THE USE OF IPADS® TO PROMOTE LEISURE ACTIVITIES FOR ADULTS WITH AUTISM SPECTRUM DISORDER (ASD) AND INTELLECTUAL DISABILITY (ID)

A Dissertation
Submitted to
the Temple University Graduate Board

In Partial Fulfillment
of the Requirements for the Degree
DOCTOR OF PHILOSOPHY

by
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May 2017

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ABSTRACT

Adults with autism spectrum disorder (ASD) are characterized by difficulties in social interactions and functional communication skills, and the presence of repetitive behaviors and restrictive interests (American Psychiatric Association, 2013). These characteristics can adversely affect the daily functioning of individuals with ASD and pose problems for them in obtaining and maintaining stable employment. In addition, their limited ability to engage in leisure activities can also diminish their quality of life (Garcia-Villamisar, & Dattilo, 2010; Patterson, & Pegg, 2009). Employing an iPad²®, the present study used a multiple-probe design across six participants to investigate the effects of a most-to-least prompting procedure on independent leisure engagement with iPad²® apps. Data on the duration of leisure engagement was also addressed. In addition, this study examined the impact of a visual schedule on the participants’ independent transitioning between leisure activities on the iPad²® as a part of daily routines. The results suggest the intervention was effective in increasing the level of independence and leisure engagement of the participants. However, differences in screen touch-sensitivity and limited compatibility between apps caused difficulties for some of the participants at times. In addition, the caregivers of the participants responded to a survey regarding the social validity of the interventions, including their social perceptions of the use of these commonly available devices, and the stigma associated with these devices. The results indicated the caregivers felt the interventions with the iPad²® were effective improving participants’ independence and leisure engagement. They also thought the individuals would stand out less in the community with the use of the iPad²®.
DEDICATION

For my husband, son, and daughter……….
ACKNOWLEDGMENTS

I would like to express my gratitude to my supervisor, Dr. Lois Meszaros and Chimes staff, especially my colleague, Marc Fields for continuous support on this project.

I would also like to thank the Dissertation Advisory Committee members, Dr. Saul Axelrod for his clinical guidance and emotional support and Dr. Ken Thurman for his guidance and opportunities to grow as a professional.

I am grateful that Dr. Philip Hineline was the External Chair who introduced the field of behavior analysis and provided with many opportunities to me. Without him, I would not have become a behavior analyst.

Lastly, special thanks to my advisor Dr. Matt Tincani for his on-going support, guidance, and mentorship. Without his support, I would not have completed this dissertation project.
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CHAPTER 1
INTRODUCTION

The Use of iPad® to Promote Leisure Activities for Adults with Autism Spectrum Disorder (ASD)

The characteristics of individuals with ASD include social and communication deficits as well as the presence of stereotypical behaviors (American Psychiatric Association, 2013). In addition, individuals with ASD often exhibit challenging behaviors such as physical aggression, self-injurious behaviors (SIB), and property destruction. These behaviors may prevent individuals with ASD from obtaining and maintaining employment, developing meaningful friendships, and accessing activities in the community (Persson, 2000). It is also very common that individuals with ASD do not develop leisure skills due to their restricted interests and their lack of social skills (Orsmond, Krauss, & Seltzer, 2004). Since adults with ASD are unemployed or underemployed due to behavioral challenges and limited vocational and social skills (Hendricks, 2010; Hurlbutt & Chalmers, 2002; Wehman et al., 2014a; Wehman et al., 2014b; Wehman et al., 2015; Wehman, 2006), they have more time to spend in other activities, such as leisure activities or undesirable behaviors. This has especially been the case since the economic recession began in 2007, significantly diminishing the employment rate for individuals with intellectual disabilities (Kaye, 2010). Individuals with ASD have very low employment levels (Shattuck et al., 2012; Taylor and Seltzer, 2012), and the overall post-high school outcomes of individuals with ASD have been consistently rated “poor” or “very poor”, especially for those with comorbid disorders (Eaves & Ho, 2008; Henninger & Taylor, 2013; Shattuck et al., 2012; Taylor & Seltzer, 2012).
Quality of life (QOL) has gained increasing attention as an outcome measure for people with ASD (Burgus & Gustein, 2007; Halpern, 1993) to measure broader outcomes in life, such as social support, academic or employment satisfaction, family relationships, and self-determination. Despite the lack of a universally agreed-upon measure of QOL, leisure engagement has consistently been reported as an essential component that influences QOL (Burgus & Gutstein, 2007; Garcia-Willamisar & Dattilo, 2010; Patterson, & Pegg, 2009; Schalock, & Keith, 1993).

While QOL is important, individuals with ASD often struggle with developing leisure skills that enhance QOL due to their restricted interests and social skills. Additionally, they do not have the same access to technology including digital mobile devices that could also enhance QOL (Fox, 2011; Gell et al., 2013). The lack of access to commonly available digital devices is a huge disadvantage for individuals with ASD since those devices have been demonstrated as effective tools in teaching various skills to individuals with ASD (Odom et al., 2015) along with providing a means to deliver behavior analytic interventions to teach adaptive skills, including most-to-least prompts (Cengher et al., 2015; Jerome, Frantino, & Sturmey, 2007; Krantz, & McClannahan, 2014; Vuran, 2014) and visual activity schedules (VAS) (Carlile, Reeve, Reeve, & DeBar, 2013; Chan, Lambdin, Graham, Fragale, & Davis, 2014; Knight, Sartini, & Spriggs, 2014; Mechling, Gast, & Seid, 2009; Pierce, Spriggs, Gast, & Luscre, 2013). Since the use of mobile devices has become a major means of engaging in leisure activities such as accessing social media, watching video clips, and playing video games for the general population (Beginning College Survey of Student Engagement: BCSSE, 2011; U.S. Census Bureau for the Bureau of Labor Statistics, 2014; PEW Research Center, 2015), these devices are a critical component of teaching leisure skills to individuals with ASD.
Thus, given the importance of leisure skills to QOL of people with ASD, the focus of the study was to investigate the effectiveness of a teaching package using a most-to-least prompting procedure to teach leisure skills (i.e., playing simple games, reading/looking at magazines, and listening to music on iPad2®) to adults with ASD. Additionally, the investigator examined the impact of a visual activity schedule on independent leisure engagement for longer durations and on the transition between those leisure activities. The purpose the visual schedule was to teach participants to further develop independence in daily activities beyond leisure activities. Furthermore, social validity, including the possible reduction of stigma associated with traditional and physical recreation materials compared to ones on iPad2® was explored.

The current study investigated the following research questions:

1. Can a teaching package that includes most-to-least prompting be effective in improving independent leisure engagement on a mobile device and increasing the amount of time adults with ASD spend in leisure activities during free time?

2. What are the effects of a visual schedule, delivered by a mobile device, on the duration of leisure engagement and the level of independence in transitioning between activities that are a part of daily routines (e.g. navigation, schedule following, organization) with adults with ASD?

3. Does engaging in the leisure activities on a mobile device affect the social outcomes, such as stigmatization of adults with ASD?
CHAPTER 2
LITERATURE REVIEW

Autistic Spectrum Disorder

ASD is a neurodevelopmental disorder, characterized by social and communication deficits as well as the presence of stereotypical behaviors (American Psychiatric Association, 2013). Given the heterogeneity of symptoms, including severity and the possible presence of comorbid disorders such as intellectual disabilities and attention deficit hyperactivity disorders, the diagnosis is considered to be a spectrum condition with significant individual differences. In reflecting these differences, the spectrum previously had five categories including Autism, Asperger’s Disorder, Childhood Disintegrative Disorder, Rett’s Disorder, and Pervasive Developmental Disorder NOS (American Psychiatric Association, 2004) which has now been replaced by levels of severity in the Diagnostic and Statistical Manual of Mental Disorder, 5th edition (DSM-V) and Rett’s Disorder were excluded (2013).

In addition to the complexity of its diagnosis, the direct causes of ASD are not known, despite advances in genetic and neurological research that revealed the presence of genetic defects and brain abnormalities (Park et al., 2016). Therefore, to this date, there is no direct cure for ASD. However, applied behavior analytic interventions have been effective in treating social and communication skills, and decreasing undesirable behaviors (Carlile, Reeve, Reeve, & DeBar, 2013; Cengher et al., 2015; Chan, Lambdin, Graham, Fragale, & Davis, 2014; Hammond, Whatley, Ayre, & Gast, 2010; Jerome, Frantino, & Sturmey, 2007; Kagohara, 2011; Knight, Sartini, & Spriggs, 2014; Krantz & McClannahan, 2014; Lorah et al., 2013; Mechling, Gast, & Seid, 2009; Nepo, Tincani, Axelrod, & Meszaros, 2015; Odom et al., 2015; Pierce, Spriggs, Gast, & Luscre, 2013; Vuran, 2014). In addition, early detection and intervention are
critical components for maximizing the potential of individuals with ASD (Koegel, Koegel, Ashbaugh, & Bradshaw, 2014).

The significant increase in the prevalence of ASD in the past decade has been well documented. It is estimated that as many as 1 in 68 children were diagnosed with ASD based on a 2010 survey, compared to 1 in 150 children were identified with ASD in 2000 (CDC, 2012). This is about a 120 % increase in the number of children with ASD over a five-year period. Although there are several possible reasons for the increase, such as better diagnostic tools, more available information regarding ASD, and more trained professionals who can competently diagnose ASD, the true reason for this increase remains unknown (Weintraub; 2011). Given this significant increase in the number of individuals with ASD and the existence of effective and evidence-based practices, policy and regulations have changed over time to reflect their needs. However, outcomes for those individuals on the Overall Outcome Rating (OOR) scale (Goode, Hutton, & Rutter, 2004), especially for those with comorbid disorders, continue to be “poor” or “very poor” (Eaves & Ho, 2008; Henninger & Taylor, 2013; Shattuck, et al., 2012; Taylor & Seltzer, 2012).

**Outcomes for Individual with ASD**

**Employment Rate**

Shattuck et al. (2012) analyzed the data from the National Longitudinal Transition Study 2 (NLTS2) with respect to postsecondary education and employment for young adults with ASD. The study included 680 young adults with ASD as well as 470 youths with speech/language impairment (SLI), 460 youths with a learning disability (LD), and 430 youths with mental retardation (MR) for comparison. Young adults and their parents answered questions about postsecondary education and paid employment via phone interview. In addition,
the respondents provided demographic information including age, gender, ethnicity, and household income. They also provided data on functional skills such as mobility, communication ability, the ability to use public transportation and the capacity to tell time on an analog clock/watch with a four-point scale. The results indicated that the rate of employment for individuals with ASD (55.1%) was significantly lower than that of youth with SLI, LD, or MR (86%, 93.8%, and 68.9% respectively). It was also found that the percentage of the individuals with ASD who did not participate in postsecondary education or paid employment was the highest (58.5%), compared to SLI, LD, and MR groups (19.5%, 5.1%, and 26.2% respectively). Furthermore, nearly a quarter of individuals with ASD had left high school within the first year.

Taylor and Seltzer (2012) conducted a study to examine the relationship between the independent functioning of young adults with ASD and their post-high school outcomes. They used data from 66 individuals with ASD as a subgroup in their longitudinal study sample (N = 406, Seltzer et al., 2003; Shattuck et al., 2007). This subgroup consisted of young adults with ASD who had graduated from school systems between 2004 and 2008. Their average age was 22.98 (SD=1.51), and post-graduation information was available in 2008. Some of the young adults with ASD in this subgroup also had comorbid diagnoses including Intellectual Disability (ID), Anxiety Disorder, Obsessive Compulsive Disorder (OCD), Attention Deficit Disorder (ADD), Bipolar Disorder, Depression, and Oppositional Defiant Disorder (ODD). The results suggested that there was a significant interaction between post-high school activities and the presence or absence of ID. For example, about 47% of youths without ID attended postsecondary education programs, but only 2% of youths with ID were in such programs. Young adults without ID were competitively employed three times more than those with ID (12% vs. 4%). Youth with ID were also more likely to participate in adult day programs (74%)
compared to those without ID (6%). Furthermore, about 24% of youths without ID did not participate in any of postsecondary activities; higher education, competitive or supported employment, or adult day programs. This study also revealed that there were statistically significant differences between groups of participants in postsecondary activities including the presence of maladaptive behaviors, autism symptoms, and level of independence. For instance, youths who attended postsecondary education program displayed fewer autism symptoms ($t(56) = -3.02$ and $-4.58, \ p < .01$) compared to the group that participated in supported employment or day programs. Similarly, youths with competitive employment also had statistically significantly fewer autism symptoms than those in supported employment or day programs ($t(56) = -2.68$ and $-3.43, \ p < .01$). Additionally, youths who participated in adult day programs exhibited statistically significantly more maladaptive behaviors than those in postsecondary education and competitive employment ($t(56) = 2.97$ and $2.03, \ p < .05$). Young adults who participated in the adult day program were also less likely to have more independent skills compared to all other groups. There were also statistically significant differences between those in postsecondary education program, competitive employment, supported employment, and those with no activity ($t(57) = 7.20, 3.74, 2.85,$ and $3.53, \ p < .01$ respectively). This highlights the poor post-high school outcomes of individuals with ASD, especially for those with ID who have less independent skills and exhibit more maladaptive behaviors.

**Overall Outcomes**

Henninger and Taylor (2013) synthesized the results of previous studies and suggested the incorporation of a multidimensional standardized measure of outcomes for adults with ASD. The authors examined post-high school outcomes from the mid-1900s to 2011. The results showed that most studies used subjective measurements until the early 2000s. For example,
Steffenberg (1987) used ratings of good, fair, poor, or very poor as outcome measures, based on Rutter Greenfeld, and Lockyer’s criteria (1967) for 46 individuals with ASD or “autistic-like condition”. Billstedt, Gillberg, and Gillberg (2005) also used the same outcome measures for 120 individuals with ASD or “autistic-like” tendencies. The vague and subjective criteria notwithstanding, studies indicated “poor” post-high school outcomes for youths with ASD. Recent studies incorporated more reliable and quantifiable outcome measures (Henninger & Taylor, 2014). For example, Howlin, Mawhood, and Rutter (2000) used quantifiable indices for overall functioning level with four measures: autistic behaviors, friendship, language, and independence. Next, Howlin, Goode, Hutton, and Rutter (2004) proposed using the Overall Outcome Rating (OOR) scale with three indices: work, friendship, and independent living. The results showed that about 57% of 68 adults with severe intellectual disabilities fell into the categories of “poor” and “very poor” in relation to these areas. This more rigorous outcome scale was adopted by later studies. For example, Eaves and Ho (2008) analyzed the OOR for 48 adults with ASD who resided in British Columbia. The results indicated that about 50% of individuals fell in a “poor” to “very poor” categories. Esbensen, Bishop, Seltzer, Greenberg, and Taylor (2010) found that more than 60% of individuals with ASD fell in the “poor” and “very poor” categories with the OOR scale.

Regardless of the differences in outcome measures, previous studies have revealed the “poor” outcomes for young adults with ASD on measures of overall post-high school outcomes. This clearly highlights the risk of poor post-high school outcomes for young adults with ASD and the immediate need for interventions for youth with ASD before and after high school graduation.
Policy and Regulations

Along with the significant increases in the number of individuals diagnosed with ASD in the past decades (CDC, 2012), there are many changes needed in state and federal regulations to support people with ASD. The Individuals with Disability Education Improvement Act (IDEA, 2004) guarantees a free and appropriate education for individuals with ASD. Currently, autism insurance reform has been passed in 45 states; ensuring autism-related services will be included in health insurance policies (Autism Speaks, 2016; Johnson, Danis, & Hafner-Eaton, 2014). However, the focus of those changes has been more for the educational rights for inclusion and necessary services for children with ASD rather than the rights and services for older individuals with ASD. Recently, there has been more research on transition services since, of course, the needs of youth with ASD will not disappear when they leave the school system (Schall, Wehman, & McDonough, 2012; Shattuck et. al., 2012; Taylor & Seltzer, 2012; Wehman, 2012; Wehman et al., 2015). Policy and government regulations should support the needs of individuals with ASD beyond the school system.

The recent amendments of the Rehabilitation Act which is part of the Workforce Innovation and Opportunity Act of 2014 (WIOA), require inclusive employment opportunities for individuals with disabilities. However, implementation of the regulations has yet to occur, and a high unemployment rate of individuals with disabilities continues to exist (National Council on Disability; NCD, 2014). As reflected in the WIOA (Butterworth et al., 2014), some states have started to redistribute funding from segregated “sheltered” workshops to integrated employment services. However, the funding for integrated employment services for adults with disabilities, including ASD, is still minimal compared to that for children with disabilities afforded through IDEA, insurance reform, and other sources only apply until the age of 21. This
lack of funding significantly affects the quality of services available for adults with ASD. Thereby quality of life (QOL) of adults with ASD also affected.

QOL and Importance of Leisure Activities

Historically, the primary outcome of intervention with adults with disabilities was competitive employment (Halpern, 1993; Novak, 2015). Yet, Halpern (1993) questioned the narrowness of this transition outcome and suggested QOL as a more meaningful outcome measure. QOL measure includes happiness, personal satisfaction, and well-being, all of which reflect the complexity of needs experienced by people with disabilities.

Burgus and Gutstein (2007) reviewed the QOL literature and proposed that the indicators for QOL be more specific to individuals with ASD, given that previous research focused on other psychiatric or medical conditions such as eating disorders (de la Rie, Noordenbos, & van Furth, 2005; Button, 1990) or schizoaffective disorders (Caron, Lecomte, Stip, & Renaud, 2005). Despite the lack of a single QOL measure for any specific population, Burgus and Gutstein (2007) found similarity in components of across measures reported in previous studies. For instance, QOL measures for adults generally consist of social inclusion and relationships with others, physical health, family relationships, rights, personal achievements, leisure, and security (Verdugo, Schalock, Keith, & Stancliffe, 2005). Similarly, QOL measures for children include social, physical, emotional, and school functioning (Bastiaansen, Koot, & Ferdinand, 2005). Burgus and Gutstein (2007) concluded that QOL for individuals with autism includes social support, academic or employment satisfaction, family relationships, and self-determination. The authors also suggested that measures were clinically supported, practical, age-appropriate, and multidimensional with each domain being measured with both objective and subjective indicators.
Garcia-Villamisar and Dattilo (2010) evaluated the effects of leisure activities on QOL for adults with ASD. The randomly assigned participants were 15 females and 22 males between 17 and 39 years old in the treatment group, and 15 females and 19 males between the ages of 24 and 38 in the randomly assigned control group. All participants were recruited from an adult day program in Madrid, Spain. The QOL Questionnaire (Schalock & Keith, 1993), as well as the Stress Survey Schedule for Persons with Autism and Other Pervasive Developmental Disabilities (SSS) (Groden, 2001), were used to compare the groups during two time periods (pre- and post-intervention). The treatment group received a leisure program based on an assessment of leisure patterns and interests prior to the study. The leisure program consisted of group activities, access to media, reading magazines, and engaging in physical activities such as swimming, hiking, or bowling, attending events such as parties or concerts, and playing games. The results of a repeated measure ANOVA indicated that the group that received the leisure program had significantly less stress ($F_{1.69} = 22.42, p < 0.001$), and higher overall QOL scores ($F_{1.69} = 44.14, p < 0.001$), compared to the control group. However, only two out of four sub- indicators of QOL - satisfaction and competence/productivity- reached statistical significance difference between the groups ($F_{1.69} = 134.86, p < 0.001, F_{1.69} = 22.43, p < 0.001$ respectively). The authors concluded that participation in leisure activities positively affected stress and QOL for individuals with ASD.

Patterson and Pegg (2009) conducted a qualitative study to explore the benefits of leisure engagement for individuals with intellectual disabilities (ID). The authors used measures of social networking and self-esteem. Additionally, they investigated whether leisure activity engagement would assist individuals with intellectual disabilities to access job opportunities. Their results revealed that leisure engagement positively affected the participants’ self-worth,
self-esteem, psychological well-being, socialization, skill development, and overall satisfaction in life. This, in turn, led to more job opportunities. These findings are consistent with the earlier literature (e.g., Celen-Demirtas, Konstam, & Tomek, 2014; Lloyd & Auld, 2001; Schalock & Parmenter, 2000; Turygin & Matson, 2014; Wehmeyer, Palmer, Shogren, Williams-Diehm, & Soukup, 2010).

**Mobile Technology as a Medium of Leisure**

It has been reported that access to technology is somewhat limited among adults with disabilities including ASD due to restricted resources and/or accessibility (Chadwick, Wesson, & Chris, 2013; Fox, 2011; Gell, Rosenberg, Demiris, LaCroix, & Patel, 2013; Kane, Jayant, Wobbrock, & Ladner, 2009). For example, according to a national survey conducted in 2010 (Fox, 2011), only 54% of adults with disabilities use the internet compared to 81% of adults without disabilities. The results of a study that used data from the 2011 National Health and Aging Trends Study (Gell et al., 2013) also revealed that technology use decreases with the level of severity of disabilities. Additionally, a qualitative study by Kane, Jayant, Wobbrock and Lander (2009) identified barriers to the use of mobile devices for individuals with disabilities, including the high cost of devices and repairs, and small screen and button size. Chadwick, Wesson, and Fullwood (2013) synthesized 679 studies related to technology access for individuals with intellectual disabilities (ID) and learning disabilities. The results also indicated that individuals with ID and learning disabilities, including ASD, are less likely to access the internet.

On the other hand, most individuals without disabilities use mobile devices as a medium for leisure activities. Data from the Beginning College Survey of Student Engagement (BCSSE, 2011) assessed 27,000 first year college students from 63 colleges and universities in the US and
revealed that 35% of male and 23% of female students spent an average of 16 to 26 or more hours per week on video games. In addition to time spent playing video games, those students also reported spending 16 to 26 or more hours per week on social media.

According to the PEW Research Center’s Internet & Technology Project (2015), based on 6,267 adults 18 years and older, about 20% of Americans are online “almost constantly”, 42% of them are online several times per day, and 20% are online at least once per day. Younger adults between the ages of 18 to 29 had a higher percentage of being online than older adults. Thirty-six percent of younger adults go online almost constantly and 50% are online multiple times per day. The data also indicated that about 75% of adults have a smartphone, tablet, or other mobile devices and connect to the internet daily.

The results of the American Time Use Survey (2015) also indicated that there was a significant increase in the use of digital media for leisure activities. This included playing games and engaging social media. In 2014, data showed a 21% increase in weekday use and a 30% increase in weekends use for the amount of leisure activities with digital media compared to 2004 data. Meanwhile, the number of hours spent on other entertainment activities greatly decreased. The data revealed social event attendance decreased 40% in weekdays and 29% on weekends. Non-digital based house entertainment activities such as reading or playing board games also decreased 29% in weekdays and 21% on weekends. Collectively, the data suggest that the use of mobile devices for leisure activities is socially acceptable and is embedded in daily routines for Americans without disabilities.
Evidence-Based Practices for Individuals with ASD

The concept of evidence-based practices (EBP) originated with healthcare providers in England. In the 1970s, practitioners attempted to apply findings from scientific research to their practices. This led to the formation of organizations that systematically identified and analyzed EBP and ultimately affected policies and regulations (Odom, Collet-Klingenberg, Rogers, & Hatton, 2010).

Single-Subject Research Designs

In the U.S., the Institute of Education Science (IES) established the What Works Clearinghouse (WWC) in 2002 to “promote informed education decision making by providing educators, policymakers, researchers, and the public with a central and trusted source of scientific evidence about “what works” in education” (WWC, 2016). Initially, single subject research designs were not considered “an acceptable form of empirical evidence” (Odom et. al., 2010, p.276). However, given the increased prevalence of ASD in the past several decades (DCD, 2012) and the large body of studies supporting effective interventions through single-subject designs (Carlile, Reeve, Reeve, & DeBar, 2013; Cengher et al., 2015; Chan, Lambdin, Graham, Fragale, & Davis, 2014; Hammond, Whatley, Ayre, & Gast, 2010; Jerome, Frantino, & Sturmey, 2007; Kagohara, 2011; Knight, Sartini, & Spriggs, 2014; Krantz & McClannahan, 2014; Lorah et al., 2013; Mechling, Gast, & Seid, 2009; Nepo, Tincani, Axelrod, & Meszaros, 2015; Odom et al., 2003; Pierce, Spriggs, Gast, & Luscre, 2013; Sennott, & Bowker, 2009; Vuran, 2014), single subject research methodology has gained increasing attention and acceptance (Horner et al., 2005; Odom et al., 2003; Odom, Collet-Klingenberg, Rogers, & Hatton, 2010). In 2010, WWC published its single-case design technical information (Kratochwill et al., 2010), and then a few years later WWC (2016) added a section of single-case
design in its Procedures and Standards Handbook (2016). Most-to-Least prompting and visual activity schedules are a few of the many behavior analytic techniques supported by evidence (Carlile, Reeve, Reeve, & DeBar; 2013; Cengher et al., 2015; Jerome, Frantino, & Sturmey, 2007; Knight, Sartini, & Spriggs, 2014; Krantz & McClannahan, 2014; Mechling, Gast, & Seid, 2009; Vuran, 2014).

**Most-to-Least Prompting**

A prompt is a supplementary stimulus that increases the likelihood of a learner’s correct responding (Cooper, Heron, & Heward, 2007). Prompts are most effective in teaching skills when they are presented and faded in a systematic manner, as occurs with most-to-least prompting (Cengher et al, 2015; Jerome, Frantino, & Sturmey, 2007; Krantz & McClannahan, 2014; Vuran, 2014). In most-to-least prompting, prompts are systematically presented and faded from the most intrusive one to lesser ones in order for learners to respond correctly (Wolery & Gast, 1984). For example, first hand-over-hand will be used, then partial physical, gestural, and finally verbal prompts will be presented to ensure learners’ correct responses. Researchers and practitioners often select most-to-least prompting for individuals with ASD because it promotes independence while minimizing errors and the possibility of prompt dependency (Carr & Durand, 1985; Demchak, 1990; Krantz & McClannahan, 2014).

Vuran (2008) investigated the effects of a most-to-least prompting procedure for teaching leisure skills to individuals with ASD. The participants were two males, 21 and 23-year-old, who attended a special education program and who lacked functional leisure skills at the time of the study. A multiple-probe design across participants was used and data were collected on completion of a 17-step-task of making a basket shape with clay. During the intervention, participants were provided with most-to-least prompts when they did not initiate the first step
within five seconds of the introduction of the task, did not initiate the next step within five seconds of completion of the previous task, or did not complete the step correctly. The results indicated that both participants acquired the skills with 100% accuracy after implementation of the intervention. The participants also maintained the skills during follow-up sessions.

Jerome, Frantino, and Sturmey (2007) evaluated the effectiveness of most-to-least prompting with backward chaining for teaching three adults with developmental disabilities leisure skills. The participants were diagnosed with ASD and mental retardation or mild mental retardation and hearing impairments and were between the ages of 24 and 32. The dependent measure was the independent completion of task analyzed steps to search topics of interests on a computer. A multiple-probe experimental design across participants (Gast, 2010) which consisted of baseline, intervention, and generalization probe, was used. All sessions were conducted in a day rehabilitation center that the participants attended. The intervention included most-to-least prompting procedures and backward chaining in which the last step of the task analysis was taught first in a hand-over-hand manner. The prompts were gradually faded to be less intrusive. Once the participant completed the step independently for two consecutive sessions, the second to the last step was introduced. This continued until all 13 steps were completed independently. The results indicated that all participants mastered the skill with 100% accuracy and generalized the skill to a novel computer.

A more recent study compared the effectiveness on skill acquisition of most-to-least prompting with least-to-most prompting procedures for children with ASD (Cengher et al., 2015). In this study, the participants were three pre-school boys with ASD who attended a special education program and who were referred by their school professional due to a history of difficulty in learning. Data were collected on response to one-step directions, using a parallel
treatment design (Gast, 2010). During the intervention phase, the participants were provided with most-to-least, least-to-most, or no prompts when they did not respond to verbal directions within two seconds. Each condition included two target responses for each participant. The results showed that all participants acquired skills faster with the most-to-least prompting than with the least-to-most prompting.

**Visual Activity Schedules**

Visual Activity Schedules (VAS) are frequently used to teach various skills, including the transition between activities, socialization, and task completion for individuals with ASD. The intervention is very useful, especially when learners do not respond consistently to auditory cues alone, as is often the case with individuals with ASD (Rosenkrantz, 2009).

Knight, Sartini, and Spriggs (2014) reviewed studies published between 1993 and 2013 that used VAS as an intervention. To evaluate each study, they used the criteria for evidence-based practices (EBP) for individuals with ASD established by Horner et al. (2005). They concluded that 16 studies were considered “acceptable” by meeting the five criteria for high-quality single-subject studies. The results suggest that VAS is effective in teaching both children and adults with ASD various skills such as transition, leisure, and daily living while reducing undesirable behaviors and promoting independence.

Carlile, Reeve, Reeve, and DeBar (2013) examined the impact of activity schedules delivered by the iPod Touch® in teaching children with ASD leisure skills. The participants were four children with ASD between the ages of 8 and 12 who attended a special program which used applied behavior analytic approaches. All participants were exposed to an iPod Touch® at school and home for learning to play games or listen to music. They were also familiar with activity schedules that were printed on paper, but they never used the VAS on a digital device.
The authors used a multiple-probe across participants design, consisting of baseline, intervention, and maintenance sessions. Physical prompts and systematic time delay of prompts were also used during intervention sessions. Data were collected on independent completion of the activity schedule and on-task behavior for all sessions. In addition, generalization data were collected for untaught activity schedules. The results indicated that VAS with physical prompts and time delay prompting increased independent completion of tasks for all participants. Their on-task behaviors were also improved after the intervention. They also generalized their skills to a novel activity schedule and maintained the skills during maintenance sessions.

Mechling, Gast, and Seid (2009) used a personal digital assistant (PDA) as a VAS with auditory and video prompts. The participants for their study were three high school students with ASD who received special education services with an individual education program (IEP). Prior to the study students were screened for dexterity, visual and auditory ability, attention spans, and motor imitation skills. A multiple-probe across activities design was used, and it was replicated across three participants. Prior to baseline, the participants received pre-training to navigate the PDA. This involved tapping an icon to activate a video clip or an auditory prompt. During the intervention sessions, the participants were provided with least-to-most prompts as well as the PDA. Data were collected on correct completion of steps across phases. The results indicated that the intervention was effective in teaching students with ASD to prepare basic meals. All participants exhibited the skills during maintenance sessions.

Pierce, Spriggs, Gast, and Luscre (2013) examined the effectiveness of VAS on the transition between activities with children with ASD. The participants were four students with moderate ASD who were in a self-contained classroom. Prior to the intervention, all students required frequent prompts to complete tasks and to transition between activities. The dependent
variables were independent task completion and transition as well as the level of prompts needed to complete the steps. The experimental design used for this study was an ABAB withdrawal design (Gast, 2010). Additionally, generalization of skills was assessed before the first no schedule and after the second VAS conditions. During the VAS condition, participants were given the VAS, and least-to-most prompts were used when the subjects did not respond to a natural discriminative stimulus such as the teacher direction, or to the completion of the previous tasks. The results showed that the intervention, VAS with least-to-most prompts, was effective in increasing the participants’ independent completion of tasks and transition between activities. The participants also generalized the skills to novel tasks.

Chan, Lambdin, Graham, Fragale, and Davis (2014) evaluated the effectiveness of a photographic schedule in teaching adults with intellectual disabilities (ID) to play simple video games on an iPad2®. The participants were three adults with mild intellectual disabilities who attended a sheltered workshop and were between 33 and 57 years old. The steps for navigating the iPad2® and playing a game were task analyzed into nine steps, including opening the iPad2®, selecting the game, playing, and then exiting the game. The corresponding pictures of the steps were printed on an 8.5” by 11” paper as a visual schedule. The investigator used a multiple-baseline across participants design (Gast, 2010) to evaluate the effects of the visual schedule on the participants’ independent completion of each step. In addition to the visual schedule, verbal prompts and modeling prompts were provided during the intervention phase. However, no feedback or reinforcers were provided upon correct and independent completion of steps. After implementation of the intervention, the participants achieved 89-100% correct responding, and they maintained their skills after the visual schedule and prompts were faded.
Assistive Technology

Recent advances in technology have provided more options for devices with greatly improved portability, functionality, accessibility, and reasonable cost. In addition, increased software options with high customizability are available to meet the diverse needs of individuals with and without intellectual and developmental disabilities. The iPod Touch® and iPad2® have increasingly gained attention as intervention tools, especially for individuals with ASD in the area of communication (Blum-Dimaya, Reeve, Reeve, & Hoch, 2010; Hammond, Whatley, Ayre, & Gast, 2010; Kagohara, 2011; Lorah et al., 2013; Nepo, Tincani, Axelrod, & Meszaros, 2015; Sennott, & Bowker, 2009). The advantage of using these commonly available electronic devices is that the users can access multiple functions, including leisure activities such as playing games and listening to music, visual schedules, and augmentative communication.

Odom et al. (2015) synthesized studies using technology devices as interventions for adolescents with ASD. Their results suggest that various technological devices can be effectively implemented with interventions using video modeling/prompting, self-management, feedback, and coaching. The interventions improved the participants’ academic, communication, and social skills, and their independent completion of tasks.

Hill, Belcher, Brigman, Renner, and Stephens (2013) implemented antecedent strategies using an iPad2® to improve the independent functioning of adults with ASD and other developmental disabilities at their vocational and residential settings. Participants in their case study were three adults diagnosed with ASD and with other comorbid disabilities such as Tourette syndrome or ADHD. Their iPad2s® were used to provide visual cues, auditory prompts, and video models, for teaching recreational activities and to reduce reliance on their family and support staff to complete daily living skills. This included hygiene, cooking, grocery
shopping, age-appropriate leisure activities, self-medication, and money management. Although quantitative data were not available, improvement in the level of independence for various daily living skills of all participants was anecdotally reported with antecedent interventions via iPad®.

Uphold, Douglas, and Loseke (2014) examined the effectiveness of a constant time delay procedure to increase the independent completion of leisure activities with “an electronic photographic activity schedule (ePAS)” on an iPod Touch®. The participants were six adults with developmental disabilities between the ages of 20 and 57 who attended a specialized postsecondary education program that taught vocational, daily living, and academic skills. The study was conducted at the recreation room of the participants’ postsecondary education program. Fourteen exercises were selected as target activities because all participants could complete those exercises without assistance prior to intervention. Each session consisted of four to six randomly selected exercise activities out of the fourteen targeted activities. The authors used a single-subject withdrawal (ABAB) design followed by generalization probes to examine the effects of their intervention. During the intervention phases, the participants were taught to program their exercise list with immediate gestural prompts that were systematically faded. The results showed that all participants acquired the skills necessary to program their exercise activities in the iPod Touch® and followed them independently with the ePAS. Social validity data also suggested that the participants felt comfortable using the iPod Touch® and that the visual schedule helped them to organize and complete the tasks.

Kagohara et al. (2011) introduced an iPod Touch® to teach leisure skills to three youths with developmental disabilities. The participants, diagnosed with intellectual disabilities, attended a special education classroom and were between the ages of 15 and 20 at the time of the study. All sessions were conducted in the participants’ classroom where video modeling was
used to teach the participants to use an iPod Touch® in order to access their preferred music. The authors used a delayed multiple-probe across participants design to examine the effects of video modeling on the participants’ independent completion of task analyzed steps. Completing the sequence allowed them to listen to music on the iPod Touch®. The results indicated that video modeling was effective in increasing the independent completion of steps that accessed preferred music on the iPod Touch®. All participants completed over 87% of the steps correctly and independently. They also maintained their level of independence after the intervention was faded and during follow-up sessions 4-5 weeks and 9-10 weeks later.

Kagohara (2011) evaluated the effectiveness of video modeling with a least-to-most prompting procedure used to teach three individuals with severe intellectual disabilities (ID) how to access entertainment videos on an iPod Touch®. The participants were two female students ages 16 and 19, and a male student aged 15 who attended the same special education program. A delayed multiple-probe design across participants design was used. The number of independently completed steps from a task analysis was measured during baseline, intervention, video fading, and follow-up sessions. The intervention consisted of video modeling and least-to-most prompting with a 10 sec. delay. The results suggested that video modeling and a least-to-most prompting procedure were effective in increasing the independent completion of the task analysis that accessed entertainment videos on an iPod Touch® for all of the participants. The participants achieved at least 86% of independent responding during intervention sessions. The participants also maintained the level of independence after the video modeling was faded and during follow-up sessions, 2 and 10 weeks after the last intervention session.
Stigma Associated with Conventional Assistive Technology

Besides their pragmatic utility, commonly available high-tech devices could possibly reduce the stigma associated with the use of other traditional tools designed specifically to help people with disabilities such as go talk (Illustration 1) or Dynovox (Illustration 2) (Conley, 2012; Shinohara, & Wobbrock, 2011; Van Laarhoven, Johnson, Van Laarhoven-Myers, Grider, & Grider, 2009). Parette and Scherer (2004) identified three key components of assistive technology related to stigma. First, the aesthetic appearance of the devices affects social stigma. For example, if the device is “weird” looking, the individuals using the device could be perceived as someone with “special needs”. Second, customizability to meet individual needs varying in age, gender, dexterity, or cognitive ability is also related to social stigma. For instance, if the device is not age or gender appropriate, it would attract undesired attention. For example, if an adult male is playing with a pink kid pad, a tablet with games for kids (Illustration 1), the person who is using it would stand out and be associated with an undesired connotation. Third, the universal design promotes the environments and products to accommodate everyone with various abilities and needs. Therefore, specialized devices only for people with disabilities that are associated with stigma are discouraged in environments where universal design principles are applied. These three components of stigma are consistently identified in the literature (Bispo & Branco, 2008; Bispo, & Branco, 2009; Conley, 2012; Doughty, 2011; Shinohara, & Wobbrock, 2011; Vaes, Strappers, Standaert, & Desager, 2012).
Illustration 1: Dragon Touch: This picture represents a tablet with games for children.

Illustration 2: Go Talk 32: This picture represents a specialized AAD device, Go Talk 32.
Vaes, Stappers, Standaert, and Desager (2012) suggested three key components for designing “a stigma-free” assistive technology atmosphere. The first component is to understand social acceptance in various contexts in which assistive technology is used. Understanding how devices are perceived would help the future development of devices to reduce stigma. The second component is to change the appearance of devices by removing stigmatizing features and diverting attention to more appealing features while maintaining functionality and usability. If the device is not attractive and creates undesired attention, it would increase the stigma associated with the device. Even worse, individuals with disabilities may abandon the device. The third component is to promote a society that empowers individuals with disabilities to use assistive technology. This could further promote better assistive technology designs with high quality and positively affect the ability of individuals with disabilities to use quality products.

Shinohara and Wobbrock (2011) conducted a qualitative study on the effectiveness of assistive technology for 20 individuals with disabilities. Their results suggested that social stigma associated with some unusual looking technological devices limits its use despite its functionality. The participants also indicated more conventional and “strange looking” devices
tended to attract undesired attention. Therefore, the use of commonly available technology devices such as iPod® Touch or iPad2® has an advantage over more conventional devices.

**Conclusions**

Individuals with ASD often have social communication impairments and may exhibit non-contextual repetitive behaviors (APA, 2013). Comorbid diagnoses such as intellectual disability, obsessive compulsive disorder, and attention deficit disorder, are often observed in this group. Their restricted interests, lack of social and communication skills, and the presence of challenging behaviors adversely affect the development of functional skills including leisure skills, especially when there are comorbid diagnoses.

In the past decade, there has been a significant increase in the number of children diagnosed with ASD (CDC, 2012). There also has been an improvement in the policies and regulations to address the needs of individuals with ASD; however, the focus has been mainly on educational rights and services for children with ASD. These changes have supported the development of better diagnostic tools and the implementation of early interventions in which children have opportunities to gain communication, social, and independent skills before they graduate from the special education system. On the other hand, there are increased numbers of adults with ASD who require continuous support since they did not achieve the necessary levels of independence before graduation.

Post-high school outcomes for individuals with ASD do not look bright. The literature indicates that young adults with ASD fall into “poor” or “very poor” outcome categories, regardless of which evaluation procedure is used (Eaves & Ho, 2008; Esbensen, et al., 2010; Henninger & Taylor, 2013). The results are especially discouraging for those who have comorbid diagnoses, but even when the individuals are capable of completing job tasks with
minor modifications, the employment rate of individuals with ASD continues to be much lower than that of people without ASD (Shattuck et al., 2012; Taylor & Seltzer, 2012).

As QOL has increasingly gained attention as an outcome measure for individuals with ASD (Burgus & Gutstein, 2007; Garcia-Villamisar & Dattilo, 2010; Halpern, 1993; Novak, 2015) and leisure engagement is an important component of QOL (Bastiaansen et al., 2005; Garcia-Villamisar & Dattilo, 2010; Verdugo et al., 2005), teaching appropriate leisure skills is critical for individuals with ASD (Celen-Demitras, et al., 2014; Loyd & Auld, 2001; Patterson & Pegg, 2009; Schalock & Parmenter, 2000; Turygin & Matson, 2014; Wheymeyer et al., 2010). However, accessing typical leisure activities for adults with ASD is somewhat limited due to restricted resources compared to those available for children with ASD and people without disabilities.

The types and modes of leisure activities have changed over the past few decades, especially with the advancement of technology. The general population spends more and more time on mobile devices such as smartphones and tablets for work, daily living activities, leisure activities (BCSSE, 2011) compared to a decade ago.

Given changes in leisure activities for the general population and the important role of leisure engagement related to QOL, teaching leisure skills on mobile devices is critical for adults with ASD. There are applied behavior analytic interventions in the literature that incorporate commonly available technology devices (Hammond, et al., 2010; Kagohara, 2011; Lorah, et al., 2013, Nepo, Tincani, Axelrod, & Meszaros, 2015; Odom, et al, 2015; Sennott & Bowker, 2009). Additionally, the literature also indicates that the use of mobile devices could possibly reduce the stigma associated with specialized assistive technology devices or age inappropriate leisure materials (Conley, 2012; Shinohara & Wobbrock, 2011; Van Laarhoven, Johnson, Van
Laarhoven-Myers, Grider, & Grider, 2009). Furthermore, only a handful of studies has investigated strategies for teaching leisure skills to adults with ASD (Jerome, Frantino, & Sturmey, 2007; O'Reilly, Lancioni, & Kierans, 2000; Vuran, 2008; Yalon-Chamovits, & Weiss, 2008). Therefore, the present study will add additional insights to the field by teaching a critical and understudied skill, leisure skill, which affects QOL to not well-focused population, adults with ASD. The research questions addressed by this study are

1. Can a teaching package that includes most-to-least prompting be effective in improving independent leisure engagement on a mobile device and increasing the amount of time adults with ASD spend in leisure activities during free time?

2. What are the effects of a tablet based visual schedule on the duration of leisure engagement and the level of independence in transitioning between activities (e.g. navigation, schedule following, organization) with adults with ASD?

3. Does engaging in the leisure activities on a mobile device affect social validity measures such as stigmatization of adults with ASD?
CHAPTER 3

METHODS

Participants

The participants were six adults with ASD, between 34 and 45 years old, who attended a vocational program and reside in a supported community home in the Mid-Atlantic region of the United States. The primary investigator contacted clinicians, case managers, and direct care staff to explain the purpose of the current study and to recruit participants. Independent leisure skills were assessed through interviews with participants’ caregivers and observation. Individuals with ASD with no independent leisure skills or independent engagement in less than three leisure activities per day based on interviews and observation were included in this study. Passive and sedentary behaviors such as sitting near the TV while it was on were not counted as an independent leisure activity. The participants also had sufficient dexterity to tap and navigate the iPad2®, including the ability to point and move a pointed finger on the table at least 5 inches. This skill was assessed prior to the preference assessment below. In order to protect their identity and privacy, their names were arbitrary assigned.

Tom

Tom was a 40-year-old Caucasian male who attended a vocational program and lived in a community home with staff support. His current diagnoses were ASD, moderate Intellectual Disability, and Mood Disorder, NOS. Prior to involvement in this study, he only engaged in listening to music on a radio. Tom could understand when others were speaking to him and answer simple social questions with phrases. However, he might not respond immediately or at all. He could read simple sentences and at times he might write simple phrases to communicate. His most recent Vineland Adaptive Rating Scale was 24 with age equivalent of 4 to 5 years old.
The results of the Stanford-Binet partial composite score was 47 which suggest his cognitive functioning in the moderately impaired range. These assessments were conducted prior to him entering the vocational and residential program.

**Kate**

Kate was a 43-year-old Caucasian female who attended an adult day program and lived with four housemates in a residential program. She was diagnosed with ASD, Schizoaffective Disorder, and severe Intellectual Disabilities. She relied on staff to offer any recreational activities and prior to the intervention she only engaged in doing the puzzle when it was offered. She also liked to listen to music on a radio. She did not typically initiate social interactions but she might express her needs and wants with one word or phrases. She might answer simple social questions with one word or phrases but she often would not respond immediately or at all. Her most recent the Stanford-Binet score prior to the admission to the vocational program was 41 which was reportedly within the moderately impaired range. In addition, her Peabody Picture Vocabulary Test score was 40.

**Donna**

Donna was a 45-year-old Caucasian female who was diagnosed with ASD, mild Intellectual Disability, and seizure disorder, NOS. She received supported employment services and lived with three housemates with staff support. Prior to the intervention, she only engaged in doing puzzles and sorting beads when prompted. According to the assessments conducted prior to the admission to the program, her most recent Peabody Picture Vocabulary Test was 26 with age-equivalent of 3 years and 1 month and her cognitive function fell within the range of mild intellectual disability. She did not initiate social interactions but she would greet when others
spoke to her. Donna might answer simple social questions with simple phrases but her vocalization would be repetitive.

**Lenny**

Lenny was a 36-year-old African American male who was diagnosed with ASD, moderate Intellectual Disability, and ADHD. He attended a vocational program and lived in a community home with staff support. His most recent composite score of Vineland Adaptive Behavior Scale pre-admission to the vocational program was 34 which categorized him as moderately deficient in adaptive behavior. His WISC-III indicated full-scale IQ of 40. Prior to the intervention, he did not independently engage in leisure activities except to dance along while he was listening to music. He might initiate social interactions and answer simple social questions at times but would not stay on the topic. His current behavior plan indicated that he would exhibit elopement several times per year and scratching his hands daily to weekly.

**Daniel**

Daniel was a 36-year-old African American male who was diagnosed with ASD, moderate Intellectual Disability, and ADHD. He lived in a community home with three housemates. He worked in a cafeteria four times per week with staff support. His most recent Vineland Adaptive Behavior Scale prior to the admission to the program was 22, with an age equivalence of 1 year and 11 months. His last tested IQ derived from Leiter International Performance Scale was 37 with a mental age of 4 years and 4 months which reportedly within moderate ID range. He was exposed to a communication app on an iPod touch® in the past but he was never taught to use other functions on iPad2®. He had a history of elopement and non-compliance.
Gabe

Gabe was a 34-year-old Caucasian male who was diagnosed with ASD and severe Intellectual Disability. He lived with his parents and attended a day program. At the day program, he was offered recreational activities throughout his day but he often declined to participate. He did not initiate to engage in any leisure activities prior to the intervention. His most recent Vineland Adaptive Behavior Scale prior to the admission in the vocational program was below 20 within the range of profoundly deficient in adaptive behavior. Additionally, Gabe’s Stanford-Binet composite score of 36 indicated his cognitive functioning in the severe range of intellectual disability.

Table 1. Participants’ Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Diagnosis</th>
<th>Function Level Age Equivalence (AE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tom</td>
<td>Male</td>
<td>40</td>
<td>ASD, moderate ID</td>
<td>VABS=24, IQ=47 AE =4-5yrs old</td>
</tr>
<tr>
<td>Kate</td>
<td>Female</td>
<td>43</td>
<td>ASD, severe ID</td>
<td>IQ=41, PPVT=40 Moderately impaired PPVT=26 AE=3yr 1mo</td>
</tr>
<tr>
<td>Donna</td>
<td>Female</td>
<td>45</td>
<td>ASD, mild ID</td>
<td></td>
</tr>
<tr>
<td>Lenny</td>
<td>Male</td>
<td>36</td>
<td>ASD, ADHD Moderate ID</td>
<td>VABS=34, IQ=40 Moderately impaired VABS&lt;20, IQ=37 AE=1yr 11mo-5yrs</td>
</tr>
<tr>
<td>Daniel</td>
<td>Male</td>
<td>36</td>
<td>ASD, ADHD Moderate ID</td>
<td></td>
</tr>
<tr>
<td>Gabe</td>
<td>Male</td>
<td>34</td>
<td>ASD, severe ID</td>
<td>VABS&lt;20, IQ=36 AE=1yr 9mo</td>
</tr>
</tbody>
</table>

Experimental Design

Since the investigator was interested in the progress of each participant on each the dependent variables, a multiple-probe design across participants was used. This design allowed the investigator to examine the efficacy of the most-to-least prompting intervention strategy in
teaching adults with ASD to engage in leisure activities and to follow a visual schedule on the iPad®. Under this design, baseline data were collected for all participants in the first three-to-five trials and then for three-to-five trials prior to implementation of the intervention. Six participants were separated into two groups so that two sets of multiple-probe designs were formed. The first intervention involved the use of most-to-least prompts to teach participants to engage in leisure activities identified from preference assessments. The intervention was implemented in a staggered manner within each group in order to assess the effects of the intervention. The intervention for each participant was implemented only when an acceptable baseline (i.e., one that did not have a therapeutic trend) was achieved. Once the participants had acquired at least four leisure activities, the second experiment began.

This investigator also used a multiple-probe design across participants in the second experiment. The intervention, teaching the participants to use the visual schedule app or printed schedule to independently transition from one activity to another through most-to-least prompts, was introduced in a tiered manner for each group of three participants. Baseline data were also collected for all participants during the first few baseline trials and a few trials prior to the introduction of the intervention. The intervention for each participant was introduced only after an acceptable baseline was achieved.

**Settings and Materials**

The preference assessment, baseline, and training sessions were conducted in a quiet 4m X 6m office in the participants’ vocational program. The generalization sessions were conducted in each participant's work area (2.5m X 3.5m to 4m X 6m) during their scheduled break time. Additional generalization sessions in the vocational program were conducted after the
acquisition of the leisure skills and the use of VAS in their work area or the cafeteria where the participants took scheduled breaks.

After identifying the participants’ preferences for leisure activities with MSWO (Multiple Stimuli without Replacement, DeLeon, & Iwata, 1996), the preferred music and corresponding game apps were programmed for the iPad® 32GB.

Once the participants acquired independent completion of a game app with iPad® for at least 80% of the task analysis for two consecutive sessions, additional apps were programmed. Once all the participants acquired use of at least four game apps, a visual schedule app was programmed on their devices or printed on a visual schedule for the second experiment.

Table 2. Materials

<table>
<thead>
<tr>
<th>Device/Application</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>iPad® 32 GB, second generation of iPad®</td>
</tr>
<tr>
<td>Leisure App</td>
<td>music, puzzle, matching, memory, word search, video</td>
</tr>
<tr>
<td>Schedule App</td>
<td>First Then Visual Schedule® app, printed visual schedule icons</td>
</tr>
</tbody>
</table>

**Dependent Measures**

Data were collected on the independent completion of steps in the task analysis that were required to access and engage in leisure activities and the duration of leisure activity engagement across sessions. In addition, independent schedule following data were collected for experiment 2. Probe data were generally collected after two to four training sessions and the availability of the independent observer also affected the timing of data collection.
1. **Independent completion of leisure activity task analysis:** Each leisure activity was task analyzed, with the activity broken down into small steps (12-14 steps). For example, the task analysis of a puzzle was 1) open box/game app, 2) select puzzle (only for puzzle app on a device, 3) select a puzzle piece, 4) put the piece in place, 4) repeat step 3 and 4 until the puzzle is complete, 5) close app/clean up puzzle pieces. (see Appendix A)

2. **Duration of leisure engagement:** The duration of each activity engagement was also recorded with a stopwatch. The watch was started when the participant opened a game app and ended when the participant closed the app.

3. **Schedule following/independent access to leisure activities:** Schedule following consists of a) checking the schedule app, b) opening the activity on the schedule, c) closing the app, and d) checking the next activity on the schedule app. The independent completion of each step was recorded (see Appendix B).

**Interobserver Agreement**

Interobserver Agreement (IOA) data were collected on 28% of the trials for experiment 1 and 32.3% of trials for experiment 2 by trained observers. IOA for independent completion of tasks was calculated by dividing the number of agreements by the total number (sum of the number of agreements and the number of disagreements) and multiplying by 100. IOA for duration data was calculated by dividing the shorter duration by the longer duration and multiplying by 100. The primary observer, the investigator, who was a Board Certified Behavior Analyst, and additional master’s level staff were trained as observers through didactic teaching on data collection and by defining each of the dependent variables with examples and non-examples, and also with in-vivo training on data collection. The training continued until the observers obtained at least 90% agreement with the primary observer for two consecutive
sessions. The average IOA of experiment 1 was 98.5 % (range, 80-100 %) for independent completion of task analysis for leisure skills and was 96.5 % (range, 86-100 % for the duration. The average IOA of experiment 2 for schedule following was 99.7 % (range, 93.3-100 %) and that for the duration was 98.8 % (range, 91.2-100 %).

**Procedural Fidelity**

A procedural fidelity checklist was used to assess the accuracy of implementation of baseline sessions, training sessions, and generalization sessions for at least 50% of across all sessions for both experiments. The instructor marked yes if a step on the checklist was implemented accurately, or marked no if it is not. The percentage of procedural fidelity compliance was calculated by dividing the number of steps that were marked yes by the total number of steps (Appendix C). The procedure was implemented as planned with 100 % accuracy for both experiment 1 and experiment 2. The independent observers also collected data on the procedural fidelity on 28 % of the sessions for experiment 1 and the average IOA was 98.9 % (range, 87.5-100 %). For the experiment 2, the independent observers collected data on the procedural fidelity on 32.3% of the sessions and the IOA was 100 % for those trials.

**Stimulus Preference Assessment**

Prior to the baseline phase, the student investigator conducted a preference assessment to determine music and game apps that were programmed on the iPad2® for each participant. First, information was collected through interviews with each participant's guardians and relevant support-staff members in order to identify each participant's daily activities. The people answered questions on the Reinforcement Assessment for Individuals with Severe Disabilities (RAISD; Fisher, Piazza, Bowman, & Amari, 1996) about preferred leisure activities and preferred music, in order to identify and rank each participant's preferences. The participants’
preference for these identified leisure activities were assessed through multiple stimuli without replacement (MSWO; DeLeon, & Iwata, 1996). The instructor presented physical materials or representation of leisure activities (e.g. a corresponding picture of TV shows, printed coloring page/word search, or a CD player) on a table in front of each participant and gave the direction, “Take one”. The participant had access to the activity for 30 sec. The material or representation of the selected activity was not returned to the choices. Then, the participant was given another direction, “Take one”. The sequence was repeated until all of the activities were selected or the participant refused to choose anymore after chose at least 5 items. The four sets of MSWO assessments were conducted for each participant, and the hierarchy of his/her preferences was determined by averaging the results of four assessment sessions. The corresponding app for the most preferred activity was programmed on the iPod Touch® or iPad2® initially, and then additional activities were added in the sequence of preferences with the minor modification described below until the participant acquired 80% of independent completion for two consecutive data sessions.

**Experiment 1 Procedures**

**Baseline**

During the baseline sessions, the instructor and independent observer collected data on the level of each participant’s independent completion of the task analysis for each leisure activity identified in the preference assessment and the duration of leisure activity engagement. The iPad2® with the preferred leisure apps on the home screen was placed on a table in front of each participant. No prompts were provided on how to use the device or to engage in the leisure app. If the participant pushed the device away, the instructor waited for 10 sec and then placed the device within participant’s reach on the table again. If the participant did not engage in
activities with iPad2®, a random activity was provided from the preference assessment for 30 sec. to maintain their participation and prevent maladaptive behaviors. Then, the next trial followed. The session ended after 15 min had elapsed or when the participant exhibited maladaptive behaviors and could not be redirected within 5 min. Additionally, the participants were provided opportunities to engage in any activities from the preference assessment for up to 5 min. after each session in order to prevent maladaptive behaviors as well as reinforce their participations.

**iPad2® Training**

After stable baseline data were achieved, the iPad2® training was implemented. During this phase, the instructor and trained independent observers collected data on the degree of each participant's independent completion of the task analysis of leisure activities, and the duration of each activity. The participants were provided with a turned-on iPad2® with an identified leisure app corresponding to the results of the preference assessment. If the participant did not initiate the first step of the task analysis within 5 sec of the session or the next step within 5 sec of the completion of the previous step, the instructor used most-to-least prompts to initiate and complete the step.

The most-to-least prompting system consisted of hand-over-hand, gestural, and verbal assistance. The prompts were presented in a sequential manner, so they could be faded gradually. Hand-over-hand prompts were defined as placing a hand over the participant’s hand and guiding the hand to engage in or complete the steps. Gestural prompts involve pointing or tapping the activity or device in order to increase the likelihood of performing a response that would support skill acquisition. Verbal prompts were defined as supplemental vocal stimuli that
promote correct responding. For example, the instructor might say, “What’s next?” or “Choose a puzzle.”

The participant’s independent engagement in the steps of the task analysis was followed by social praise. The primary investigator determined whether tangible reinforcers, such as snacks, were necessary for each participant and implemented as needed. Those tangible reinforcers were faded gradually. Attempts were also followed by social praise. The prompts were faded out gradually and systematically in the sequence of most-to-least until the participant acquired the skill with 80% independence for two consecutive data sessions.

Once the participant met the criterion for acquisition, an additional leisure app was programmed and introduced. The second app was taught through a most-to-least prompting procedure as described above with social praise and tangible reinforcers as needed. This process was repeated until the participant had learned to independently engage in at least four leisure activities.

**Generalization**

Generalization sessions were conducted in each participant's vocational area or in the cafeteria during scheduled break time (untrained and natural settings). No prompts were given during the generalization sessions. The instructor and an additional trained observer collected data on the duration of the participants’ activity engagement and the independent completion of the task analysis for each activity app.
Experiment 2 Procedures

Baseline

During the baseline sessions, the participants were given an iPad2® with preferred leisure apps and a visual schedule app. The instructor and the independent observers collected data on the duration and independent completion of the leisure engagement. In addition, the instructor and independent observers collected data on the independent completion of the task analysis for schedule following with the visual schedule app.

No prompts were provided on how to use the device or the schedule app. If the participant pushed the device away, the instructor waited for 10 sec and then place the device within participant’s reach on the table again. The session ended after 15 min had elapsed or until the participant exhibits the maladaptive behaviors and could not be redirected within 5 min.

Visual Schedule Training

Once stable baseline data were obtained, the intervention was introduced in tiers. During this phase, the instructor and trained independent observers collected data on each participant's independent navigation of the visual schedule, access to leisure activities (Appendix B), and her or his duration of activity engagement. Within the visual schedule app, the visual representation of preferred activity apps that the participants choose during the generalization trials of experiment 1 was programmed, and the alarm was set for each transition if the activity did not have a clear ending. Since the participants were required to close the visual schedule app to access other activity apps, which were difficult to discriminate icons on the schedule app from ones on the home screen, printed out icons were used as the visual schedule for four out of six participants. Thus, the schedule was readily available to them at all times. The instructor used most-to-least prompting to teach participants to a) check the schedule app, b) open the activity on
the schedule, c) close the app when the alarm went off or end of the activity, and d) check the next activity on the schedule app.

For example, if the participant did not respond to the alarm within 5 sec or completion of an activity, the instructor used hand-over-hand or other necessary prompts so that each participant would respond to the alarm and/or close the activity. If the participant did not open the corresponding activity app on the schedule within 5 sec of checking the visual schedule, the instructor used prompts to open and start the game. The prompts were faded out gradually and systematically until the participant learned to independently follow the visual schedule on 80% of the steps for two consecutive data sessions. The purpose of this training was to teach participants to engage in various leisure activities for longer durations and to transition from one activity to another which would lead to more independence in daily activities such as self-care routines and job tasks if the participant worked beyond leisure engagement.

Generalization

The generalization sessions were conducted in each participant's break area at the vocational program throughout the day. No prompts were given during the generalization sessions. The instructor and the additional trained observer collected data on independent access with the visual schedule app as well as the duration of each participant's activity engagement and independent completion of the task analysis for each activity app. Due to the limited timeframe of this study, additional generalization sessions were only held for Tom. Those sessions were conducted in his natural environments such as doctor’s office or at his annual meeting in order to assess the generalization of the skills after the acquisition of independent completion of the leisure apps and the use of visual schedule.
Social Validity Measures

After the completion of this study, the participants’ guardians, support staff, and master’s level clinicians were asked to complete a survey with 5-point Likert scale regarding their satisfaction, the usefulness of the intervention, and stigma compared to other leisure activities or materials (Appendix D). The summary of the data is reported in chapter 4.

Data Analysis

All data were plotted in staggered graphs immediately after the session. The level, variability, and trend of the baseline data were visually analyzed to ascertain whether an acceptable baseline had been attained. An acceptable baseline was defined as a zero-celerating or non-therapeutic trend without extreme variability. The baseline data for each participant were compared to the intervention response level of each participant to examine the impact of the intervention. In addition, experimental control was demonstrated if there are immediate changes in behavior when the intervention was introduced. The degree of the impact and stability of the intervention on the behaviors was analyzed with the percentage of non-overlapping data (PND) along with Tau-U in which possible undesirable trend in baseline compared to intervention trend could be controlled with additional statistical analysis (Parker, Vannest, Davis, & Sauber, 2011). PND was calculated by dividing the number of data in intervention phases outside the data range into baseline data by the total number of data points in intervention phase. Tau-U was calculated with Kendall’s Rank correlation and the Mann-Whitney U test using the online Tau-U calculator (Vannest, Parker, Gonen, & Adiguzel, 2016). The data for generalization of skills across settings and the degree to which the skills were maintained were also assessed with visual analysis.
CHAPTER 4

RESULTS

Experiment 1

Group 1

Group 1 consisted of Tom, Kate, and Donna. Experimental control of the intervention was demonstrated on the independent completion of the task analysis and the duration of leisure engagement for the group 1 participants. As depicted in Figure 2, the level of the participants’ independence and the duration of leisure engagement were increased only after the implementation of the intervention not during the baseline trials. Additionally, those changes were abrupt with 100% PND and Tau-U of 1. The results for each participant are described below.

Tom.

Stimulus Preference Assessment. According to the RAISD (Fisher, Piazza, Bowman, & Amari, 1996) completed by his caregivers, it was suggested that Tom liked to listen to music, watch sports, do a word search or puzzles, get balloons, and read magazines. The results of MSWO (DeLeon, & Iwata, 1996) indicated that these observations were accurate for Tom who selected word search for an average of 60% of opportunities and balloon for an average of 58.3% of opportunities. The next activity he selected, more than an alternative, was matching cards with an average of 43.75% when they were presented. Looking at magazine and puzzle were the next highest of his selection with an average of 30% when they were available (Figure 1). Therefore, a word search game was initially introduced on the iPad2®, and then a balloon-related game was programmed.
Figure 1. Tom’s Stimulus Preference Assessment. This figure represents the percentage of selection for each item when it was presented.
**Independent Completion of Task Analysis.** As presented in Figure 2, baseline data were collected over six trials for Tom. During the baseline phase, Tom independently completed the first step of the task analysis (opening an app) but he did not attempt to engage in any of the activities on the iPad2®. This reflected in an average of 8.7% independent completion of steps (range, 7.6-9.1%). After the introduction of the intervention, Tom’s independent completion increased immediately to 63.6% for the first game (word search game) and achieved the criteria for mastery (above 80% for two consecutive trials) during the next two trials. Then he acquired skills for all five games within a period of two weeks with overall independent level with an average of 89.9% (range, 63.6-100%).

**Duration.** During the baseline phase, Tom did not engage in any of activities on iPad2® even though he opened the games (0 min for all six trials). Once the intervention was implemented, Tom engaged in activities on iPad2® for an average of 2.4 min (range, 0.96-4.37 min).

**Generalization.** During generalization trials, Tom maintained a high level of independence. He achieved an average of 100% of independent completions of task analysis across all sessions and an average of 3.93 min (range, 2.63-6 min) in duration. The variability for duration was based on the game and his break time. He also used the iPad2® at a doctor’s office and during a meeting. Data for these sessions were not collected but he completed all steps independently for at least 10 min.

**Percentage of Non-Overlapping Data.** Comparing the baseline and intervention data, the percentage of non-overlapping data for Tom was 100% for both duration and independent completion of task analysis. This indicates the intervention had an impact on his behavior.
Figure 2. Leisure Engagement of Group 1. This depicts the percentage of independent completion of tasks analysis for each activity and the duration of leisure engagement for Tom, Kate, and Donna during baseline, intervention, and generalization trials.
Kate.

Stimulus Preference Assessment. The RAISD indicated that Kate preferred listening music on the radio, playing cards, and doing puzzles. According to the results of the MSWO, listening music on the radio was her most preferred activity with an average of 80% of opportunities. Kate selected puzzle 50%, matching cards 50%, and then magazine 27.1% when they were available. However, radio was omitted from the choice when it was introduced on the iPad2® since she was unsuccessful in navigating the device and did not enjoy listening to music and resulted in exhibiting challenging behaviors. Thus, matching and puzzle were her main activities programmed on the iPad2®.
Figure 3. **Kate’s Stimulus Preference Assessment.** This figure depicts the percentage of her selection of activities when they were available.
**Independent Completion of Task Analysis.** During the baseline, Kate did not engage in any leisure activities on the iPad®. Her average independent completion of task analysis during the baseline was 0% for all trials (Figure 2). Once the intervention was introduced, her independent completion of task analysis increased immediately to 76.9% and she achieved the criteria of mastery within 3 trials for the first app. Since she struggled with tapping and dragging a puzzle piece on the screen for the next game app, she required additional training to tap the screen. However, she mastered all five game apps within three weeks.

**Duration.** The duration of leisure engagement was also 0 min for all trials during the baseline. When the intervention was introduced, the duration of her leisure engagement abruptly increased to 1.03 min and achieved an average of 1.4 min per game (range, 0.8 – 2.57 min).

**Generalization.** During the assessment of generalization, Kate maintained a high level of independence, an average of 92.3% and duration with an average of 3.03 min per session (range, 3.01-3.05 min).

**Percentage of Non-Overlapping Data.** The comparison of the baseline data and intervention data yielded the percentage of non-overlapping data of 100% for independent completion of task analysis and 100% for the duration. This suggests abrupt changes in both of her dependent variables when the intervention was introduced.
Donna.

Stimulus Preference Assessment. The RAISD answered by her caregivers indicated Donna prefers doing a puzzle, matching cards, sorting, putting things together, and looking at pictures. As depicted in Figure 4, through four trials of MSWO, Donna selected puzzle an average of 100%, matching cards for 50%, coloring for 31.25% of opportunities. For the rest of the activities, she did not show much preference and selected magazine with an average of 23.75%, balloon, and music for 20.2% and 19.2% respectively. Therefore puzzle and matching activities were programmed for the iPad2® for her.
Figure 4. Donna’s Stimulus Preference Assessment. This figure depicts the percentage of Donna’s selection of activities when they were presented.
**Independent Completion of Task Analysis.** During her baseline phase, Donna did not complete any of the steps in the task analysis independently for each of the 8 trials (the second panel of Figure 2). Once the intervention was introduced, her independent completion of a puzzle app immediately increased to 90% and she mastered the game within two sessions. Donna acquired additional four game apps related to puzzle and matching within 3 weeks with an average of 86.7% (range, 72.7-92.3%).

**Duration.** Donna did not engage in any leisure activities on the iPad2® during the baseline phase for all 8 baseline trials. However, once the intervention was implemented, her leisure engagement increased immediately to 1.2 min and achieved an average of 2.6 min per trial during the intervention trials (range, 0.8-3.62 min per trial).

**Generalization.** Two generalization data points were collected. During these trials, Donna maintained the high level of independence during the generalization trials with 92.3% for both trials. Donna’s leisure engagement was also maintained with an average of 3.8 min per trial (range, 2.4-3.5 min per trial).

**Percentage of Non-Overlapping Data.** Comparing the baseline and intervention data for Donna yielded the percentage of non-overlapping data with 100% for independent completion of tasks. That of the duration also resulted with 100%.
Group 2

Group 2 consisted of Lenny, Daniel, and Gabe. As depicted in Figure 6, experimental control was demonstrated on the independent completion of the task analysis and the duration of leisure engagement for the group 2 through immediate changes in the level of both dependent variables with the intervention. The results of each participant are described below.

Lenny.

Stimulus Preference Assessment. The RAISD completed by his caregivers suggested that Lenny liked to listen to music, dancing, and watching old TV shows. It is also suggested that Lenny enjoyed playing with balloons and bubbles. Four trials of MSWO were conducted showing that in average Lenny selected music 100%, TV shows 50%, balloon 27.9%, puzzles 23.2%, matching cards 22.9%, and bubble 19%, and magazines 16.3% when the items were available (Figure 5). Although Lenny selected TV, he did not watch the show for more than 5 seconds during MSWO. Therefore, TV was omitted from the choices on iPad2®.
Figure 5. Lenny’s Stimulus Preference Assessment. This figure represents Lenny’s selection of activities when those items were available.
**Independent Completion of Task Analysis.** During baseline trials, Lenny did not complete any steps of task analysis for any of the seven trials. Once the intervention was implemented, his independent completion of task analysis for the music app immediately increased to 80%. Four additional activity apps were introduced sequentially and Lenny acquired all five apps within 2 weeks with an average of 90.4% (range 80 – 100%) as depicted in Figure 6.

**Duration.** Lenny did not engage in any of the leisure apps during the baseline phase for all seven trials (0%). Once the intervention was introduced, the duration of his leisure engagement abruptly increased to 11.75 min (Figure 2) with an average of 2.89 min per trial.

**Generalization.** Lenny maintained a high level of independence during generalization trials with an average of 100% for independent completion of the task analysis. He also continued to engage in the leisure activities on the iPad2® with an average duration of 5.64 min (range, 5.57-6.7).

**Percentage of Non-Overlapping Data.** Comparing the baseline data and intervention data, the percentage of non-overlapping data for independent completion of the task analysis was 100% and that for the duration was also 100%.
Figure 6. Leisure Engagement of group 2. This figure depicts the percentage of independent completion of task analysis for each activity and the duration of his leisure engagement on the iPad2® for Lenny, Daniel, and Gabe during baseline, intervention, and generalization.
**Daniel.**

**Stimulus Preference Assessment.** The RAISD completed by his caregivers suggested that Daniel enjoyed listening to music, dancing, watching TV, doing puzzles, and playing with bubbles. Based on the information, music, bubble, balloon, TV, matching cards, puzzle, coloring book, and a magazine were assessed with MSWO. Through four trials of his MSWO, on average Daniel selected music 87.5%, balloon 37.5%, puzzle 33.3%, magazine 30%, matching cards 27.1%, TV 27.1%, and bubble 14.3% when they were available (Figure 7). Although he chose magazine and TV during the MSWO, he did not look at a magazine or watch TV. Thus, those items were not programmed on the iPad2® to be taught.
Figure 7. Daniel’s Stimulus Preference Assessment. This figure depicts the percentage of Daniel’s selection of activities when they are presented.
**Independent Completion of Task Analysis.** As depicted in Figure 6, Daniel did not complete any of the steps of task analysis during the seven baseline trials. However, when the intervention was implemented, the percentage of independent completion of task analysis increased immediately to 62.5%. Then he achieved the first leisure app (music) within 2 trials with an average of 85.15% (range, 82.3-90%). Daniel acquired leisure skills for additional four apps within two weeks with an average of 86.8% (range, 81.8-92.3%) as displayed in Figure 6.

**Duration.** During the baseline trials, Daniel did not engage in any leisure app with 0 min for six trials. Once the intervention was implemented, the duration increased immediately to 6.7 min and he engaged an average of 4.83 min for the music app. For the rest of four leisure apps, Daniel engaged in activities an average of 2 min for each activity (range, 0.59-2.53 min).

**Generalization.** Daniel maintained a high level of independence and duration of leisure engagement during the generalization trials. He completed the steps in task analysis with 100% for both generalization trials and averaged 3.19 min per trial (range, 3.17-3.2 min).

**Percentage of Non-Overlapping Data.** Comparing the baseline data and intervention data, the percentage of non-overlapping data for independent completion of task analysis was 100% and that for the duration was 100%. This represents no overlapping in data for the baseline and intervention trials.
**Stimulus Preference Assessment.** Gabe’s caregivers completed the RAISD and the results suggested that Gabe liked to listening music in the car, watching a video of Shrek and Pee-Wee Harman, balloon, and looking at pictures of familiar people. Four trials of MSWO were conducted prior to the baseline. On average, Gabe selected video clips of Shrek for 87.5%, video clips of Pee-Wee Harman for 62.5%, a puzzle for 33.3%, a balloon for 25.8%, radio for 25.8%, and color for 20% (Figure 8).
Figure 8. Gabe’s Stimulus Preference Assessment. This figure depicts the percentage of Gabe’s selections when those items were available.
Independent Completion of Task Analysis. Gabe did not complete any of steps of the task analysis for leisure engagement during the nine baseline trials (Figure 6). Once the intervention was implemented the percentage of his independence increased to 80% immediately. Gabe averaged 87.4% during the intervention trials (range, 80-91.7%) and acquired four leisure activities within 3 weeks.

Duration. During the baseline trials, Gabe did not engage in any leisure activities which resulted in 0 min for all 9 trials as depicted in Figure 6. After the intervention was introduced, the duration of his leisure engagement abruptly increased up to 7.36 min. Gabe averaged 2.84 min per trial during the intervention trials (range, 0.46-7.36 min per trial).

Generalization. Although only one generalization data point was collected, Gabe maintained a high level of independence and duration of leisure engagement during the generalization trial. He achieved 89.5% for independent completion of the steps for leisure activities and engaged in those activities for 4.38 min.

Percentage of Non-Overlapping Data. Comparing the baseline data and the intervention data, the percentage of non-overlapping data was 100% for independent completion of the task analysis. The percentage of non-overlapping data for the duration was also 100%.
**Tau-U**

**Group1.** An online Tau-U calculator (Vannest, Parker, Gonen, & Adiguzel, 2016) was used to aggregate the results (Table 3) for each group. Group 1 consisted of Tom, Kate, and Donna. Their baseline data were stable for independent completion of the task analysis ($p>0.05$) and it was not necessary to correct the data. The omnibus Tau-U score was 1.0 ($p < 0.01$, 95% CI [0.675, 1]) which indicated a large or strong effect of the intervention on the dependent variable (Parker, & Vannest, 2009; Rispoli, Lang, Neely, Camargo, Hutchins, Davenport, & Goodwyn, 2013). The baseline trend was assessed for the duration measure and the correction was not necessary for the duration since the baseline data were stable ($p>0.05$). The omnibus Tau-U score for duration was also 1.0 ($p < 0.01$, 95% CI [0.673, 1]). This suggested a large or strong effect of the intervention on the duration (Parker, & Vannest, 2009; Rispoli et al., 2013).

**Group2.** For the second group with Lenny, Daniel, and Gabe, the baseline data for independent completion of task analysis were stable for all participants ($p>0.05$). Thus, it was not necessary to correct the baseline data. The aggregated Tau-U score was 1.0 ($p<0.01$, 95% CI [0.673, 1]) with a large or strong effect of the intervention on the dependent variable. The assessment of baseline trend for the duration indicated no correction was necessary ($p>0.05$). The omnibus Tau-U for the duration was 1.0 ($p<0.01$, CI [0.673, 1]) which demonstrated the large or strong effect of the intervention on the duration measure.
Table 3. Tau-U (Experiment 1)

<table>
<thead>
<tr>
<th>Group</th>
<th>DV</th>
<th>Tau</th>
<th>Z</th>
<th>P</th>
<th>CI 95%</th>
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</thead>
<tbody>
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<td>1</td>
<td>Independent Completion</td>
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<td>6.032</td>
<td>&lt;0.001</td>
<td>0.765-1</td>
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<tr>
<td>1</td>
<td>Duration</td>
<td>1</td>
<td>5.990</td>
<td>&lt;0.001</td>
<td>0.673-1</td>
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<tr>
<td>2</td>
<td>Independent Completion</td>
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<td>5.987</td>
<td>&lt;0.001</td>
<td>0.673-1</td>
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<tr>
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<td>Duration</td>
<td>1</td>
<td>5.987</td>
<td>&lt;0.001</td>
<td>0.673-1</td>
</tr>
</tbody>
</table>

Experiment 2

Group 1

Group 1 consisted of Tom, Lenny, and Donna for experiment 2. Experimental control was demonstrated on the participants’ independent schedule following and the duration of leisure engagement since the level of independence and duration improved only when the intervention was implemented for all participants. Additionally, changes in the level of independence and duration were abrupt after the introduction of the intervention with PND of 100% and Tau-U of 1. The results of each participant are described below.

Tom.

Independent Schedule Following. The three activities that Tom selected during the generalization trials were programmed in the visual schedule app for this experiment. Five baseline data trials were conducted for Tom and he did not complete any steps of task analysis during this phase at all (0%). Once intervention was implemented, Tom acquired the skill to navigate the visual schedule app immediately and achieved mastering criteria within two trials. He averaged 94.7% during the intervention trials (range, 86.7-100%).
**Duration.** During the five baseline trials, Tom independently engaged in activities he was familiar with, including the word search app. However, he only played an activity once during this phase with an average of 1.3 min per trial (range, 0.78-1.63 min per trial). After the intervention was introduced, the duration of his leisure engagement immediately increased to 6.38 min. Tom averaged 6.81 min per trial during the intervention phase (range, 6.22-7.7 min).

**Number of Activities.** Tom engaged only in one activity per trial for all five baseline trials. However, once the intervention with the visual schedule app was introduced, he engaged in three activities per trial during the phase.

**Generalization.** Tom maintained a high level of independence for schedule following and leisure engagement during the generalization trials. His independence level was 100 % for both trials and he averaged 3.92 min per trial (range, 3.87-3.97 min). Although only anecdotal data were available, Tom was offered to engage in activities on the iPad® at the doctor’s office and during his annual meeting. He completed all steps with 100% independence.

**Percentage of Non-Overlapping Data.** The percentage of non-overlapping data was calculated to assess the impact of the intervention on independent schedule following and the duration of leisure engagement. The percentages of non-overlapping data for schedule following and the duration were both 100%. This suggested the immediate effect of the intervention on schedule following and the duration.
Figure 9. Schedule Following of Group 1. This figure represents the percentage of independent schedule following and the duration of leisure engagement with iPad2® during baseline, intervention, and generalization trials for Tom, Lenny, and Donna.
Independent Schedule Following. Five baseline data sessions were conducted for Lenny. The three activities he chose to play during the generalization for experiment 1 were programmed on the iPad2®. During the baseline, Lenny did not complete any steps of schedule following (0%). After the intervention was implemented, his independent schedule following increased to 80.0% immediately and Lenny averaged 84.5% (range, 80.0-86.7%).

Duration. During the five baseline trials, Lenny did not follow the visual schedule and engaged only one activity per trial in which the duration of his leisure engagement was an average of 1.20 min per trial (range, 0.62-2.95 min). Once the intervention was introduced, the duration of his leisure engagement increased to 6.4 min and he averaged 8.7 min per trial during the intervention trials (range, 6.40-10.37 min).

Number of Activities. Lenny only engaged in an activity per trials. However, the number of activities increased after the implementation of the intervention to 3.

Generalization. Lenny maintained a high level of independence for schedule following and leisure engagement during generalization. He achieved 93.3% for both generalization trials and an average of 8.16 min per trial (range, 7.76-8.55 min).

Percentage of Non-Overlapping Data. With the comparison of baseline and intervention data, the percentage of non-overlapping data for schedule following was 100%. That of the duration was also 100% which indicates the immediate effect of the intervention for both dependent variables.
Donna.

Independent Schedule Following. During the six baseline trials, Donna did not complete any of steps of the task analysis with 0% for all trials (Figure 9). After the introduction of the intervention with the visual schedule app, the level of her independence for schedule following immediately increased to 66.7%. Since Donna struggled with remembering the next activity after she checked the visual schedule app, a printed schedule was implemented. Once the printed visual schedule was introduced, the level of her independence increased further to 75% and then she achieved the mastery criteria with 80% (range, 75-80%).

Duration. Donna did not engage in any of leisure activities during baseline trials but once the intervention with the visual schedule app was introduced, the duration of her leisure engagement increased to 7.03 min (Figure 9). Due to her difficulties in navigating back and forth of apps, the printed visual schedule was introduced. After the implementation of a printed visual schedule, Donna averaged 6.47 min per trial (range, 5.08-7.27 min).

Number of Activities. As depicted in Figure 9, Donna did not engage in any of leisure activities during the baseline trials. However, once the intervention was implemented, she engaged in three activities per trial for all intervention trials.

Generalization. Donna maintained a similar level of independence for schedule following during generalization trials with an average of 76.7% (range, 73.3-80%). She also maintained the duration of leisure engagement with an average of 6.22 min per trial (range, 5.9-6.53 min. Although data were not collected on her independent access to iPad®, she requested for games several times when she saw the investigator in the vocational program.

Percentage of Non-Overlapping Data. Comparing the baseline data and intervention data, the percentages of non-overlapping data for schedule following and the duration were both
100% which indicates the immediate effect of the intervention for both dependent variables, including the level of independence and the duration of leisure engagement.

**Group 2**

Group 2 consisted of Kate, Daniel, and Gabe. As depicted in Figure 10, the level of independence and the duration of leisure engagement for all participants increased only when the intervention was introduced. The results of each participant were described below.

**Kate.**

**Independent Schedule Following.** As depicted in Figure 10, four baseline data sessions were conducted. During this phase, Kate did not independently complete any of steps of task analysis for schedule following with 0% for all four trials. However, once the intervention with the printed visual schedule, the level of her independence immediately increased to 66.7% and then Kate achieved the mastery criteria with 80%.

**Duration.** Kate did not engage in any of leisure activities during the baseline trials with 0 min for all four trials. After the intervention with a printed visual schedule was introduced, the duration of her leisure engagement increased to 7.02 min and Kate averaged 5.65 min per trial (range, 4.72-7.02 min).

**Number of Activities.** During the baseline trials, Kate engaged in no activities. However, once the intervention was introduced, Kate engage in three activities as the visual schedule set up.

**Generalization.** Kate maintained a high level of independence during generalization with 80%. She also maintained the similar level of leisure engagement in the phase with 5.63 min.
**Percentage of Non-Overlapping Data.** Comparing the baseline data and intervention data, the percentage of non-overlapping data for schedule following was 100% with no overlapping between the highest baseline data point and the lowest intervention data point. Additionally, the percentage of non-overlapping data for duration was also 100%. This suggested an immediate effect of an intervention on all dependent variables.
Figure 10. Schedule Following of Group 2. This figure depicts the percentage of independent schedule following and the duration of leisure engagement on the iPad2 during baseline, intervention, and generalization trials for Kate, Daniel, and Gabe.
**Daniel.**

**Independent Schedule Following.** Four baseline data sessions were conducted for Daniel. During this phase, he did not complete any of the steps of task analysis for schedule following with 0% of all trials. Once the intervention with a printed visual schedule was implemented, the level of his independence increased to 83.3% and he acquired the skill with 83.3% for two intervention trials.

**Duration.** Daniel did not engage in any of leisure activities during baseline trials. After the intervention was introduced, the duration of his leisure engagement increased to 7.03 min. He averaged 6.6 min per trial (range, 6.18-7.03 min).

**Number of Activities.** The intervention with the printed visual schedule affected the number of activities that Daniel engaged. During the baseline trials, Daniel did not engage in any of leisure activities. However, once the intervention was implemented, the number of his leisure engagement increased to three activities.

**Generalization.** Dante maintained a high level of independence during generalization trials and averaged 96.7% (range, 93.3-100%). His leisure engagement during generalization trials was also similar to the intervention trials with an average of 6.18 min per trial (range, 6.13-6.23 min).

**Percentage of Non-Overlapping Data.** With the comparison of baseline data and intervention data, the percentages of non-overlapping data for schedule following and the duration were both 100%. This suggested the immediate impact of the intervention on both dependent variables.
Gabe.

Independent Schedule Following. Six baseline data sessions were conducted for Gabe. During this phase, Gabe did not independently engage in any of steps of task analysis for schedule following with 0% for all trials. However, once the intervention with a printed visual schedule was implemented, the level of his independence increased to 66.7%. Then, Gabe achieved the mastery criteria with 83.3% for two consecutive sessions (range, 66.7-83.3%).

Duration. As depicted in Figure 10, Gabe did not engage in any of leisure activities during baseline trials. After the intervention with the printed visual schedule was introduced, the duration of his leisure engagement increased to 5.05 min with an average of 4.41 min per trial (range, 4.05-5.05 min).

Number of Activities. During all six baseline trials, Gabe did not engage in any of leisure activities. However, after the implementation of the intervention, the number of activities that he engaged was increased to three per trials as indicated on his schedule.

Generalization. Gabe maintained a high level of independence during generalization trials with an average of 79.15% (range, 75-83.3%). He also maintained the similar level of leisure engagement during generalization phase and averaged 4.17 min per trial (range, 4.15-4.18 min).

Percentage of Non-Overlapping Data. Comparing baseline and intervention data, the percentage of non-overlapping data for schedule following and the duration were both 100%. This indicated the immediate effect of the intervention on both dependent variables.
**Tau-U**

**Group 1.** An online Tau-U calculator (Vannest, Parker, Gonenc, & Adiguzel, 2016) was used and the results for each group were listed in Table 4 below. Group 1 consisted of Tom, Lenny, and Donna. The baseline data were stable for schedule following for those three participants ($p > 0.05$), thus it was not necessary to correct baseline data. The omnibus Tau-U score was 1.0 ($p < 0.01, 95\% \text{ CI} [0.495, 1]$) which indicated a large or strong effect of the intervention on schedule following according to the criteria (Parker, & Vannest, 2009; Rispoli, et al., 2013). Assessing the baseline trend with the calculator no correction of baseline data needed for the duration ($p > 0.05$). The omnibus Tau-U score for the duration was also 1.0 ($p < 0.01, 95\% \text{ CI} [0.495, 1]$). This suggested a large or strong effect of the intervention on the duration (Parker, & Vannest, 2009; Rispoli et al., 2013).

**Group 2.** Tau-U score was calculated with the Online Tau-U calculator (Vannest, et al., 2016). Group 2 consisted with Kate, Daniel, and Gabe. The baseline data were stable for schedule following ($p > 0.05$) and it was not needed to correct those data. The aggregated Tau-U score for schedule following was 1.0 ($p < 0.01, 95\% \text{ CI} [0.454-1]$) which suggested a large or strong effect of the intervention on schedule following. The baseline data for duration were also stable and did not require correction ($p > 0.05$). Tau-U score for duration was also 1.0 ($p < 0.01, 95\% \text{ CI} [0.454-1]$) with a large or strong effect of the intervention on the duration.
Table 4. Tau-U (Experiment 2)

<table>
<thead>
<tr>
<th>Group</th>
<th>DV</th>
<th>Tau</th>
<th>Z</th>
<th>P</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Schedule Following</td>
<td>1</td>
<td>3.884</td>
<td>&lt;0.001</td>
<td>0.495-1</td>
</tr>
<tr>
<td>1</td>
<td>Duration</td>
<td>1</td>
<td>3.884</td>
<td>&lt;0.001</td>
<td>0.495-1</td>
</tr>
<tr>
<td>2</td>
<td>Schedule Following</td>
<td>1</td>
<td>3.588</td>
<td>&lt;0.001</td>
<td>0.454-1</td>
</tr>
<tr>
<td>2</td>
<td>Duration</td>
<td>1</td>
<td>3.588</td>
<td>&lt;0.001</td>
<td>0.454-1</td>
</tr>
</tbody>
</table>

**Social Validity Data**

After the completion of both experiments, the participants’ caregivers including parents and direct care staff as well as clinicians who were familiar with them were asked to complete the social validity survey (Appendix D). The results of social validity data are summarized in Table 3. The survey included nine questions with a 5-point Likert scale for each question. Questions regarding acceptability of the use of iPad2® and stigma associated with non-tablet-based activities were included in the survey.

Overall, the caregivers rated the intervention as valuable for the participants and effective to teach leisure skills to them. The raters felt the participants engaged in more leisure activities with an average of 4.47 (range, 4-5), the use of iPad2® was beneficial for the participants with an average of 4.52 (range, 4-5), and iPad2® promoted various leisure activities with an average of 4.47 (range, 3-5). The raters also indicated that the use of VAS improved the level of independence of the participants with an average of 4.35 (range, 4-5). Further, the majority of the raters scored 5, strongly agree, to recommend the use of iPad2® for individuals with ASD and ID (average, 4.82; range, 4-5).
The question that related to the participants’ maladaptive behaviors was scored lowest (average, 3.58; range, 3-5). However, it was understandable since functional behavior assessments for those behaviors were not conducted and the frequency of maladaptive behaviors for those participants was relatively low prior to the current study.

The raters scored an average of 4.41 (range, 3-5) for a question related to stigma (H. Do you believe the participants stand out less in the community by using the iPad2® for leisure activities compared to other materials (picture books, puzzles...etc.)?). However, the raters scored somewhat lower for another stigma related question (F. Do you feel the participants are accepted more by others in the community by use of the iPad2®?) with an average of 4.00 (range, 3-5). This was possibly due to the perceptions of these caregivers who interacted with individuals with ASD and ID daily. Since the caregivers had been advocating for these individuals to receive educational, vocational, and residential services, they most likely had strong opinions regarding how individuals with disabilities should be treated in the community. Thus, they might have felt that the individuals should be accepted in the community with or without using iPad2®.
Table 5. Social Validity Survey Results

<table>
<thead>
<tr>
<th>Item</th>
<th>Average Response</th>
<th>Range of Response</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Do you feel that the participant’s engagement in leisure activities improved?</td>
<td>4.47</td>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>B. Do you think that the use of visual schedule improved the participant’s independence?</td>
<td>4.35</td>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>C. Do you think it is easy for the participant to use iPad2®?</td>
<td>4.24</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>D. Do you think the use of iPod Touch® or iPad2® was beneficial for the participant?</td>
<td>4.52</td>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>E. Did the incidents of the participant’s maladaptive behaviors decrease?</td>
<td>3.58</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>F. Do you feel the participants are accepted more by others in the community by use of the iPad2®?</td>
<td>4.00</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>G. Do you think the use of iPad2® promotes the participants’ engagement in various activities?</td>
<td>4.47</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>H. Do you believe the participants stand out less in the community by using the iPad2® for leisure activities compared to other materials (picture books, puzzles...etc.)?</td>
<td>4.41</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>I. Do you recommend use the iPad2® for other people with ASD/intellectual disabilities?</td>
<td>4.82</td>
<td>4-5</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 5
DISCUSSION

In this chapter, first, each research question will be discussed with the results of the current study comparing with the findings from previous research. Second, the limitations of the current study will be addressed. Finally, the investigator will provide implications for future studies.

Research Questions

Question 1

Can a teaching package that includes most-to-least prompting be effective in improving independent leisure engagement on a mobile device and increasing the amount of time adults with ASD spend in leisure activities during free time?

Results of the current study were consistent with the literature in that the teaching package with most-to-least prompting was effective in teaching leisure skills to adults with ASD. Vuran (2008) examined the effect of a most-to-least prompting procedure for teaching adults with ASD making a basket with clay. Two male participants successfully learned a 17-step task with the teaching procedure. Jerome, Frantino, and Sturmey (2007) also investigated the impact of most-to-least teaching procedure to teach three adults with ASD and ID to search topics of their interests on a computer along with backward chaining. Their results indicated that the teaching procedure was effective and all participants completed all 13 steps of the task analysis with 100% accuracy. Similarly, the current study demonstrated that intervention with most-to-least prompting was effective to teach leisure activities on the iPad® to six adults with ASD and ID.
As depicted in Figures 2 and 6, the teaching procedure with most-to-least prompting was effective in improving the level of independence on leisure engagement for all participants. While the participants did not independently complete steps of the task analysis during baseline with the exception of Tom, who completed the first step (opening an app), the level of independence immediately increased after the implementation of the teaching procedure. The average percentage of independent completion of task analysis during the intervention was 87.86% (range, 62.5-100 %). Additionally, all participants maintained high levels of independence during generalization trials with an average of 97.41% (range, 89.5-100 %).

The teaching procedure of this study was also effective in increasing the duration of all participants’ leisure engagement (Figures 2 and 6). During the baseline phase, none of the participants independently engaged in leisure activities, showing a duration of 0 min across baseline. However, once the intervention was implemented, the duration increased immediately with an average of 2.5 min per trial (range, 0.46-11.75 min). In addition, all participants maintained the same duration of leisure engagement during generalization trials.

**Group 1.** Group 1 of experiment 1 consisted with Tom, Kate, and Donna. Kate and Donna did not independently complete any of the steps of the task analysis for leisure activities during baseline (Figure 2). Tom independently completed only the first step of the task analysis, tapping an icon on the iPad2® during baseline. Only when the intervention was introduced did the level of their independence increase. All of three participants maintained a high level of independence during generalization. There were no overlapping data between baseline and intervention data for all three participants and the omnibus Tau-U score indicated a large effect of the intervention on the dependent variable.
Similarly, all three participants did not independently engage in any of the leisure activities during baseline. Duration of their engagement increased only when the intervention was implemented. Three participants also maintained the similar level of leisure engagement during the generalization trials. Duration data during baseline and intervention did not overlap and the aggregated Tau-U score suggested a large effect of the intervention on duration.

**Group 2.** Group 2 for experiment 1 consisted of Lenny, Daniel, and Gabe. All three participants did not independently complete any of the steps of the task analysis nor engage in any of activities during baseline (Figure 6). However, when the intervention was implemented the level of their independence and the duration of their leisure engagement increased. Those participants also maintained the same level of independence and leisure engagement during generalization trials. Baseline data and intervention data of both levels of independence and leisure engagement did not overlap for all three participants. Consequentially, Tau-U scores for both dependent variables were 1 indicating a large effect of the intervention.

As discussed in Chapter 2, previous studies demonstrated that a most-to-least prompting procedure was effective in teaching various skills including leisure skills (Vuran, 2008; Jerome, Frantino, & Sturmey, 2007; Cengher et al., 2015). However, only handful of studies were conducted targeting leisure skills of adults with ASD and ID, especially incorporating commonly available technology devices to the intervention (Hill, Belcher, Brigman, Renner, and Stephens, 2013; Jerome, Frantino, & Sturmey, 2007; Kagohara et al., 2011; Uphold, Douglas, and Loseke, 2014; Yalon-Chamovits, & Weiss, 2008). Therefore, the current study not only supplies additional evidence of the effectiveness of most-to-least prompting but also expands the use of the teaching procedure to leisure activities on commonly available technology devices such as iPad2®.
Question 2

What are the effects of a tablet based visual schedule on the duration of leisure engagement and the level of independence in transitioning between activities (e.g. navigation, schedule following, organization) with adults with ASD?

The results of the current study indicated the effectiveness of the intervention on schedule following which was consistent with previous studies. Knight, Sartini, and Spriggs (2014) conducted a systematic review of studies used visual activity schedule (VAS) as an intervention. They concluded that VAS is an effective strategy to teach both children and adults with ASD various skills including leisure and daily living skills while promoting their independence and reducing challenging behaviors. Chan et al. (2014) examined the impact of a photographic schedule on leisure activity of three adults with ASD and ID. The participants successfully learned to play simple video games on the iPad® using a printed visual schedule. Pierce et al. (2013) also examined the effectiveness of the VAS on the transition between activities with four children with ASD. The results indicated that the VAS was effective in increasing the participants’ level of independence.

As depicted in Figures 9 and 10, the teaching procedure in the current study increased independence for all participants after the intervention was implemented and its experimental control was demonstrated. However, the tablet based visual schedule was not user-friendly due to compatibility issues with leisure apps and the printed visual schedule needed to be added for four out of six participants.

**Group 1.** Group 1 of experiment 2 consisted of Tom, Lenny, and Donna. During baseline, all three participants did not complete any of the steps of the task analysis for schedule following (Figure 9). Only after the intervention was implemented did the level of their
independent in schedule following increase. Tom and Lenny responded to the visual schedule app. However, Donna kept pressing the schedule icons within the schedule app instead of closing the schedule app to access leisure activities. Thus, the printed visual schedule was introduced to her. The level of her independence for schedule following further increased with the printed visual schedule (Figure 9). All three participants maintained a high level of independence during generalization trials. Baseline data and intervention data for schedule following did not overlap for all three participants and aggregated Tau-U score was 1 suggesting a large effect of the intervention on schedule following.

Tom and Lenny independently engaged in one leisure activity during baseline without checking their schedule. The level of their leisure engagement was low with an average of 1.2 min per trial for Tom and 1.3 min per trial for Lenny. On the other hand, Donna did not engage in any of leisure activities during baseline. Only when the intervention was introduced did the duration of their leisure engagement increase. Tom, Lenny, and Donna maintained a similar level of leisure engagement during generalization. Duration data during baseline and intervention also did not overlap at all with a Tau-U score of 1. This indicated a large effect of the intervention on their leisure engagement.

**Group 2.** Groups 2 of experiment 2 consisted of Kate, Daniel, and Gabe. All three participants did not complete any of the steps of schedule following during baseline. Since all three participants struggled to discriminate the icon within the visual schedule app from the activity apps like Donna, the printed visual schedule was used for them. The participants also maintained a high level of independence during generalization trials. Only when the intervention was introduced did their level of independence increase. Baseline data and intervention data for
schedule following for group 2 did not overlap with PND of 100 % and Tau-U score of 1.0 which indicated a large effect of the intervention on schedule following.

Similarly, all three participants did not engage in any of leisure activities during baseline. However, after the intervention was implemented, their leisure engagement increased. The participants continued the similar level of leisure engagement during generalization trials with an average of 5.26 min per trial (range, 4.15-6.23 min). Duration data during baseline and intervention for group 2 did not overlap with PND of 100 % and Tau-U of 1.0. This suggested a large effect of the intervention on duration.

The tablet based visual schedule was effective for two of four participants and both participants acquired the skill to navigate iPad® to check the visual schedule on the app and then close the app to go to each leisure app. It was observed that four participants kept pressing the icon within the visual schedule app attempting to open each leisure app (Illustration 1). Unfortunately, the visual schedule app was not able to be linked with the icons within the home screen. Therefore, participants could not always refer back to the app-based visual schedule and the printed visual schedule was needed for four out of six participants. Regardless of the adjustments needed to the intervention, the visual schedule was effective to improve the level of the participants’ independence as well as leisure engagement.
Question 3

Does engaging in the leisure activities on a mobile device affect social validity measures such as stigmatization of adults with ASD?

Results of the social validity survey suggested overall the use of the iPad2® had a positive impact on the participants. The caregivers indicated that the participants’ leisure engagement and level of independence improved after the interventions with the iPad2® were introduced. They also thought the use of the iPad2® was beneficial for the participants and its use would prevent the participants to stand out in the community. This is consistent with the
findings of previous studies suggesting commonly available high-tech devices can reduce the stigma associated with the use of specialized and traditional tools (Conley, 2012; Shinohara, & Wobbrock, 2011; Van Laarhoven et al., 2009).

Parette and Schere (2004) identified three components of assistive technology that affect social stigma, appearance, customizability, and commonality. If the device was strange looking, it would attract undesired attention. If the device was not gender- or age-appropriate, it would also attract undesired social attention. Finally, if the device was only for people with disabilities, the user would stand out. Shinohara and Wobbrock (2011) investigated the effectiveness of assistive technology for individuals with disabilities taking a qualitative approach. They found that the participants felt the more conventional and “strange looking” devices attract undesired attention which could discourage them from using them. Collectively, the use of commonly available technology such as iPad2® would be beneficial for adults with ASD and ID to engage in leisure activities while it helps to reduce the stigma associated with more conventional devices.

Although the participants were not able to answer questions on the social validity survey, they displayed vocal and non-vocal behaviors to request sessions with the investigator. For example, when the investigator entered the vocational area, Kate jumped up and requested iPad2®. Gabe also talked about the game app every time the investigator walked by his area. Tom also jumped out of his seat expecting his sessions every time he saw the investigator walking through the hallway beside his work area. Additionally, the participants’ demeanor during the sessions suggested they were enjoying the activities on the iPad2®. Daniel and Gabe showed their excitement with smiling and rocking back and forth when they first acquired the skill of tapping and dragging on the iPad2®. Those participants’ vocal and non-vocal behaviors
indicated how much they enjoy engaging leisure activities on the iPad2®. Even though a formal QOL measure was not included in the current study, the results of the survey and the participants’ behaviors described above indicated that their leisure engagement had a positive impact on their affects and activity level that could potentially influence their lives. This was also consistent with the literature regarding effects of leisure engagement on QOL.

Garcia-Villamisar and Dattilo (2010) evaluated the impact of leisure activities on QOL for adults with ASD. The results of their randomized control trial indicated the experimental group who received the leisure program scored significantly higher than the control group on two out of four indicators, satisfaction, and competence. Patterson and Pegg (2009) explored the effect of leisure engagement on QOL for individuals with ID through qualitative methods. Their results suggested that the leisure engagement positively affected the self-esteem, self-worth, psychological well-being, skills development, socialization, and overall satisfaction in the life of the participants.

Limitations

Although all participants acquired leisure skills and their level of their independent was improved with the intervention package, there are several limitations of the current study that warrant description.

Participants

The results of a literature review by Knight, Sartini, and Spriggs (2014) suggested that VAS is effective in teaching adults with ASD various skills such as transition, leisure, and daily living skills while reducing undesirable behaviors. The frequency of challenging behaviors could have been additional dependent variable in the current study. However, the frequency of the participants’ challenging behaviors prior to this study was as low as less than once a month.
Thus, the impact of VAS on undesirable behaviors was not assessed. This low frequency of the participants’ challenging behaviors might also have impacted their performance in this study.

Additionally, it was reported by the caregivers that the participants had not been exposed to the iPad2® prior to the intervention. However, it is possible that they were exposed to the iPad2® or similar devices by at least seeing the devices in their daily life prior to the study. This might have affected their learning curve in the intervention.

**Research Design**

Although generalization of skills was assessed in the participants’ natural environments, all data were collected in the vocational program except for one individual, Tom, due to the limited time frame of the study. The independent access was not assessed since the participants did not own an iPad®, so they did not have constant access to the device across settings. This limits the generalizability of skills to more natural settings such as in the community and their houses. Further assessments across settings would be required to conclude its generalizability.

In the current study, the instructor was the student investigator who collected primary data and implemented interventions. Although the independent observer collected IOA data with high reliability, the knowledge of the intention of the study potentially affected the results. Additionally, the investigator had been working as a behavior analyst and teaching individuals with ASD and other developmental disabilities over 18 years prior to this study. The experience of the investigator possibly affected the acquisition rate of the participants.

Further, the participants learned to engage in up to five leisure apps relatively quickly, but the long-term effects of the intervention were not assessed in the current study. The participants may not maintain the skills in the long term if they don’t have constant access to the devices as they did in the current study, or over time they may lose interest with the leisure apps.
they had learned. Supplementary teaching sessions would benefit the participants to explore additional apps, but this was not included in the current study.

**Stimulus Preference Assessment**

The investigator used an MSWO (DeLeon & Iwata, 1996) to assess preference of the participants prior to the study to identify target activities on the iPad2®. However, the assessment might not have reflected the participants’ preference for the iPad2® apps at times. In the current study, it was necessary to identify game apps closely related to their preferences. Since the participants never engaged in leisure activities on the iPad2® and the purpose of the current study was to examine the impact of the intervention on their leisure skills, actual game apps could not be used for MSWO. Thus, physical materials such as puzzles made out of paper or printed out word search were used for the assessment. As a result, their preferences with physical materials were not always consistent with their preferences with leisure apps on the iPad2®. This was possibly due to differences in the response effort to access to activities with physical items such as a radio versus the radio app on the iPad2® in the case of Kate. With her limited dexterity, Kate initially struggled with navigating the app on the iPad2® to access music and exhibited screaming and pushed the iPad2® away during the intervention to learn the radio app. Once she accessed music, she did not want to listen to her preferred music on the iPad2® and requested a radio. Kate was also used to listening to background music while she was working or engaging in other activities. This might have affected her performance because she may have preferred to listen to background music rather than listening to music as a sole leisure activity.
Device

This study was originally planned for the use of both iPod Touch® and iPad2®. However, some of the game apps are difficult to manipulate in the smaller iPod Touch®. Thus, the iPad2® was used for all participants. Due to the size of the device, the portability was somewhat compromised which could affect further generalization to other locations in the community.

Although the advancement of technology has made the devices more accessible to individuals with disabilities, the touch sensitivities of the home screen and the apps were noticeably different from each other. This caused the participants to learn different ways to tap and drag to navigate the device and apps. At times these differences in screen sensitivity seem affected the acquisition of skills of the participants.

The visual schedule app had limited compatibility with other apps. During the second experiment, the participants were expected to open to check the schedule and then close the app in order to access the leisure apps. When they went back to the home screen, they could not see their schedule. This required the participants to remember what was on the schedule which made it difficult for some participants and defeated the initial purpose of the visual schedule being readily available to refer back. As a result, the intervention for some participants needed to be modified. This limitation of the device compatibility may also have affected the results including the duration of skill acquisition.

Dependent Measure

Although the duration of leisure engagement significantly improved for all the participants when the both interventions were implemented, it might not be, by itself, the best measure to assess their progress. The length of each app activity has affected the duration of
engagement, thus the participants engaged in some of the activities for much shorter time periods than others. In addition, the duration of leisure engagement decreased when the participants became more fluent with leisure activities. Therefore, at times this measure did not reflect their level of independence.

Further, variability in duration was observed across all participants. Although it was an acceptable range, IOA never reached 100% for the duration when the participants engaged in leisure activities. The reaction time to start and stop the timer might have affected these results. In the current study, the possibility of automated data collection of the duration was explored but the existing app did not accommodate the necessary measurement of dependent variables. A few apps for iPad2® would keep track of the total duration of the use of iPad2® but those apps could not collect data on which apps the participants engaged in on the iPad2®.

**Future Research**

Given limited generalizability beyond the participants in the current study, replication of the current study is needed to further validate the effectiveness of the most-to-least prompting procedures to teach leisure skills with technology devices. Additionally, the future studies should continue to target the adults with ASD and ID to evaluate effective interventions in order to expand existing research.

As discussed as a limitation, the duration of leisure measure was not always reflective of participants’ progress. For example, when participants’ fluency in navigating leisure apps improved, their duration of access decreased. The duration of each activity also varied. Thus, the measurement did not accurately demonstrate the participant’s progress at times. Future studies should explore alternative or additional measures to demonstrate improvement in the participants’ skill more accurately. Additionally, due to the nature of the data collection method
with starting and stopping a timer, 100 % IOA was never achieved except for baseline data. Future studies should include automated data collection as this technology becomes more available, thus increasing the accuracy of duration data collection.

Although the commonly available technology was beneficial for all of the participants in improving their leisure engagement, the existing device and apps have some limitations as discussed above. This warrants the further advancement of technology to make devices and apps more accessible for individuals with ASD and ID. An interdisciplinary approach has been promoted to improve health, educational, and behavioral services for individuals with and without disabilities (Connor, Gabel, Gallagher, & Morton, 2008; Reinhold-Keller, et al., 2000, Spelt, Biemans, Tobi, Luning, & Mulder, 2009). Compatibility of the leisure apps with the visual schedule app and adjustment of the touch screen sensitivity could be easily addressed with an interdisciplinary collaboration between special education and information technology researchers.

The current study used an MSWO (DeLeon, and Iwata, 1996) to identify the participants’ preference for leisure activities. However, in order to prevent exposure to the iPad2® prior to the intervention, physical materials of each activity such as puzzles made out of papers or music on CDs were used. For some cases, the results of the MSWO were not reflected into the preference of leisure activities on the iPad2® due to differences in response effort along with the complexity of navigating a particular leisure app. For example, Kate refused to learn to listen to music on the iPad2® when it was introduced, and the session needed to be ended due to her challenging behaviors. She also was used to listening to music in the background while she was working or engage in other leisure activities. This could have affected her preference during the intervention sessions. Thus, future research should explore adapted ways to conduct a
stimulus preference assessment reflecting differences in the response effort and in mediums such as physical materials versus technology devices.

Although the results of the social validity survey indicated that the caregivers felt the interventions were effective to improve the participants’ level of independence and leisure engagement on the iPad²®, the participants could not answer questions on the survey. The participants’ verbal and non-verbal behaviors suggested that they enjoyed engaging in leisure activities on the iPad²® and their perception of the interventions would be valuable to capture. Future studies should explore additional measures to assess their perception of such interventions and its long-term impact on their quality of lives.

**Summary**

The teaching strategies employed in the current study were effective in increasing independence with and duration of the participants’ engagement in leisure activities. The participants also learned to respond to either a tablet-based or printed visual schedule to engage in multiple leisure activities. The study provided additional evidence in support of most-to-least prompting procedures in teaching use of technology devices for adults with ASD and ID.

Despite the lack of a universally agreed-upon measure of QOL, QOL has increasingly gained attention as an outcome measure of the interventions for individuals with ASD and ID (Burgus and Gutstein, 2007). Previous studies suggested that leisure engagement increase QOL with individual ASD and ID (Garcia-Villamisar and Dattilo, 2010; Patterson and Pegg, 2009). Given the importance of leisure engagement, it is critical to teach individuals with ASD and ID to engage in leisure activities.

With the advancement of technology in recent decades, most individuals without disabilities use technology devices such as the iPad²® or smartphones as a medium for leisure
activities. The American Time Use Survey (2015) concluded that there was recently a shift of leisure activities from attending social events to technology-based activities. However, due to restricted resource and/or accessibility of technology devices, individuals with disabilities have less access to such devices. For example, Fox (2011) reported only 54% of adults with disabilities have access to the internet while 81% of adults without disabilities do. Gell et al. (2013) also reported that the use of technology decreases with the level of severity of disabilities.

Regardless of limited resources for individuals with disabilities, the current study provided opportunities for adults with ASD and ID to learn leisure activities on the iPad2® and to successfully demonstrate the effectiveness of the intervention on the participants’ leisure engagement.

Further, the results of social validity survey indicated that the use of iPad2® was an acceptable and effective intervention to increase the participants’ independence level and leisure engagement. Almost all caregivers gave the highest rating for recommending iPad2® for individuals with disabilities. The collective vocal and non-vocal behaviors of participants also suggested that the participants enjoyed engaging leisure activities on the iPad2®.

Given existing research showing the importance of leisure engagement on QOL and the trend of including leisure activities along with effective interventions, consistent with the results of the current study, commonly available technology should be made accessible to individuals with ASD and ID especially to the adult population. As mentioned earlier, funding is limited for adults with disabilities to access technology devices. It is investigator’s hope not only to inform researchers to promote studies targeting adults with disabilities but also to inform policy makers to advocate making more resources available to this population.
REFERENCES


http://www.bls.gov/tus/


Conley J. (2012). Can the iPad address the needs of students with cognitive impairments by meeting IEP goals? In Resta P. (Ed.), Society for Information Technology and Teacher Education International Conference (pp. 3986-3990). Chesapeake, VA: Association for the Advancement of Computing in Education.


Shattuck, P. T., Narendorf, S. C., Cooper, B., Sterzing, P. R., Wagner, M., & Taylor, J. L.


## APPENDIX A

Sample Leisure Skill Data Sheet

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**<Prompts>**

I: independent completion, P: physical prompts, G: gestural prompts, V: verbal prompts

**<Activities>**

P: puzzle, M: music, C: crosswords, W: word search, I: ice hockey, O: other

* circle the activity and record duration for each activity engagement
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### APPENDIX C  PROCEDURAL FIDELITY CHECKLIST

#### Baseline

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<td>turn on iPad2®</td>
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<td>place the device in front of the participant</td>
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<td>record data</td>
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<td>Wait for 10 sec *if the participant pushes the device away</td>
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</tr>
<tr>
<td>Place the device in front of the participant</td>
<td>Yes  No  N/A</td>
</tr>
</tbody>
</table>

#### Intervention

<table>
<thead>
<tr>
<th></th>
<th>Accurate Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set a timer</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>Turn on iPad2®</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>Place the device in front of the participant</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>Use prompts if the participant does not initiate the step within 5 seconds of the beginning of the session or completion of the previous step</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>Provide praise/ tangible reinforce as needed</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>Wait for 10 sec *if the participant pushes the device away</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>Place the device in front of the participant</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>Fade prompts gradually</td>
<td>Yes  No  N/A</td>
</tr>
</tbody>
</table>

#### Generalization/Maintenance

<table>
<thead>
<tr>
<th></th>
<th>Accurate Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set a timer</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>turn on iPad2®</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>place the device in front of the participant</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>record data</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>Wait for 10 sec *if the participant pushes the device away</td>
<td>Yes  No  N/A</td>
</tr>
<tr>
<td>Place the device in front of the participant</td>
<td>Yes  No  N/A</td>
</tr>
</tbody>
</table>
APPENDIX D   SOCIAL VALIDITY SURVEY

A. Do you feel that the participant’s engagement in leisure activities improved?
   1) Strongly disagree  2) disagree  3) neutral  4) agree  5) strongly agree
B. Do you think that the use of visual schedule improved the participant’s independence?
   1) Strongly disagree  2) disagree  3) neutral  4) agree  5) strongly agree
C. Do you think it is easy for the participant to use iPod Touch® or iPad2®?
   1) Strongly disagree  2) disagree  3) neutral  4) agree  5) strongly agree
D. Do you think the use of iPod Touch® or iPad2® was beneficial for the participant?
   1) Strongly disagree  2) disagree  3) neutral  4) agree  5) strongly agree
E. Did the incidents of the participant’s maladaptive behaviors decrease?
   1) Strongly disagree  2) disagree  3) neutral  4) agree  5) strongly agree
F. Do you feel the participants are accepted more by others in the community by use of the iPad2®?
   1) Strongly disagree  2) disagree  3) neutral  4) agree  5) strongly agree
G. Do you think the use of iPad2® promotes the participants’ engagement in various activities?
   1) Strongly disagree  2) disagree  3) neutral  4) agree  5) strongly agree
H. Do you believe the participants stand out less in the community by using the iPad2® for leisure activities compared to other materials (picture books, puzzles…etc.)?
   1) Strongly disagree  2) disagree  3) neutral  4) agree  5) strongly agree
I. Do you recommend use the iPad2® for other people with ASD and intellectual disabilities?
   1) Strongly disagree  2) disagree  3) neutral  4) agree  5) strongly agree