iPad, etc…) with the term "autism app", netted over 1,500 results. These options ranged from basic educational games (i.e., matching, writing, letter recognition) to specific applications for individuals with autism (i.e.., augmented communication devices, or discrete trial training tools). It appears that marketers and developers are going out of their way to include mobile apps for individuals with autism and their teachers, family members and therapist, many of which have little scientific evidence to support their use.

While many of these mobile applications are high-tech extensions of evidenced based practices (i.e., social story templates, visual cueing systems, etc.…), little is known about the presentation, delivery, and interface of these applications and whether effects demonstrated through low-tech systems (i.e., paper/pencil systems, pictures cues, etc.) will transfer to high-tech systems (i.e., mobile applications). Jointly the I-Connect Pilot, Study A, and Study B represent highly relevant work connected to innovative, mobile technology interventions for use with adolescents with autism. These studies, not only answer questions related to the effectiveness and utility of the I-Connect application, but also pave the way for similar analysis of other mobile applications that are being developed for, and marketed to, individuals with autism.

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