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Mobile Device-based Interventions for Individuals with Autism Spectrum Disorder

Samantha J. Herrick [1]
Rutgers State University
Walter Harper
Pennsylvania Office for Vocational Rehabilitation
Samantha Santola
Seton Hall University School of Law
Jenna Finley
Criss Cole Rehabilitation Center

Smart phones and tablets are very powerful pint-sized personal computing devices that are used by a large percentage of the American population (Pew Research Center, 2017). Individuals with Autism Spectrum Disorder have been found to prefer learning interactions that involve computer-based learning modalities rather than interpersonal instruction. This review of the literature will recommend counselors pair the use of smartphones/tablets with four computer-based psycho-educational interventions that have been found to be effective for people with Autism Spectrum Disorder (ASD): Computer-Based Video Instruction (CBVI), Video Modeling (VM), Video Prompting (VP), and Video/Audio Priming.

Keywords: *autism, autism spectrum disorder, video modeling, video prompting, audio/video priming*

Mobile device ownership is nearly universal in The United States of America with 95% of Americans owning one or more of the following products: cell phone, smart phones, laptops and e-readers. (Pew Research Center, 2017). Since their introduction, these

[1] Samantha Herrick, Ph.D., Rutgers State University, 1776 Raritan Road, Room 315, Scotch Plains, NJ 07076, (845) 661-3043, Samantha.herrick@rutgers.edu

devices have been used as a teaching/learning tool for individuals with Autism Spectrum Disorder (ASD); (Mechling, 2011). The audio, video and web capabilities, of laptops, smartphones, and tablets have been found to be highly effective for use as a pedagogical aid for people with Autism Spectrum Disorder. For reasons not yet fully understood, individuals with Autism Spectrum Disorder prefer computer-based learning modalities over other approaches (Grynszpan, Weiss, Perez-Diaz, & Gal, 2014). Murray (1997) identified that the reasons for these preferences may include task clarity and extraneous sensory stimuli reduction. Computer-based learning provides feedback that is easily anticipated, instantaneous, easily replicable and devoid of difficult social conventions (Moore & Calvert, 2000, Murray, 1997). In addition, among people with ASD research has supported a preference for visual stimuli and strength in learning via visual-stimuli compared to other forms of sensory information (Chiak, 2011; McCoy & Hermansen, 2007). Due to the demonstrated preferences among people with ASD, the audio and video capabilities of mobile devices, and their ubiquity; (Pew Research Center, 2017), it is logical that these specific devices be utilized in concert with four technology-based teaching/learning strategies found to be effective with individuals with ASD. This article describes four interventions that can be delivered through mobile devices for individuals with Autism Spectrum Disorder. These include three types of Computer-Based Video Instruction (CBVI): Video Modeling (VM), Video Prompting (VP), Video Priming, and as well as Audio Priming for the minority of individuals with ASD who do not prefer visual stimuli. It reviews the evidence for these interventions in the literature, and recommends that counselors' use of these approaches when working with individuals with ASD and their families.

Autism Spectrum Disorder and Psycho-education

The need for effective interventions is even more critical the significant increase in ASD over the past twenty years from approximately 1 in 10,000 to 1 in 68 (Christiansen et al., 2016). This demand has taxed our medical, social and educational resources, and has precipitated an increase in the number of individuals and their families with ASD seeking counseling services. Counselors are likely to serve individuals with ASD and their families in a number of capacities including school counseling, vocational/career services, marriage and family therapy, behavioral

counseling, private practice, psycho-education, group therapy, and early childhood intervention to name a few.

This dramatic increase in ASD has also catalyzed the creation of novel teaching/learning strategies through mobile devices to meet the unique leaning needs of children, adolescents and adults with ASD. Due to their observed preferences for technology-based interactive tools (i.e. computers, smart phones, tablets etc.) and recent innovation and universal use and acceptance of these technologies, many technology-based of learning-tools have been developed for individuals with ASD (Grynszpan et al., 2014). The explosion of the number, breadth, and depth of these interventions prompted the National Autism Center to categorize these practices as "Technology-based Treatment" (National Autism Center, 2011). These strategies are varied in scope and sophistication and address numerous ASD needs including social skills, adaptive behaviors, communication, and academic learning (Grynszpan et al., 2014). McCoy & Hermansen, (2007) observed there is a need for discrete instruction in everyday skills for individuals with ASD, due to their significant difficulties with spontaneous learning.

Video-based Intervention

Due to deficits in auditory processing often associated with an Autism Spectrum Disorder diagnosis, many individuals with ASD are better visual than auditory learners and also express a preference for learning via visual stimuli (McCoy & Hermansen, 2007). Chiak (2011) found many people with ASD are inclined to respond to visual stimuli before other forms of sensory information. As such, several behavioral interventions target this relative strength (Gardner & Wolfe, 2013). These interventions are referred to by the umbrella term "Visual Supports", and include Treatment and Education of Autistic and Related-Communication-Handicapped Children (TEACCH), Picture Exchange Communication System (PECS), Social Stories, a visual scheduling, and a visual organizer (Hayes et al., 2010; Rao & Gagie, 2006). In addition, some people with ASD have difficulty focusing and discerning the essentials of a task, while giving undue attention to those elements that are significantly less relevant to skill acquisition (Attwood, 2006). Video-based intervention (VBI) has long shown promise for possible interventions for children with ASD who had difficulties with learning various behaviors such as activities of daily living (ADL), social interaction skills, and academic learning (Rayner, Denholm, & Sigafoos, (2009). Grynszpan, et al.

(2014) observed video-based interventions included Computer-Based Video Instruction (CBVI), Video-Modeling (VM), Video Prompting (VP), Video Self-Modeling, and Video Priming. Mechling (2005) noted that studies into the effectiveness of VBI have used at least one of the aforementioned video-based interventions to teach six types of target behaviors communication, community interaction/participation, challenging behaviors, social interaction, self-help, and daily/home living skills. Bellini and Akullian (2007) identified three categories of target behaviors in the literature including functional skills, behavioral functioning, and social-communication skills. A similar review by Delano (2007) added one other sub-category of target behavior, perspective-taking skills. Despite differences in the types of video-based interventions and the behaviors targeted. Looking at five previous reviews, Rayner et al. (2009) found VBI was a successful intervention for individuals with ASD. Rayner et al. (2009) asserted however, that further study of VBI was warranted to better understand which elements of VBI were responsible fore treatment effects for instance participant characteristics, VM model type, VM point of view, type of video presentation, and VBI in combination with other interventions among others. A systematic review of 44 VBI studies by Kagohara (2010) concluded that most of the research focused upon social and communication skills, equivalent numbers of videos used had peers or adults as models as self models, the interventions were administered in the home or school settings, and most utilized single-case, or small-*n* pre-experimental designs. Despite these identified weaknesses, Kagohara (2010) concluded that VBI is an "empirically supported" intervention for the remediation of adaptive, social and communication behaviors for children with ASD. Banda and Okungu (2011) performed a systematic review of VBI and identified several limitations including 1) supplemental interventions were sometimes used, 2) the procedural integrity was most often not reported, and 3) not all studies used new technology as learning tool. Despite these limitations the authors offered the tempered conclusion that their "results seem to support the use of video-based instruction in rehabilitating children with ASD. This is because a majority of the studies (39/49) reported positive intervention effects" (p. 146).

Computer-based Video Instruction (CBVI)

Computer-based Video Instruction involves the use of a variety of interactive media to teach a target skill. CBVI is also referred to as 'multimedia' and might utilize various sources of

media in isolation or in concert including music, pictures, text, and/or videos (Rayner et al., 2009). CBVI has been used with learners with ASD and intellectual disabilities to teach bus route recognition and bus driver 'stop' signaling (Mechling & O'Brien, 2010), job tasks (Mechling & Ortega-Hurndon, 2007), grocery store purchasing (Ayres, Langone, Boon, & Norman, 2006), fast food ordering and verbal responding to questions (Mechling, Pridgen, & Cronin, 2005), grocery store location and word association (Mechling & Gast, 2003), making debit card purchases (Mechling, Gast, & Barthold, 2003), reading grocery store signage (Mechling, Gast, & Langone, 2002), reduction of echolalia (Hetzroni & Tannous, 2004), and for prompting of augmentative communication usage (Mechling & Langone, 2000). Rayner, Denholm, & Sigafoos, (2009) identify Computer-Based Video Instruction (CBVI) as including Video-Modeling (VM), Video Prompting (VP), Video Self-Modeling, and Video Priming. More than a decade ago, Mechling (2005) observed that that CVBI techniques have been used to teach at least six types of target behaviors: communication, community interaction/participation, challenging behaviors, social interaction, self-help, and daily/home living skills. Bellini and Akullian (2007) identified three categories of target behaviors in the literature including functional skills, behavioral functioning, and social-communication skills Delano's review (2007) added one other sub-category of target behavior, perspective-taking skills. Despite differences in the types of video-based interventions and the behaviors targeted. In a 2012 systematic review, Ramdoss et al. evaluated the effectiveness of social/emotional skill computer-based interventions for individuals with ASD. The authors concluded that the findings from 11 studies (n = 330) that met the selection criteria suggested that CBI produced mixed results on social/emotional skill building. However, they still regarded CBI to be a "promising practice" and observed that it could be as effective as face-to face instruction.

Video Modeling (VM)

Video modeling allows individuals with ASD to watch a modeled behavior, imitate the behavior, and practice the behavior until it is mastered. This technique is supported for its simplicity and ease of use (Bellini & Akullian, 2007; McCoy & Hermansen, 2007). Research suggests that video modeling supports individual instruction and is applicable towards a variety teaching opportunities (McCoy & Hermansen, 2007). Video modeling is further supported for its ability to advance the development of functional skills, vocational skills, motor skills, athletic

skills, social skills, communication, behavioral functioning, and emotion regulation (Bellini, Akullian, & Hopf, 2007; McCoy & Hermansen, 2007). VM is a form of instruction that involves filming a task or behavior to be learned and providing access to the video for the student to replay and repeat as needed, with or without external prompts, until the task is mastered. The short film clip depicts the performance of the steps of a task or target behavior and may or may not include corresponding audio instruction (Gardner & Wolfe, 2013). The "actor" in the video is often someone other than the learner, and can be an adult, or a peer. This specific type of VM is often referred to as Video Modeling Other (VMO). In contrast, with Video Self-modeling (VSM), the "actor" is the learner his or herself. The target behavior can be a full-body (gross motor) activity, such as opening a door for someone, or hands-only (fine motor), such as tying a shoe. The perspective can be taken from that of the model (also referred to as point-of-view (POV) or from that of an external observer (i.e. third person; Gardner & Wolfe, 2013). Many practical skills have been effectively taught to individuals with intellectual disabilities and ASD using VM including bed-making (Lasater & Brady, 1995), grooming (Charlop-Christy, Le, & Freeman, 2000), personal safety (Mechling, Gast, & Gustafson, 2009), cooking (Mechling & Stephens, 2009; Rehfeldt, Dahman, Young, Cherry, & Davis, 2003; Van Laarhoven, Zurita, Johnson, Grider, & Grider, 2009), sink cleaning, and battery-changing of everyday electronics (Van Laarhoven et al, 2009).

A VM is fairly easy to produce and can be done in a relatively short period of time. At a 2016 conference presentation in which VM was discussed, Herrick, Santola, and Finley introduced an activity in which presentation participants were asked to form groups of two or three, and take 25 minutes to create a VM. They were instructed to use a personal mobile device and select any basic "task" that could be performed using what was available within the workshop space. Within the time allotted all 17 groups of participants were able to produce a VM of a basic task. Participants produced Video Models of organizing and stuffing a conference folder, putting in an earing, tying a shoe, holding a door open for another, and dialing 911 to name a few.

In a 2012 meta-analysis of VMO single case studies with individuals with ASD and other developmental disabilities (DD), Mason et al. utilized the results of 42 empirical studies of VMO completed between 1989 and 2010 that averaged three participants per study. The 126 participants in these studies were separated into two categories (ASD, DD) and included young children, adolescents, and adults. In these studies, VMO was successfully used to teach a number of different types of behaviors/skills including eye contact, a library task, furniture assembly, making copies,

sending a fax, making coffee, grocery shopping, toileting, hand washing, and toy cleanup among others. Mason et al. (2012) concluded that VMO was "highly effective" for individuals with ASD, and only moderately so with individuals with other developmental disabilities.

Buggey and Ogle (2012) summarized the research from 49 empirical studies on VSM for individuals with ASD and DD. The studies were all single case or small quasi-experimental designs, and ranged in number of participants from one to 32. They found positive results for target behaviors in 44 of the 49 studies. Fifteen of these studies targeted learners with ASD. In 13 of the 15 studies, VSM resulted in positive outcomes for the targeted behaviors/skills. In the two that yielded no significant results, the participants were young children ranging in age between three and eleven years old. The authors found that VSM was effective for the improvement of various target behaviors/skills of the participants with ASD including social initiations, responding to questions, making copies, sending a fax, packaging first aid kits, greeting another, and spontaneous requests to name a few. Buggey and Ogle (2012) concluded "although we must be cautious about claims for VSM, it seems safe to say that this technique has great promise for children with and without disabilities (p. 67)."

Wong et al. (2015) performed a comprehensive review of 456 studies utilizing focused interventions for children, youth, and young adults with ASD (n = 847). Within this review the authors identified that 11% of the studies utilized a group design (n = 48), and most of these used randomized controlled trials 0n = 38). In 408 of the studies, the researchers used a single case design, and 89% of these utilized a multiple baseline design. Less frequently, withdrawal of treatment (n = 79) and multiple probe designs were also utilized (n = 52). Through close examination of the interventions used in these studies, Wong et al. identified VM to be one of 27 interventions that met the criteria for an evidenced based practice (EBP).

Video Prompting (VP). Video Prompting is a simplified form of video modeling that breaks down a task into smaller component steps. Rather than showing all steps of a task at once, video prompting involves showing one component at a time to the learner, practicing only this step and not moving on to the next component until the previous step could be reliably performed (Gardner & Wolfe, 2013). The additional advantage of relaying information in more minute segments permits greater individualization of the intervention to the learner and is the primary difference between VM and VP. VP may also simply be the intervention of choice in situations

where the targeted skill involves mastery of many sub-steps. VP has been used to teach learners with ASD and developmental disabilities self-help skills (Norman, Collins, & Schuster, 2001) and food preparation/cooking tasks (Graves, Collins, Schuster, & Klineirt, 2005; Mechling, Gast, & Fields, 2008; Mechling, Gast, & Seid, 2010).

In a review of 18 studies of VP published between 1990 and 2010, Banda, Dogoe, and Matuszny (2011) found VP effective for the instruction of various behaviors/skills including table setting, cooking, ATM money withdrawal, laundry washing, emergency exiting skills, cleaning, mopping, and dishwashing among other. The 18 studies included 68 participants with developmental disabilities ranging in age from eight to 41 years old. All participants had some level of intellectual disability with 24 participants having an additional diagnosis of Autism. The authors observed that 67 of the 68 participants improved in their performance of the targeted behavior using VP alone or VP in addition to other prompting and/or error correction strategies. The authors concluded that VP was a viable for teaching individuals with DD including ASD, independent living, life, vocational, and domestic skills (Banda, Dogoe, & Matuszny, 2011).

Gardner and Wolfe (2013) reviewed 13 studies of VM and VP for 38 individuals with ASD, and found that VM and VP "have been successful at teaching individuals with ASD a variety of daily living skills. Very little evidence exists however, on the relative effectiveness and comparative advantages or disadvantages of VM and VP (Gardner & Wolfe, 2013). Due to the methodological limitations in the existing studies on VM and VP, which include small sample sizes (including case studies), largely quasi-experimental designs, and some variation in the definition of autism spectrum disorder among participants, Gardner & Wolfe, (2013) cautiously concluded VM and VP to be "somewhat effective" with the instruction of daily living skills.

Video & Audio Priming. Transitions, new situations, deviation in routine, and change in general are difficult for individuals with ASD (American Psychiatric Association, 2013). So much so, that it is during these situations that individuals with ASD are most likely to exhibit behaviors that express their discomfort and displeasure. These so called "challenging behaviors" might include physical self-harm, verbal and/or physical aggression, crying, protesting, refusal, elopement, and verbal outbursts among others (Matson, Wilkins, & Macken, 2009). Priming has been proposed to mollify or eliminate the negative impact of environmental changes and situational transitions (Schreibman, Whalen, & Stahmer, 2000). Priming involves the deliberate

pre-exposure to an event or important elements of an event to introduce, familiarize, create predictability, and increase comfort with the activity prior to engagement in the in-vivo experience (Koegel, Koegel, Frea, & Green-Hopkins, 2003). Koegel et al. (2003) found that exposure to school assignments prior to introduction in class, for instance, reduced the disruptive behaviors of two students with ASD and increased their academic engagement with the assignment.

Video Priming introduces an individual with ASD to an event or situation, creates familiarization and predictability, and effectively increases comfort with the specific activity prior to the real-life experience (Koegel, Koegel, Frea, & Green-Hopkins, 2003; Schreibman, Whalen, & Stahmer, 2000). Findings suggest that video priming serves to decrease distress with situations such as transitions, deviations in routines, and change in general, which may lead to an individual with ASD demonstrating behaviors expressing discomfort or displeasure (Koegel, Koegel, Frea, & Green-Hopkins, 2003; Schreibman, Whalen, & Stahmer, 2000). In a meta-analysis of 165 articles using 15 different behavior interventions for individuals with ASD, (computing 1,502 effect sizes), Ma (2009) identified priming, including video priming, as one of five "highly effective" interventions for individuals with ASD.

An example comes from Schreibman, Whalen, & Stahmer (2000) who used a multiple baseline design (baseline, treatment, post-treatment, and one-month follow up) to measure the effectiveness of Video Priming on the disruptive transition behavior of three children with ASD. Each child was exposed to a video presentation of a setting that created distress for each child. Video Priming was effective in reducing transition-related problem behaviors for the three participants. Additionally, they discovered the children were able to generalize these effects to other transition situations (unprimed), and maintained these effects at both post-treatment and one month follow up.

Given that deficits in audio processing are commonly associated with ASD (McCoy & Hermansen, 2007), video-based interventions are usually preferred (Chiak, 2011). Audio priming, however, may be an option for certain individuals with ASD. Audio priming (audio only) focuses the listener on the essential acoustic aspects of a task or situation. This is particularly good for an individual with auditory hypersensitivity. Such audio recordings can easily be made accessible so individuals can play and replay the audio when and where they want, as often as they want.

Discussion

There is a growing body of literature documenting the efficacy of technology-based interventions for individuals with ASD. Technology-based interventions such as Video Modeling, Video Self-Modeling, Video Priming, and Audio Priming have proven useful for eliciting positive behavioral responses from some individuals with ASD. These findings suggest that they serve to promote skill and behavior acquisition (Attwood, 2006; Bellini, Akullian, & Hopf, 2007; Chiak, 2011). In addition, the research further supports the notion that skills acquired through such interventions are maintained over time and transferred across situations and settings (Attwood, 2006; Bellini, Akullian, & Hopf, 2007; Chiak, 2011). In addition, there is increasing support to suggest that these technology-based approaches should be used when working with individuals with ASD (Hayes et al., 2010). In the past, these supports for individuals with ASD utilized bulky or clumsy materials (picture cards, large paper signs, desk top computers) that were highly impractical, cumbersome, and potentially stigmatizing. The use of universally accepted mobile devices removes many of the prior barriers associated with Computer-based Video Instruction (CBVI), Video Modeling (VM), Video Prompting (VP), Video Priming, and Audio Priming. With the elimination of these barriers to use, interventions that play to the strengths of individuals with ASD are more likely to be utilized.

Many individuals with ASD learn better with visual stimuli compared to other sensory input (Bellini, Akullian, & Hopf, 2007; Chiak, 2011). Interventions such as Video Modeling, Video-Self Modeling, Video Priming are therefore useful techniques for counselors working with individuals with autism and/or their family. Some individuals with ASD do not demonstrate a preference for visual processing, nor a deficit in audio processing, but have significant hypersensitivity for audio stimuli. Audio priming may be an effective option for these individuals, since the audio input can be manipulated to match individual tolerance levels, and later gradually increased as desensitization occurs.

Video self-modeling (VSM) allows the individual with ASD to act out a specific behavior and then observe him or herself successfully performing that behavior (Bellini, Akullian, & Hopf, 2007; Lasater & Brady, 1995). This permits the individual to practice and master a target behavior while replacing memories of past maladaptive behaviors with memories of more adaptive and effective behaviors (Bellini, Akullian, & Hopf, 2007; Lasater & Brady, 1995). Findings suggest that this technique contributes to self-efficacy by enhancing the individual's confidence in their

ability to execute behaviors and produce positive results (Bellini, Akullian, & Hopf, 2007; Lasater & Brady, 1995).

Since minimal human interaction is involved with technology-based interventions, the literature suggests, that these approaches serve to reduce distress and social anxiety for the individual with ASD that may interfere with attending to learning new tasks (Attwood, 2006; Bellini, Akullian, & Hopf, 2007; Chiak, 2011). The standardization and social acceptance of technology allows for individuals with ASD to use these resources in various settings and environments as needed. Further, technology-based interventions in their various forms are largely supported for their ability to be personalized for the service user. The interventionist's ability to edit and focus these tools for the unique needs of each individual adds to their practicality.

The discussed "technology-based interventions" may assist counseling professionals to effectively meet the learning and adjustment needs of individuals with ASD. These interventions can easily be combined with other strategies and have a low risk of harm. The following are examples of settings and circumstance where counselors working with individuals with ASD might benefit from these mobile-device-based interventions. Career and vocational counselors, for instance, are likely to find these techniques helpful for assisting an individual to learn new job tasks, basic interviewing skills, or adjust to a new work setting. Counselors providing individual or group social skills training can use them for psycho-education. Counselors working with families might recommend the use of one or more of these techniques to address the learning and/or behavioral concerns of the family member with ASD in the home. Lastly, counselors in private practice might use these techniques to assist a client who wants to improve a certain area of skill deficit causing him/her distress.

Although the efficacy of these interventions has some support, limitations to the research do exist. For instance, all of the literature reviewed here used very small sample sizes including case studies that do not permit generalizability of findings. In addition, none of the aforementioned was a true experimental design nor used comparison groups. In addition, the definition of autism spectrum disorder was not universal among researchers of these studies, and some of the research included children with other developmental disabilities (i.e. intellectual disabilities, learning disabilities etc.). Research has not yet compared the relative merits of technology-based interventions with other approaches, nor the integration of these approaches with more traditional interventions. The counseling field, therefore, may benefit from additional research exploring the

implications of standardizing technology-based interventions to be included as key components of treatment as usual for counselors working with individuals with ASD. More specifically, future research should address the methodological shortcomings of previous studies to include larger sample sizes with more disability specific homogeneity. In addition, a true experimental design is warranted to determine if treatment effects are indeed due to the mobile device based intervention and not other influences. Despite the weaknesses in the research literature on mobile device based interventions, preliminary findings suggest it is a low-risk, potentially high reward intervention for counselors, parents, care-givers, teachers, and other professionals supporting the learning and/or adjustment processes of individuals with autism spectrum disorder.

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