USING HANDHELD APPLICATIONS TO IMPROVE THE TRANSITIONS OF STUDENTS WITH AUTISM SPECTRUM DISORDERS

Abstract

While the knowledge that has been gained from previous studies has accelerated the understanding of the difficulties facing individuals with ASDs, there is concern regarding the speed with which and the overall lack of translation of research into interventions that make differences in the everyday lives of individuals with ASDs (Gresham et al., 2001; Volkmar et al., 2004; Volkmar, Reichow, & Doehring, 2011). For example, the symptoms of Autism Spectrum Disorders can greatly impair an individual's ability to navigate independently through everyday events. Translating this knowledge into instructional practice requires, then, the design of methods for easing students' transitions within the school, home, and community. While research has validated the use of low-tech visual supports (e.g., National Autism Center, 2009), little has been done to analyze the utility and appropriateness of high-tech assistive technology, such as those interventions administered through smartphones, tablets, and other handheld devices, which are devices that are being used more frequently in education settings (Gray et al., 2010). This chapter presents the results of federally-funded research to determine whether the use of iPrompts—a software application for iOS and Android-based smartphones and tablet computers—assists teachers and other educational professionals as they help students with ASD transition from one activity to the next or from one setting to another.

Characteristics of Autism Spectrum Disorders

Children with autism spectrum disorders (ASD) have difficulties with social interactions and social communication, and have restricted, repetitive, or stereotyped behaviors (American Psychiatric Association, 2013). Once thought to be a rare condition, the most recent prevalence estimates for autism spectrum disorders from the Centers for Disease Control and Prevention (CDC, 2012) estimate that 1 in 88 children in the United States has an autism spectrum disorder. Although it is common and recommended practice for students with ASDs to be educated in general education settings with their like-aged peers, modifications and adaptations are needed to optimize learning opportunities in general education settings for these students. Major difficulties in social interactions are consistently identified as a central feature of ASD (Carter et al., 2005) and can be a powerful predictor of educational outcomes (Malecki & Elliot, 2002; Myles et al., 2005; Welsh et al., 2001). Thus, the underlying social deficits in ASD likely hinder the developmental, cognitive, communicative, academic, social, behavioral, and functional outcomes of students with ASDs (Loveland & Tunali-Kotoski, 2005).

When entering new or unfamiliar social and physical environments, individuals with autism spectrum disorder (ASD) often experience a high level of anxiety that may result in inappropriate behavioral manifestations (e.g., tantrums, crying) and/or social withdrawal. The high level of anxiety and resulting inappropriate behaviors make it difficult for these students to transition to a new environment or setting and to immediately engage in educational and social tasks. Moreover, students with ASD may feel lost or anxious, if daily activities are not clearly indicated, or if the sequence of events is not understood. Students may become prompt-dependent if adults are constantly required to move them from activity to activity, and students may want to shut down (Hume, 2009).

Students with ASDs struggle with the rapid comprehension required for spoken communication. The fleeting nature of verbal language (i.e., once spoken, the words disappear) is especially problematic, when the information is complex and/or lengthy (Hume, 2009). On the other side of the equation, research has consistently shown that individuals with ASD have superior visuo-spatial skills, and learn easier and faster with visual presentation of materials (Garreston, Fein, & Waterhouse, 1990). Therefore, in order to accommodate students with ASD in classroom settings, visual supports will be necessary.

Therefore, developing methods to assist students with ASD transition has been a major focus of educational interventions for individuals across the autism spectrum. There is not one specific intervention that will be effective at reducing problem behavior and social withdrawal during transitions for all students with ASD, and there has not been a great deal of research focusing specifically on transitions. However, our clinical experience and knowledge of how individuals with ASD best learn leads us to believe that visual supports, including visual schedules, "first/then" displays, social narratives, and countdown timers can be used effectively for this purpose. All of these supports can be delivered using both low- and high-tech mediums, the latter of which will be the focus of this chapter.

Assistive Technology

Visual supports can be considered assistive technology using the definition of assistive technology (AT) provided in the Individuals with Disabilities Education Act (IDEA) of 2004, 20 U.S.C. § 1401:

> 1) Assistive Technology Device—
> (A) In General—The term 'assistive technology device' means any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability
> (B) Exception—The term does not include a medical device that is surgically implanted, or the replacement of such a device (Public law 105-394 [29 USC 2201]).

Assistive technology encompasses a wide array of devices and conceptualizing such devices in terms of a spectrum ranging from low-tech to high-tech devices may be helpful. Low-tech devices do not use electronic components, whereas high-tech devices are often based on computer technology. High-tech devices are typically more complicated to operate than low-tech devices, and often require more training, and expenses, as well. However, relative to low-tech devices, high-tech devices may offer unique benefits that make their monetary and training demands worthwhile (Dell, Newton & Petroff, 2008).

The value of assistive technology in the education of students with disabilities is recognized by federal legislators. When IDEA was reauthorized in 1997 it mandated that the assistive technology needs of every student receiving special education services be considered during the process of developing their Individualized Educational Plan. This requirement was maintained in the 2004 reauthorization.

Belief in the benefits of AT is echoed by the results of a 2010 survey that we conducted of assistive technology specialists, speech language pathologists, special education teachers, occupational therapists, and school guidance counselors (Ben-Avie et al., 2010). Two salient themes emerged in the data analysis. The first was that assistive technology increases students' level of success and independence in the classroom and community. Representative statements included, "Assistive technology expands students' ability to communicate with as well as understand the world around them and the choices they have," "Assistive technology helps students become more independent and to participate more fully in daily routines and classroom activities," and "Assistive technology opens the door to life experiences. It gives them an opportunity to be active participants in their learning." The second theme was that assistive technology provides students with disabilities with access to the curriculum and educational opportunities that are more on par with their typical peers. This theme was derived from comments such as, "Assistive technology provides equal access to the curriculum and life," "Assistive technology provides educational and communicative opportunities that greatly enhance that child's world, and would not exist otherwise," and "Assistive technology gives students access to the general education curriculum and participate in ways that may be different but equally effective in learning amongst peers." The teachers and related service providers in the study also identified such advantages of assistive technology for students with ASDs as providing access to the curriculum, communication, myriad life experiences both in school and out of school.

This chapter will focus on how visual supports delivered using assistive technology (AT), especially high-tech AT, can facilitate transitions for students with ASDs. First several evidence-based practices that can be employed using assistive technology will be presented. This will be followed by additional evidence-based practices that are dependent upon mid- or high- assistive technology, where mid-assistive technology refers to devices that use batteries to power voice, text, or light output (Desch & Gaebler-Spira, 2008) and high-assistive technology consists of more complex devices. Finally, considerations for the successful implementation of assistive technology based on our research will be presented.

Video Modeling

Research shows video modeling to be an evidence-based practice (Franzone & Collet-Klingengerb, 2008; Reichow & Volkmar, 2010) for individuals with ASD. Video modeling is an instructional strategy, in which students view videos that depict the targeted behavioral skill. Depending upon the objective of the video and the functional level of the individual, the model in the video might be the student himself or herself (known as video self-monitoring), a typical peer, or an adult.

Video modeling can be used effectively to address behaviors of students with ASDs across all domains. Communication, participating appropriately within the school setting, completing self-care activities, and engaging in leisure and recreation activities are among the functions that video model may target. Research has shown that video modeling can support students' smooth transition between locations and activities within a given school as well as to major transitions such as moving from one school to another (Cihak, Fahrenkrog, Ayres, & Smith, 2010; Ganz, Earles-Vollrath, & Cook, 2011).

Video modeling provides visually supported instruction within a limited area that can increase attention and focus and in a way that requires little social interaction. This capitalizes on the strength of students with ASDs as visual learners, while minimizing learning challenges such as inattention and the demand for social engagement. Being able to view the recorded video numerous times and in a context that students typically associate with recreation may also contribute to the effectiveness of video modeling (Corbett & Abdullah, 2005).

Unlike many visual support strategies that can be implemented using low-tech through high-tech assistive technology this is not the case for video modeling. Sophisticated equipment is required for recording video clips that can be played back at a later time, either edited or unedited. In the past, this could require several pieces, one for recording the video and another for viewing it. Often this would restrict the environment in which the video could be watched. Today, handheld assistive technology provides a compact, all-in-one solution that both captures videos and plays them back. The videos can be played and viewed as often as required and in any environment. Handheld assistive technology makes it possible for students to view videos in multiple environments, including the actual environment in which they will need to practice or imitate the modeled skill.

Commercial video modeling apps are available for purchase and for use on handheld devices. Some of these apps include premade videos, which can be a convenience and timesaver. However, most handheld devices today have a built in camera to record videos that can then be viewed directly on the device, so a dedicated app is not an absolute necessity.

While video modeling was not directly studied in the research described below, the ability to show videos on an iPhone or equivalent when students with ASD are in the community or "on the fly" is a considerable advantage over previous methods in which a video could be shown only on a desktop computer.

Visual Supports

As mentioned earlier, students with ASD typically learn better with the use of visual supports (Hayes, Hirano, Marcu, Monibi, Nguyen, & Yeganyan, 2010). Current research has found the use of visual supports to be an evidence-based practice to support individuals with ASD across many behaviors and activities. The National Research Council (2001) defines visual supports as

> … any tool presented visually that supports an individual as he or she moves through the day. Visual supports might include, but are not limited to pictures, written words, objects within the environment, the arrangement of the environment or visual boundaries, schedules, maps, labels, organization systems, timelines, and scripts. They are used across settings to support individuals with ASD (p. 1).

Visual supports can be created in a variety of formats and for a variety of different purposes. They may provide an analysis of a complex task, a label showing where to find or place materials required to complete a task, they may serve as a static reminder of the expectations of a situation (e.g., sit during circle time, raise your hand to ask the teacher a question), or offer a schedule to help a student understand where to go or what to do next, among other things. Visual supports can help to build independence, because in the presence of visual supports the student needs fewer prompts from adults.

Visual supports facilitate students' comprehension of the environment and transitions. Studies pertaining to support strategies for school-aged students with ASD provide evidence that priming to reduce disruptive-transition behavior and social narratives to support transitions are effective strategies (Briody & McGarry, 2005; Cihak, 2011; Dettmer, Simpson, Myles, & Ganz, 2000; Massey & Wheeler, 2000; Schreibman, Whalen, & Stahmer 2002).

Visual supports are encountered frequently in everyday life and help individuals with and without disabilities to navigate and comprehend the world around them. Examples of visual supports include visual schedules (e.g., train schedules and calendars or day planners), visual reminders (e.g., quiet during story time), and "first/then" displays (e.g., first finish work, then play). Visual supports can help individuals with ASD anticipate daily events and better understand the often complex social milieu surrounding them, thus reducing anxiety and facilitating transitions from one task to the next or from one environment to another.

Visual supports can compensate, in part, for the problems students with ASDs encounter due to the preponderance of information that is conveyed by speech within school settings. Visual schedules provide access to information by focusing on students' strengths in processing visual information, and provide a static reminder of expectations (whereas verbal instructions are often fleeting and only provided once). When students with ASD fail to comprehend orally-presented messages or forget the information, the student can refer to the visual schedule to be reminded of the next step in a task sequence, the next task to be completed, or the next environment to which they need to move. This can be a tremendous help in reducing the anxiety, stress level, and inappropriate behaviors that can result when students with ASDs do not understand the expectations of the environment (Illinois Autism Training & Technical Assistance Project, undated).

Mesibov, Schopler, and Shea (2005) indicate that visual supports, are beneficial because they help to compensate for problems students with ASDs have with sequential memory, organization of time, and attentional issues, as well as receptive language deficits that make comprehending oral directions difficult. Visual picture schedules provide predictability; students know what events, activities, environments, etc. to expect and in what order they will be encountered. These schedules can be especially beneficial to ease transitions from preferred to non-preferred activities (Downing & Peckham-Hardin, 2001).

Current research validates the use of low-tech visual supports, such as visual picture schedules drawn or printed on paper, to facilitate students' comprehension of the sequence in which events will occur or the order in which the steps of a specific task need to be completed. Visual picture schedules support successful transitions from task-to-task or from environment-to-environment (Banda & Grimmett, 2008). Many teachers currently create visual supports, including visual schedules using printed media, often with the assistance of special software, computers and printers (e.g., symbols are selected from a picture library, printed on to paper, cut out with scissors, and then laminated to increase durability). This process can be time-consuming and requires that the visual supports be constructed in advance. This can result in large, physical products (e.g., notebooks containing printed symbols) that may be cumbersome to carry and stigmatizing to use). Typically, these visual picture schedules use graphics that are generic, rather than representative of the actual social or physical environment in which the child is expected to function (e.g., a generic image of a dentist, rather than the actual dentist the child will be visiting; or a generic line illustration of a gymnasium, rather than the actual gymnasium to which the child is expected to transition). The use of generic graphics can be especially problematic for students with ASDs who benefit from the concrete presentation of information, and requires teaching the child the meaning of each abstract symbol – another time-consuming process. While low-tech visual picture schedules that incorporate actual photographic images are more readily comprehensible, constructing them requires even more pre-planning, can be more time consuming, and offers even less flexibility when plans change or unexpected situations are encountered.

Given the proven benefit of visual schedules (National Autism Center, 2009) it is not surprising that those supporting individuals with ASD would seek to capitalize on the portability and multi-functionality of smartphones and other handheld technology to construct high-tech visual picture schedules. The significant data storage capacity of handheld technology permits an almost limitless number of images to be stored – without adding bulk or weight. Photographic images are easily captured in advance or on an "as needed" basis using the built-in cameras. Connectivity to the Internet via Wi-Fi or cell capability provides access to a virtually unlimited supply of visual images that can be downloaded. The visual supports can then be presented to the student with ASD on a device that has a "cool factor" and is used by typical peers instead of using low-tech laminated cut-outs which are secured with Velcro to a cardboard square and often look out of place and atypical.

One method that can be used to incorporate these visual images in a visual schedule is the use of an "app," a software program/application designed for handheld devices. The number of apps that can be used to create a visual picture schedule has increased along with the increased use of smartphones and other handheld technology; a recent App Store search for "visual schedule" resulted in a display of 39 apps. The features available within each app vary as does the complexity of creating schedules, accessing them when needed, and using them with students. To maximize the benefits derived from high-tech visual schedules within a school setting, they must work reliably, consistently, and be easy to use. Regardless of the specific app, the use of high-tech visual schedules that are reliable and easy to use is a promising practice. Within the school setting, these visual supports can be used in a variety of ways to promote student success. Visual schedules that use pictures, optionally accompanied by supportive text, indicating a sequence of events can support transitioning from one class to another or from one activity to another as well as for completing a specific task. For example, a visual picture schedule to support transition might show the following:

- A picture of a math textbook, notebook, and pencil (with or without text such as "Get your textbook, notebook and pencil for math class"),
- A picture of students standing in line (with or without text such as "Line up for math class"),

- A picture of students walking in line in a school hallway (with or without text such as "Walk quietly, in line down the hallway to Mrs. Green's room"), and
- A picture of a teacher standing in her classroom doorway (with or without text such as "Math lesson").

A visual picture schedule to support completion of a specific task might show the individual steps of the task. For example a visual picture schedule to support washing one's hands might include all the discrete steps in the process. Depending upon the app, users may be able to customize the visual supports by selecting (a) illustrations and/or digital pictures included in a digital library within the app, (b) digital pictures taken with the handheld device's camera, and/or (c) images downloaded from the Internet. It is important to have a range of image options available to meet the needs of individual students.

Case Study 1: Feasibility of Using High-Tech Visual Schedules in School Settings

In an effort to determine the feasibility of educational personnel using high-tech visual schedules effectively in actual classroom settings, a study was undertaken by researchers from our Center of Excellence on Autism Spectrum Disorders to evaluate the use of the handheld application iPrompts® in school settings. iPrompts, a software application for iOS and Android-based smartphones and tablet computers developed by HandHold Adaptive includes three main features, each corresponding to a different type of visual support commonly used to assist the learning needs of individuals with ASDs: Schedules, Choices, and Countdown:

- Schedules: Educators create sequences of pictures, guiding those they care for through activities of any sort. Captions can be edited for each image, allowing users to create social narratives. Caregivers can also create simple "First this, then that" picture prompts using only two images.
- Choices: Educators present choices between images for those who cannot vocalize their preferences.
- Countdown: Educators show students a graphical countdown timer (set to any duration).

iPrompts was originally conceived as an app to use in didactic interactions (e.g., caregiver and child) to make it easier for users to create visual supports in advance or "on-the-go" in response to unexpected situations and schedule changes or to take advantage of the "teachable moment." Each of the visual supports available within iPrompts can help individuals with ASDs transition from one activity to the next, understand upcoming events, and/or to focus on the task at hand. This study sought to examine the use of iPrompts in classroom settings.

To launch the study, 25 teachers were trained to use iPrompts and the iPhone and/or iPodTouch. Participants were asked to incorporate iPrompts during their work with students; no directives were given regarding specific visual supports to use or how frequently to use them. Participants were simply asked to use iPrompts how and when they deemed appropriate. Data collection was accomplished through direct observation, video recordings, surveys, and through a focus group.

A scoring rubric for analyzing the 33 videotaped observations was developed by the interdisciplinary research team at the Center for Excellence on Autism Spectrum Disorders ("Autism Center"). The scoring rubric is comprised of three sections: (1) the reliability and ease of use of iPrompts; (2) the teachers' use of iPrompts with the students, including specific features; and (3) the students' responses to iPrompts. The videos were scored by multiple faculty of the Autism Center for a total of 61 scored rubrics that captured the work of all the teachers using iPrompts to help their students with transitions. In almost a third of the videotapes (31%), an exemplary score was given to the teachers' use of the assistive technology to ensure students' "smooth transitions to the next activity." Prior to the use of the scoring rubric for analyzing the videos, inter-rater reliability was calculated and disagreements were resolved through mediation. The process of establishing inter-rater reliability was as follows: (1) four raters observed all of the videos independently; and (2) the raters discussed amongst themselves the reasoning behind the scores that they assigned to each variable. An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among the raters. For example, the inter-rater reliability for the Chair of the Department of Special Education and Reading and the Senior Research Analyst from the Office of Assessment and Planning was found to be Kappa = .865 with (p = .001). Inter-reliability training continued among the raters until all had achieved at least a Kappa of .85 with one another. For example, the Director of the Autism Center and the Chair of the Department of Special Education and Reading started with Kappa = .842 with (p = 001) and this increased to almost identical scores after that. All data collected in this feasibility research suggested iPrompts could be used successfully to ease students' transitions within the school setting (Newton, Eren, Ben-Avie, & Reichow, 2013; Zamfir, Tedesco, & Reichow, 2012).

The focus group discussion confirmed the feasibility of using iPrompts within a school setting. It also provided evidence that visual schedules created in the iPrompts app contributed to smooth transitions. Teachers indicated that they preferred using the iPrompts scheduler to help prepare students for transitions versus using a computer program to create hard copy (low-tech AT) visual schedules. The ease of use of the scheduler application, the amount of time and effort that was saved using the scheduler, and the ability to create schedules "on the fly" as needs arose made it more convenient for the teachers to create and then use the schedules to support students' transitions. Overwhelmingly, the teachers agreed that they would use iPrompts in their classrooms.

The focus group elicited details regarding how, specifically, the use of iPrompts contributed to smooth transitions. Many declared that the visual support they used most often was the visual timer. The visual timer (the "Countdown" feature) provides a colored square that loses color in sync with the displayed numerical countdown. When time is up, the numerical countdown displays 00:00, a tone sounds, and the square has no color left. The user can include a graphic image to support students' understanding. To help transition from one activity to another, for example, a picture of art supplies could be used to indicate that when the timer sounds, it will be time for art. To help maintain focus on a task, a picture of a math worksheet could be displayed to let students know they must continue working until the allotted time is up, for example.

The visual timer was utilized to support whole group transitions, and several teachers commented on its effectiveness. The teachers mainly used the timer tool to indicate when whole group activities would be ending. The timer tool helped students to keep working until time was up and to stop working at the appropriate time. One teacher commented that the students in her group responded to the visual in the iPrompts timer tool more than to the teacher's verbal prompts.

Similar to its use with whole groups, the Countdown was used to help individual students transition from one activity to another. Also, this feature helped students to keep engaged in tasks. Several teachers commented on the effectiveness of the iPrompts Countdown tool for both of these purposes. One pair of teachers illustrated the effectiveness of the visual timer by explaining that they had a student who would not sit at the table and work on individual or groups tasks; rather, he would wander around the classroom or try to leave the room. When the iPrompts timer tool was set and the iPodTouch or iPhone was positioned next to him so he could view the timer, he would calmly sit at the table and engage in an individual fine motor task for the requisite amount of time assigned by the teacher.

Visual timer apps on handheld devices can support transitions as well as students' time-on-task as illustrated in the case study. Analog, digital clocks and countdown timers present the passage of time in ways that require students to have a good understanding of certain mathematical concepts. Timers that employ a visual image (e.g., the colorized and animated iPrompts Countdown timer) show the passage of time in an easily understood and concrete manner.

On the *Self-Reflection on Teaching Index* that the teachers completed, they were asked to describe how their students responded to the use of iPrompts to help with transitions. The following are selected comments:

- The Countdown specifically helped our kids to prepare for what could be difficult transitions; the timer helped ease their anxieties.
- The Countdown helped students transition. When presented with the timer, and it went off, two children would verbalize "all done" and transition to the next activity. I watched them be more compliant rather than melting down. Choice maker allowed them to make choices. As these students are nonverbal, being able to make a choice also avoided meltdowns. The visual makes all the difference.
- The visual timer was very successful for my students- they understood that they had to stop working when the timer read zero and the green bar was all done. They would periodically check to see how much time was left. The pictures from the schedule and being able to see this visual worked better in a small group setting.
- The students have responded well to the timer, schedule and choice maker. When a child is having a difficult time transitioning it has been nice to set the timer- when the timer is done, have the student make a choice of what they would like to do next and then add the choice into the schedule so they see when the choice activity will happen.
- The student I am working with using iPrompts, likes to watch the timer "tick" down and this seems to help him provide a clearer understanding of when an activity will be done and when we will be moving to the next one.
- The timer and choice maker help students to clearly visualize time left in an activity or choice available.
- They become excited when they see the green "disappear" on the timer.

- While working with high functioning 8/9 years old boys, I have found that the timer is very beneficial to keep them on task and helps them better understand the beginning and end to activities. The iPhone camera has also been great with modeling.
- One of the students likes to keep looking at the timer to see how much time is left.
- The timer and scheduler were both used to help the students and they reacted positively by transitioning to activities smoothly.

Case Study 2

To determine the extent to which an app for a smartphone could effectively aid teachers and other educational professionals as they help their students with transitions, a field study was conducted in mid-2012. The sample consisted of 31 teachers of students with ASD from three school districts in Connecticut.

For this study, we preloaded iPrompts onto Samsung Galaxy Tab 7 Plus devices running Android version 3.2 (i.e., Android-compatible tablets with a 7 inch display screen). The teachers were given a Samsung tablet and a printed user guide containing information on how to use the device, how to implement visual supports, and how to use the iPrompts application. We then instructed the teachers to use visual supports with their students during their normal educational routines. We conducted one 30-minute live observation of each teacher between three to eight weeks after receiving the device. After eight weeks, we convened focus groups and collected the devices.

Flurry Analytics is a built in statistical analysis tool that provides information on user interactions with the application. The tool automatically maintains a log of data, updating each time users select certain screens, features, and images. Data were made available to the research team through a password-protected Web portal in which user information was coded. This analytic tool allowed us to ascertain which features were most popular, the frequency of use, the duration of use, and which specific user commands resulted in software crashes, among other things. The Flurry Analytic data revealed that teachers used iPrompts for a median of 3.8 uses per day (range 1-20+) during which the median length of each session was 1.7 min (31% of sessions were > 3 min). The breakdown of usage by feature was as follows: 14% of usage was devoted to Choices, 66% of usage was devoted to Schedules, and 10% of usage was devoted to the Timer (the remaining 10% was devoted to set-up). Errors were only encountered in 7 of 238 sessions 2.9%), indicating that the app had strong reliability of use.

Observations were conducted in the classrooms as teachers used iPrompts with their students. Observers were trained by faculty from our Center of Excellence on Autism Spectrum Disorders who had demonstrated excellent reliability in previous studies. The observers noted when the teachers used iPrompts to help with students' transitions. The following are representative notes:

- Students could move through activity schedule independently. They were excited to see the times and change in schedule.
- Student turned on device to check schedule sporadically. Student was able to complete classwork and move with class to new academic activities. Student independently transitions to different activities.
- Student looks at the app and responds when asked, "What will happen next?"

- Several students used the app at snack to monitor time left until snack was over.
- Student was uninterested in the app when using it in class. When in the bathroom, however, student requested the app to be used as a timer.
- Student was able to follow multi-step directions.

Analysis of the observational data provided further confirmation that teachers were able to use iPrompts to assist their students with ASD prepare for transitions. In 71% of the observations, the teachers' use of the iPrompts scheduler for transitions received an exemplary score.

The most salient themes from the focus groups study were the high levels of student interest and engagement with the application, which teachers felt led to increased student independence. Teachers reported that, "Students paid attention to the student who was handling the device," and that their students "responded with curiosity and excitement" when the application was being used. Other teachers commented on improvements in student behavior such as increases in on-task behavior ("When [my student] used the scheduler she was 'right on the ball'), reduced anxiety, ("Timer reduced anxiety"), and better transition behavior, ("[my] student recognized that the sound meant that the activity was done [and time to transition]"). Representative comments for increasing student independence included: "My student was able to complete his task independently with iPrompts," "He was so much more independent," "He was focused and motivated," and "He could do it independently, but it kept him more focused, less prompting was needed."

Social Narratives

Once they arrive at school, students have to cope with transitions between tasks, at various locations within the classroom, and at multiple locations within the school. Students with ASDs also need to cope with transitioning from working with one teacher to another teacher, paraprofessionals, and special service providers. There are also unexpected and/or less frequent transitions and events for which social narratives can prepare students such as leaving the classroom quickly when the fire alarm sounds. Social narratives can also help student with ASDs to transition at the end of the school day to home. For example, social narratives might help them to independently pack up to go home and transition without disruptive behavior to an awaiting bus or car.

Social narratives are evidence-based treatments that provide a narrative description of what occurs during a social situation; what participants of the situation might be thinking or feeling, and the appropriate behavior for participating in the social interactions. The National Professional Development Center (NPDC) on ASD has indicated that social narratives "are aimed at helping learners adjust to changes in routine and adapt their behaviors based on the social and physical cues of a situation, or to teach specific social behaviors or skills." Social narratives were pioneered for students with ASD by Carol Gray (i.e., Social Stories; Gray, 2010) and have been shown to be beneficial for improving social and behavioral outcomes for individuals with ASDs (Reynhout & Carter, 2006; Sansosti et al., 2004), and have been identified by multiple sources as an evidence-based practice (NPDC and NAC):

> Social narratives are interventions that describe social situations in some detail by highlighting relevant cues and offering examples of appropriate responding. They are aimed at helping learners adjust to changes in routine and adapt their behaviors based on the social and physical cues of a situation, or to teach specific social skills or behaviors (http://autismpdc.fpg.unc.edu/content/social-narratives 6/25/13).

Social narratives presented in a printed format require the student to be able to read the text of the story independently or that an adult be available to read the text to the student. For the social narratives to be effective, students also must be able to attend to them. Photographs or other illustrations are often used to increase salience and attention when presenting social narratives to students with ASD. When social narratives are presented with the use of higher-tech assistive technology such as handheld technology, they become accessible to students regardless of users' reading ability. Depending on the particular app for handheld devices, it is possible to have the text read aloud using a computer generated voice or a digital recording of a human voice. Depending upon the options available within a specific app the text may be read aloud automatically upon accessing the social narrative, or students can initiate reading by executing a command (e.g. clicking on or touching the text; clicking or touching an onscreen READ button). High-tech assistive technology makes it easy to create an accessible, individualized social narrative that incorporates images in the format to which students best respond (e.g. generic pictures, photographs). Handheld AT can contribute to the efficient and effective creation and implementation of social narratives because they are easily portable and can be conveniently used with or by students with ASDs in a broad array of settings. As a high tech assistive technology solution, social narratives on a handheld device make it possible to support student success in a wide variety of situations and environments. A virtually limitless number of social narratives can be stored on the easily transported devices and are available "on demand" whenever and wherever they are needed. Stored social narratives can be quickly and easily modified, if necessary, to adjust to unexpected changes or to new situations. For instance, a social narrative created to facilitate a smooth transition from a student's classroom to the art room is easily altered when an unanticipated schedule changes occurs and the student will be going to the library instead of the art room.

Case Study 3: Evaluating the Use of Social Narratives to Guide Transitions

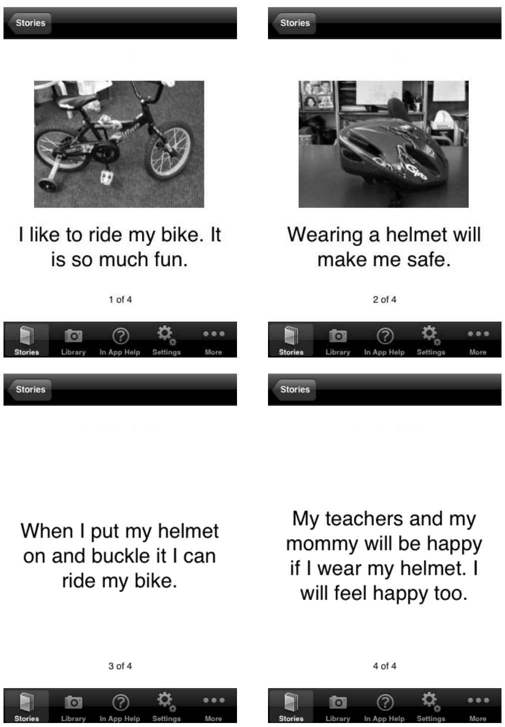
Our research compared the creation and delivery of social narratives using the StoryMaker app, by Handhold Adaptive, LLC to standard practice (e.g., low-tech, paper-based materials, desktop computers, etc.). The participants were 31 teachers of students with ASD from three school districts in Connecticut. StoryMaker allows users to create and present social narratives, including Social Stories™, using pictures, text, and audio. StoryMaker was installed on ten iPhones and 11 iPad2s. Five teachers were given iPhones, six teachers received an iPad, five teachers received both an iPhone and an iPad, and the 15 teachers using standard practice (control group) received no technology. The teachers using high-tech AT were provided with a printed user guide containing information on how to use an iPhone and/or iPad, how to create and use social narratives, and how to use the StoryMaker application. The control group received a printed guide that contained information only related to how to create and use social narratives. All teachers were instructed to create at least one social narrative to use with at least one of their students during their normal educational routines. Data collection was accomplished via direct observation and focus groups.

Observational data focused on the reliability of the StoryMaker app, the teachers' ability to effectively use a handheld device to present social narratives to students with ASDs, and the students' level of attention to the social narratives. Overall, StoryMaker was used successfully on all of the devices and functioned reliably in almost 100% of the examined cases. All teachers were able to use the assistive technology competently for presenting social narrative – accessing the app, then holding or placing the device to allow the student(s) to see or read the social narrative. We also observed and rated students' engagement with social narratives created and presented with StoryMaker. The vast majority (91.7%) of the students were rated as exhibiting acceptable levels of engagement. Annotations written by the observers indicated that engagement was frequently indicated by moving closer to the device (e.g., leaning in) as well as following along and focusing on the presented social narratives: "The student held the device closely and maintained concentration." The observational data provides evidence of the feasibility of using StoryMaker efficiently and effectively on handheld devices in school settings.

Regardless of the app that teachers elect to use or the handheld device on which the app is running, high-tech social narratives can be implemented to achieve the same goals as low-tech social narratives. They can help students with ASDs adjust to changes in routine, adapt their behaviors based on the social and physical cues of a situation, and teach specific social skills or behaviors. They are well suited to helping students respond appropriately to transitions. For example, teachers might create social narratives addressing the transitions students must go through to just get to school - leaving parents and ride the bus to school and leaving the school bus to enter the school and/or classroom.

An example of one such social narrative would be the following, which occurred in one of the classrooms under observation. A teacher used StoryMaker to help a student learn to put on a helmet before riding his bike so that he could engage with his peers during recess. The teacher reflected on a student with severe sensory needs who enjoyed riding his bike but refused to wear a helmet. Without the helmet, the student was unable to participate in the activity at school, resulting in missed opportunities to interact with his peers. Using StoryMaker, the teacher created a four page story that included pictures of the student, his helmet, and his bike (this is the story that is shown in the figure below with a slight modification to remove the student's name and image). After creating the story, the teacher showed and read the story to the student. He was "beaming from ear to ear" when he saw himself on the screen. After hearing the story, the student commented that, "I must put on my helmet to ride my bike," walked over and grabbed his helmet from the shelf, put it on his head, hopped on his bike, and began riding his bike with his peers. The teacher reported both she and her student were very excited and that he continued to enjoy listening to the story while looking at the pictures. He continued to use his helmet, which allowed him to regularly interact with his peers at school (see Figure 1).

Figure 1. Screenshots from a Social Narrative Created Using StoryMaker™



Barriers to Assistive Technology

The professionals with whom we consulted with our survey on assistive technology wrote about conditions that facilitate and impede the use of assistive technology in schools. The professionals indicated that assistive technology tends to be the responsibility of one professional, and not the responsibility of all those who work with the students. Consider the following representative comment: "Assistive technology is something that needs to be embraced by all educators, not just one staff member such as the Assistive Technology provider. The entire team that works with a child should be looking at the needs of the child and understanding the impact that the AT equipment could have on the child. This will help the entire team to use the equipment and have a great impact on the child's life and learning."

Why does this tend to occur? Time is clearly the most pressing limitation, as assistive technology devices tend to require training; Moreover, they tend to require time to set up the devices and/or software, as many are not intuitive or user-friendly. Another impediment is teachers' follow-up. As one professional explained, "Teachers and speech language pathologists do not always see the need to implement the technology. They were part of the team to assess and agree with the technology. They received training but still do not utilize the devices or systems." This, too, appears to be due to the level of training needed—and availability of an assistive technology specialist. As one professional stated, "My district has a great Assistive Technology (AT) Team, but they are often stretched thin. Initiation of AT across the district is highly varied and often depends on a given IEP team's knowledge, experience, and comfort with AT." When an AT specialist or team functions well, teachers are supported in learning how to use the assistive technology and they receive follow-up training—time permitting. As one professional mentioned, "Time is the challenge. I am now working on e-mailing teachers and therapists and trying to follow up on the student. This is not easy but it is a start." Another stated, "I go to 10 schools with a caseload of 45—all students who use alternative and augmentative communication devices."

Effective Implementation of Assistive Technology

According to ABI Research (2013), smartphone usage will total 1.4 billion by the end of 2013 and 268 million tablets will be in active use. As these handheld devices have become ubiquitous in public usage, increasing attention has been focused on the potential these devices, with appropriate apps, to be used for supporting individuals with disabilities. While the body of research related to the use of handheld assistive technology is increasing, as late as 2010 Gray and colleagues indicated that little had been done to analyze the utility and appropriateness of high-tech, handheld assistive technologies in education settings. Despite the lack of research, school districts have purchased iPads, sometimes hundreds of them, due to their beliefs in the potential these devices offer, and without any idea what they will actually do with them (Bowser, 2011; Zabala, 2011).

"As with any technological innovation, it is important to look beyond the 'gee whiz' technology and examine mobile devices within the context of best practices in assistive technology assessment and implementation," according to Newton and Dell (2011, p. 47). Best practices, or quality indicators, have been identified for the provision of assistive technology devices and services within school settings in the United States. The vast majority of the quality indicators can be applied universally, although some of them (e.g., Quality Indicators for Including Assistive Technology in the IEP) may apply only within United States school systems.

The quality indicators make clear that the selection of assistive technology for a student should be based upon the characteristics and needs of the individual, with consideration given to the tasks that the AT is supposed to help accomplish and the environments in which the AT is used. Among the questions that need to be considered when applying the quality indicators to facilitate transitions with assistive technology are whether the student is capable of accessing the technology independently or will it need to be controlled by a caregiver; which type(s) of visual supports are effective for the student; what type of images does the student respond to; what size visual display is required; and in which environments will transitions occur. The answers to these questions will help to determine whether a handheld device is a feasible solution; what size device (e.g., iPad, a smaller tablet, or a smartphone) is required or preferable; and which visual support apps should be installed and available to the student.

Just as with any other assistive technology, in order for the potential benefits of handheld devices to be realized, an implementation plan needs to be developed. It is necessary to clearly identify any individuals who will need training, the type of training each one needs, and who will provide the training.

The teachers in our studies felt that they needed additional training in three areas. First, it was clear that teachers need training on implementing the iPrompts app in the classroom, beyond knowing how the app works. Teachers need training targeted at helping them understand situations in which it is appropriate or inappropriate to use the iPrompts app. They could also be informed as to which tools within the app might be most appropriate in given situations, among other things. Numerous comments were made about the viewing screen needing to be bigger so groups of students could see it better or that the app should be able to be projected so they could get a larger image for the group. However, these comments are based on using the application inappropriately. The iPrompts application is intended to support individual students; it was not intended to be used for whole groups. For example, the scheduler tool is designed to help a particular student though difficult transitions from one activity, situation, environment, etc. to another. It was never intended to be used for or replace a whole group picture schedule.

Secondly, training on the device (i.e., iPodTouch or iPhone) on which the iPrompts app will be used must be provided. This training must address features of the device that can impact successful use of the iPrompts app. Specifically, several teachers mentioned that the image on the screen would disappear and the screen would be black. One student commented that she did not even realize this happened until she watched a video of herself using the app with her students. She was talking to the students about what they were seeing, and when she saw the video she realized they weren't seeing anything but a black screen.

The third area in which training needs to be provided relates to clearly differentiating between the device (i.e., iPodTouch or iPhone) on which the app runs and the iPrompts app itself. This became obvious as many of the SCSU teachers would say things such as, "I always had the iPrompts with me," or "I would leave the iPrompts on the desk." Another teacher discussed using iPrompts to take pictures of the students' expressions and show them to the students right away. With probing, it was determined that she took the pictures with the iPhone and then showed them the pictures. The iPrompts app wasn't used at all in this process.

Being able to take photos and incorporate them into the iPrompts app was identified by teachers as an important feature of the app. For this reason they preferred using the iPhone, which has a built in camera, rather than the iPod Touch, which does not have a camera. Many teachers commented on the value of being able to take photographs. One teacher commented that being able to take pictures on the spot could help avoid meltdowns. The teachers believed that students responded to the photographs more than the visual images in the iPrompts library.

It is worthwhile to also note that the effective implementation of handheld devices depends upon planning. For example, the handheld device will need to be charged and ready at the start of each day; depending upon the device and the amount of usage, recharging during the day may be necessary. Customized visual supports take time to create – photos must be taken, images located, the text of social narratives developed, etc. The individuals responsible for creating the visual supports must be specifically identified. Explicit identification of roles and responsibilities is especially important when a student will be using assistive technology in a variety of environments and with a variety of educational personnel; assuming that someone else is attending to the details can result in underutilization or non-utilization of the AT. This, in turn, can result in the potential benefits of the assistive technology never being realized.

An additional, vital component of any implementation plan is data collection and analysis. The data will provide insights into the effectiveness of the assistive technology in meeting the needs of students. The data can help to pinpoint what is working, what is not working, and what modifications or updates are needed related to the technology, strategies for technology use, and the implementation plan itself.

The importance of an implementation plan cannot be overstated. This planning is vital for the successful use of visual supports on handheld devices to support the transitions of students with ASDs. It is just as Winston Churchill admonished, "He who fails to plan is planning to fail."

Conclusion

As smartphones and other handheld devices have become more ubiquitous in usage, there has been increasing attention on the potential of translating research findings about how this technology benefits students with ASD into instructional practice through the use of high-tech devices. However, little has been done to analyze the utility and appropriateness of these high-tech, handheld assistive technologies in education settings (Gray et al., 2010). The research described in this chapter lends support that the use of high-tech devices may ease students' transitions within the school, home, and in the community.

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