Teaching Children with Developmental Disabilities to Operate Portable Media Players for Leisure and Learning Purposes

By

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ABSTRACT

Social, communication, academic, and leisure skills are important for healthy development and a productive life. Individuals with developmental disabilities, however, have impairments that may affect their ability to acquire these skills or may not have had the opportunity to learn them. Compared to peers, these individuals may require additional or modified instruction to acquire new skills. A number of teaching techniques have been examined in the special education literature but as new technology, such as portable devices, become available, further research is needed to examine the effectiveness of interventions employing this new technology.

The studies in this thesis examined the use of portable multimedia devices like the iPod Touch® and iPad® in combination with video modelling to teach leisure, academic and social skills to individuals with developmental disabilities. In the first two studies, students with severe intellectual disability were shown a video modelling instruction on an iPod Touch teaching them to operate the same iPod to watch video clips and listen to music. In the third study, a video modelling instruction was presented on an iPad to teach two students with Asperger syndrome how to use the spell-check function on a computer word processor. In the final study, a Social Story™ presentation and a video modelling segment were presented on an iPad to demonstrate to two students with Asperger syndrome how to greet adults at school.

An important aspect of these studies is that they afforded some degree of self-determination to the students by giving them a chance to have an input in the learning process (e.g. whether they would like to participate, how they prefer to learn, their favourite stimuli). Self-determination has been linked to a better quality of life and more positive academic, leisure, and independent living outcomes. Interventions promoting self-determination for individuals with intellectual disabilities and autism are, therefore, paramount.

The data from all studies suggest video modelling and portable devices can be successfully used to teach a range of skills to children with developmental disabilities. The devices were not only effective as teaching tools but also provided the participants with opportunities for leisure activities. The use of portable technology allowed for efficient intervention delivery and

may have had the additional advantage of being motivating to the participants. The studies also illustrate how the same procedures can be successfully used to teach children with lower and higher cognitive abilities.

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Last but not least, I would like to thank my family. For everything.

DECLARATION BY THE AUTHOR

This thesis is composed by my original work conducted for this PhD degree under supervision at Victoria University. No part of it has been previously submitted for another degree or diploma. Work by other authors has been duly referenced in text and contribution by others in jointly-authored work has been clearly stated.

The research included in this thesis was part of a broader research project: *Enhancing the communication, leisure, and social skills of children with developmental disabilities*. The ethical approval for which has been included as Appendix A. I have received input and feedback from other members of my cohort team but the studies presented in this thesis were designed and conducted by me. My primary supervisor, Jeff Sigafoos, provided assistance in data analysis and interpretation of results in all studies and edited drafts of the subsequent articles, as well as the chapters in this thesis.

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CHAPTER I

INTRODUCTION

Developmental Disabilities

Developmental disabilities are a group of lifelong conditions characterised by mental and/or physical impairments. Individuals with developmental disabilities may present limitations in intellectual functioning (e.g. learning problems) and/or physical disabilities (e.g. blindness from birth) (American Association on Intellectual and Developmental Disabilities [AAIDD], 2011b; Centers for Disease Control and Prevention, n.d.). Disorders categorised under developmental disabilities include intellectual disability (also referred to as mental retardation), autism spectrum disorder (ASD), and cerebral palsy. This thesis presents four studies focussed on educating students with ASD or severe intellectual disability.

ASD is characterized by significant impairments in social and communication development and the presence of aberrant behaviours, such as markedly restricted and repetitive repertoire of activities and interests (Adams, Gouvousis, VanLue, & Waldron, 2004; American Psychiatric Association, 2000). The autism spectrum ranges from low functioning levels, as seen in autism, to high functioning levels, as seen in Asperger syndrome. Intellectual disability is characterised by a significant limitation in general intellectual functioning as well as evidence of deficits in adaptive behaviour, such as deficits in daily living skills, communication skills and social skills (AAIDD, 2011a; American Psychiatric Association, 2000).

The terms, classification, and diagnostic criteria of these conditions vary according to the source. The information presented in this thesis was extracted from the most widely employed diagnostics and classification systems, the Diagnostics and Statistical Manual (DSM; American Psychiatric Association, 2000) and the International Classification of Diseases (ICD; World Health Organization, 1992). These two standard classification manuals classify and name the conditions slightly differently, but their diagnostics criteria are similar.

The DSM is in its 4th edition, text revision (DSM-IV-TR) and the ICD is in its 10th edition (ICD-10). Both classification systems have undergone major revision throughout the years to reflect the increased understanding of the disorders described and the changing views and practices of researchers and professionals involved. Revised versions of both manuals are underway and new editions are expected for 2013 (DSM-5) and 2015 (ICD-11). Table 1.1 illustrates the classification hierarchy for intellectual disability and ASD in the DSM-IV-TR (American Psychiatric Association, 2000) and the ICD-10 (World Health Organization, 1992).

Table 1.1. Classification of Intellectual Disability (Mental Retardation) and Autism as reported in the DSM-IV-TR and the ICD-10

DSM-IV-TR	**ICD-10**
Disorders Usually First Diagnosed in Infancy, Childhood, or Adolescence ***Mental Retardation*** *Mild Mental Retardation* *Moderate Mental Retardation* *Severe Mental Retardation* *Profound Mental Retardation* *Mental Retardation, Severity* Unspecified Learning Disorders Motor Skills Disorder Communication Disorders *Pervasive Developmental Disorders* ***299.0 Autistic Disorder*** 299.80 Rett's Disorder 299.10 Childhood Disintegrative Disorder ***299.80 Asperger's Disorder*** 299.80 Pervasive Developmental Disorder Not Otherwise Specified (Including Atypical Autism) Attention-Deficit and Disruptive Behavior Disorders Feeding and Eating Disorders of Infancy or Early Childhood Tic Disorders Elimination Disorders Other Disorders of Infancy, Childhood, or Adolescence	***F70-F79 Mental retardation*** *F70 Mild mental retardation* *F71 Moderate mental retardation* *F72 Severe mental retardation* *F73 Profound mental retardation* **F80-F89 Disorders of psychological development** F80 Specific developmental disorders of speech and language F81 Specific developmental disorders of scholastic skills F82 Specific developmental disorder of motor function F83 Mixed specific developmental disorders *F84 Pervasive developmental disorders* ***F84.0 Childhood autism*** F84.1 Atypical autism F84.2 Rett's syndrome F84.3 Other childhood disintegrative disorder F84.4 Overactive disorder associated with mental retardation and stereotyped movements ***F84.5 Asperger's syndrome*** F84.8 Other pervasive developmental disorders F84.9 Pervasive developmental disorders, unspecified F88 Other disorders of psychological development F89 Unspecified disorder of psychological development

In this thesis, the term *autism* will be used to refer to what the DSM-IV-TR calls *autistic disorder* and the ICD-10 calls *childhood autism* (also known as infantile autism, infantile psychosis, and Kanner's syndrome). Asperger syndrome will be used to refer to Asperger's disorder (DSM-IV-TR) and Asperger's syndrome (ICD-10) (also known as autistic psychopathy, and schizoid disorder of childhood). The term Autism spectrum disorder (ASD) will be used when referring to the autistic spectrum, including autism and Asperger syndrome.

Autism Spectrum Disorder (ASD)

Historical Background

In 1943, Leo Kanner published a description of a group of 11 children with unique characteristics that he initially considered to be similar to schizophrenia. The first child, seen in 1938, had remarkable memory, but was unable to carry a normal conversation. Ten other children were described as being, from birth, unable to relate to others in an ordinary way and anxiously obsessive for the preservation of sameness (Kanner, 1971, 1973). These children were seen as "feebleminded", a psychiatric term widely used at the time to describe mental disability, but Kanner noted they had "good cognitive potentialities" (Kanner, 1943). Nevertheless, they displayed marked limitations in spontaneous activities and impaired communicative language skills such as echolalia and inverted pronouns. Their behaviour was also unusual as they preferred being alone and disregarded external input as much as possible (Kanner, 1943). Almost 40 years after Kanner first described the disorder, the diagnostic criteria for autism (autistic disorder) was introduced in the DSM-III (American Psychiatric Association, 1980).

Unaware of Kanner's report, in 1944 Hans Asperger described a set of children who had similar personality characteristics and unusual limitations in social interactions with problems in nonverbal language, lack of humour and stereotypical behaviour (Attwood, 2006; Church, Alisanski, & Amanullah, 2000; McLaughlin-Cheng, 1998). Unlike Kanner's patients, these children had good communication skills (e.g., large vocabulary, use of correct syntax) albeit with some unusual linguistic patterns, such as peculiar vocal intonation, literal and pedantic speech, and long-winded monologues that did not allow for reciprocal communication (Attwood, 2006; Wing, 1998). In Asperger's original work, written in German, he named this disorder autistic psychopathy (Gillberg, 2007; Matson & Wilkins, 2008). It was only in 1981 that Lorna Wing brought the disorder to the attention of the English-speaking community when she coined the term Asperger syndrome and described children similar to those in Hans Asperger's original work (Gillberg, 2007; Myles, 2005; Witwer & Lecavalier, 2008; Woodbury-Smith & Volkmar, 2009). Wing also noted the similarities between autism and Aperger syndrome and along with making suggestions for a different diagnostic criteria, proposed the notion of an autistic spectrum (Toth & King, 2008; Wolff, 2004; Woodbury-Smith & Volkmar, 2009). Asperger syndrome was included in the DSM-IV (American Psychiatric Association, 1994) and the ICD-10 (World Health Organization, 1993) half a century after the disorder was first described.

Interestingly, numerous earlier reports have described cases of individuals who would now be likely diagnosed with an ASD (Richdale & Schreck, 2008; Wolff, 2004). For instance, accounts of "feral children", who supposedly grew up in social isolation in the wild, have raised the possibility of classical autism being recorded as early as the year 250 (Gillberg, 2007; Koegel, 2008; Wolff, 2004). In the early 18th century, John Haslam, in the United Kingdom, described the clinical case of a boy who would nowadays fit the criteria for autism (Gillberg, 2007; Itard, 1962; Wolff, 2004). Jean Itard's account of Victor, the wild boy of Aveyron illustrates how these children presented characteristics that would later be used to diagnose individuals with ASD (Gillberg, 2007; Wolff, 2004). In the mid-1800s, Herman Melville's short story named 'Bartleby' portrayed a character with social deficits that fit the diagnosis criteria on the DSM-IV for Asperger syndrome (Koegel, 2008). As Koegel (2008) argued, despite the character being fictional, the detailed description of Asperger syndrome symptoms in Melville's story indicates the author might have been familiar with a person who would now likely be considered to have an ASD.

Diagnostic Criteria and Defining Characteristics

The DSM-IV-TR (American Psychiatric Association, 2000) and the ICD-10 (World Health Organization, 1992) characterise ASD by severe developmental abnormalities in reciprocal social interactions and communication, and by the presence of stereotyped, restricted, and repetitive behaviours, interests and activities. These symptoms are pervasive and identifiable at an early age, usually before 3 years. In terms of specific diagnoses, autism takes precedence over Asperger syndrome; only after autism is ruled out can a diagnosis of Asperger syndrome be considered. The syndrome is distinguished from autism primarily by age of onset and language development. Children with Asperger syndrome may show no deficits prior to three years of age and present no significant delay in language and cognitive development. Their IQ levels are usually in the average to above-average range and their self-help skills and adaptive non-social behaviours are age-appropriate. However, like in autism, there are abnormalities in social interaction and behaviour. There has been some debate regarding the classification of Asperger syndrome as a separate condition from autism; some researchers suggest they are part of a spectrum and not distinct disorders (Church et al., 2000; Matson & Wilkins, 2008; Nebel-Schwalm & Matson, 2008; Ozonoff, South, & Miller, 2000; Richdale & Schreck, 2008). The two classification manuals referenced in this thesis classify Asperger syndrome as a separate disorder to autism but under the larger umbrella of Pervasive Developmental Disorders (PDD; American Psychiatric Association, 2000; World Health Organization, 1992). Tables 1.2 and 1.3 illustrate the diagnostic criteria for autism (Autistic Disorder) and Asperger syndrome (Asperger's Disorder) respectively. The DSM-IV-TR and the ICD-10 have similar criteria and so, only information from the former is presented.

Table 1.2. Diagnostic Criteria for Autistic Disorder

Autistic Disorder

A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):
   (1) qualitative impairment in social interaction, as manifested by at least two of the following:
      (a) marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye

gaze, facial expression, body postures, and gestures to regulate social interaction
(b) failure to develop peer relationships appropriate to developmental level
(c) a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)
(d) lack of social or emotional reciprocity
(2) qualitative impairments in communication as manifested by at least one of the following:
(a) delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)
(b) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
(c) stereotyped and repetitive use of language or idiosyncratic language
(d) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level
(3) restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
(a) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
(b) apparently inflexible adherence to specific, nonfunctional routines or rituals
(c) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole body movements)
(d) persistent preoccupation with parts of objects

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.
C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder.

Table 1.3. Diagnostic Criteria for Asperger's Disorder

Asperger's Disorder

A. Qualitative impairment in social interaction, as manifested by at least two of the following:
(1) marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
(2) failure to develop peer relationships appropriate to developmental level
(3) a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest to other people)
(4) lack of social or emotional reciprocity

B. Restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
(1) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
(2) apparently inflexible adherence to specific, nonfunctional routines or rituals
(3) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)
(4) persistent preoccupation with parts of objects

C. The disturbance causes clinically significant impairment in social, occupational, or other important areas of functioning.
D. There is no clinically significant general delay in language (e.g., single words used by age 2 years, communicative phrases used by age 3 years).
E. There is no clinically significant delay in cognitive development or in the development of age-appropriate self-help skills, adaptive behavior (other than in social interaction), and curiosity about the environment in childhood.
F. Criteria are not met for another specific Pervasive Developmental Disorder or Schizophrenia.

The essential defining feature of ASD is a markedly impaired development when compared to typical peers. Individuals with ASD also have difficulties establishing and maintaining social interactions, communicating effectively with other people, and present restricted stereotyped behaviours, interests, and activities. Some individuals with ASD may not acquire speech or have limited communication capacity (American Psychiatric Association, 2000; Wing & Attwood, 1987). Despite the evident impairments, at least half of individuals with ASD have an IQ greater than 70 and are not considered to be intellectually disabled (Geschwind, 2009).

These characteristics of ASD are considered pervasive in the sense they seem to persist through adolescence and into adulthood (Matson & Horovitz, 2010), causing clinically significant impairments in social adaptation (American Psychiatric Association, 2000; LeBlanc, Riley, & Goldsmith, 2008). As a result, individuals may be victimised, isolated and consequently develop depression and social anxiety (American Psychiatric Association, 2000; Attwood, 2007; Bellini, 2004, 2006; White & Roberson-Nay, 2009). Co-morbidity is common in ASD and along with depression and anxiety, other disorders, including intellectual disability, attention deficit/hyperactivity disorder, epilepsy, mood disorders, and oppositional defiant conduct disorder can occur (American Psychiatric Association, 2000; Attwood, 2004; Guttmann-Steinmetz, Gadow, & DeVincent, 2009; Howlin, 2000; LeBlanc et al., 2008; Nebel-Schwalm & Matson, 2008). In most cases, individuals diagnosed with autism also present with intellectual disability (American Psychiatric Association, 2000; Chakrabarti & Fombonne, 2001; J. C. Harris, 2010; Matson & Shoemaker, 2009; Nebel-Schwalm & Matson, 2008). However, most individuals with Asperger syndrome do not have a diagnose of intellectual disability (American Psychiatric Association, 2000; World Health Organization, 1992).

The prognosis for individuals with ASD is difficult to predict and may depend on the quality of education and support that such individuals receive. Kanner (1971) noted that “higher functioning” individuals with ASD are likely to become productive adults but the long-term prospect for “lower functioning” individuals is considered poor by some researchers (e.g., Howlin, 2000, 2004; LeBlanc et al., 2008). According to the American Psychiatric Association

(2000), partial independence as adults is possible for about two thirds of ASD cases. Higher functioning individuals may learn to live independently, but most are still likely to require support throughout their lives (American Psychiatric Association, 2000; Howlin, 2000, 2004).

In light of current beliefs and practices, the new edition of the DSM is reported to incorporate a number of revisions to the classification and diagnostic criteria of autism and other related conditions (American Psychiatric Association, 2011). Most notably, there will longer be a separate classification for the different disorders in the autism or PDD spectrum. Specifically, the umbrella term *autism spectrum disorder* will be used to refer to autism, Asperger syndrome, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified. Asperger's Disorder will no longer be a separate diagnosis. In addition, the social and communication deficits associated with autism will be merged and clarified. The ICD is also under revision but no changes have been reported to date (World Health Organization, 2011). Table 1.4 illustrates the new diagnostic guidelines proposed for the DSM-5 (American Psychiatric Association, 2011).

Aetiology

Autism spectrum disorders appear have multiple causes (Gillberg, 2007; World Health Organization, 1992). However, up to 80% of cases do not have a clear causality (Nebel-Schwalm & Matson, 2008). Genetic factors are very important and play a role in many cases (World Health Organization, 1992). A large number of genes seem to be involved in the expression of ASD and at least 30 different genes have been associated with the disorder (Gillberg, 2007; Nebel-Schwalm & Matson, 2008; Pickles et al., 1995). Genetic theories are also supported by familial pattern; ASD rates for relatives of individuals in the spectrum are higher than for the general population (Bailey, Palferman, Heavey, & Le Couteur, 1998; Pickles et al., 1995); 5% of siblings of individuals with ASD also have the diagnoses (American Psychiatric Association, 2000) and twin studies have demonstrated a high concordance rate in monozygotic twins (Bailey, Palferman, Heavey, & Le Couteur, 1998; Gillberg, 2007)

Table 1.4. Revised Diagnostic Criteria for Autism Spectrum Disorder

Autism Spectrum Disorder

Must meet criteria A, B, C, and D:

A. Persistent deficits in social communication and social interaction across contexts, not accounted for by general developmental delays, and manifest by all 3 of the following:
   1. Deficits in social-emotional reciprocity; ranging from abnormal social approach and failure of normal back and forth conversation through reduced sharing of interests, emotions, and affect and response to total lack of initiation of social interaction,
   2. Deficits in nonverbal communicative behaviors used for social interaction; ranging from poorly integrated- verbal and nonverbal communication, through abnormalities in eye contact and body-language, or deficits in understanding and use of nonverbal communication, to total lack of facial expression or gestures.
   3. Deficits in developing and maintaining relationships, appropriate to developmental level (beyond those with caregivers); ranging from difficulties adjusting behavior to suit different social contexts through difficulties in sharing imaginative play and in making friends to an apparent absence of interest in people

B. Restricted, repetitive patterns of behavior, interests, or activities as manifested by at least two of the following:
   1. Stereotyped or repetitive speech, motor movements, or use of objects; (such as simple motor stereotypies, echolalia, repetitive use of objects, or idiosyncratic phrases).
   2. Excessive adherence to routines, ritualized patterns of verbal or nonverbal behavior, or excessive resistance to change; (such as motoric rituals, insistence on same route or food, repetitive questioning or extreme distress at small changes).
   3. Highly restricted, fixated interests that are abnormal in intensity or focus; (such as strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
   4. Hyper-or hypo-reactivity to sensory input or unusual interest in sensory aspects of environment; (such as apparent indifference to pain/heat/cold, adverse response to specific sounds or textures, excessive smelling or touching of objects, fascination with lights or spinning objects).

C. Symptoms must be present in early childhood (but may not become fully manifest until social demands exceed limited capacities)

D. Symptoms together limit and impair everyday functioning.

Neurobiological evidence is contradictory, but it appears some structural abnormalities in the brain, such as reduced corpus callosum, are associated with ASD (Nebel-Schwalm & Matson, 2008). Immunological theories suggest ASD is associated with neurotransmitter abnormalities such as unusual number of T-cells and serotonin (Nebel-Schwalm & Matson, 2008), but evidence is not strong because reported differences have not been replicated in later studies and some of the abnormalities are also present in individuals without ASD (Anderson & Hoshino, 2005; Nebel-Schwalm & Matson, 2008). It is also not possible to ascertain if any differences are responsible for ASD or a consequence of the disorder (Gupta, 2004; Nebel-Schwalm & Matson, 2008). Perinatal factors, such as premature birth and obstetrical complications, have supporting evidence as a possible cause of autism (Gupta, 2004). There is some evidence that perinatal factors are associated with ASD, but as yet no direct causal link has been confirmed (Cryan, Byrne, O'Donovan, & O'Callahan, 1996; Piven et al., 1993).

Prevalence

In New Zealand, children with special education needs (including autism and intellectual disability) represented 5% of all children under 15 years of age in a 2006 census (Statistics New Zealand, 2007). Worldwide, the prevalence of ASD among children has increased markedly in recent years (American Psychiatric Association, 2000; Boyle et al., 2011; Matson & Kozlowski, 2011; World Health Organization, 1993). Autism was once considered a rare condition with reported prevalence rates of 4 in 10,000 people (Ritvo et al., 1989). According to more recent reviews, however, the prevalence rate for ASD is approximately 1 in every 110 children in the United States (Centers for Disease Control and Prevention, 2009), while in the United Kingdom up to 1% of the school-aged general population has an ASD diagnosis (Gillberg, 2007). Most of these children are diagnosed with autism while a smaller percentage are diagnosed with Asperger syndrome or one of the other disorders in the spectrum (e.g., PDD-NOS; Gillberg, 2007). Increasing prevalence trends have been reported in several countries including the United Kingdom, Japan, and the Netherlands (Gillberg, Cederlund, Lamberg, & Zeijlon, 2006; Honda, Shimizu, Misumi, Niimi, & Ohashi, 1996; Merrick, Kandel, & Morad, 2004). Boys are three to five times more likely to be diagnosed with an ASD than girls (American Psychiatric Association, 2000; World Health Organization, 1993). It is not clear what is causing this increase in prevalence. Some researchers have speculated that the increase in prevalence may not reflect a actual increase in the number of new cases of ASD, but may instead be due to confounding factors such a broadening of the diagnostic criteria and a greater awareness by professionals and the public in general (Campbell, Davarya, Elsabbagh, Madden, & Fombonne, 2011; Carpenter, Soorya, & Halpern, 2009; Steyn & Couteur, 2003).

Intellectual Disability (Mental Retardation)

Historical Background

Some scholars have argued that writings by philosophers like Plato and Aristotle indicate the notion of mental retardation existed in ancient Greek times (J. C. Harris, 2010; Rosen, Clark, & Kivitz, 1976; Stainton, 2001b). These arguments have their sceptics (cf. Goodey, 2001), but writings from the middle ages suggest the concept of intellectual disability may have been familiar in those times (J. C. Harris, 2010; Stainton, 2001a). In addition, the so-called feral children were described in ways that suggest they not only had characteristics of ASD, but also intellectual disability (Heward, 2006; Koegel, 2008; Seguin, 1976a; Wolff, 2004). It is possible these children had, in fact, both conditions given that the comorbidity rate of autism and intellectual disability is high (Matson & LoVullo, 2009; Nebel-Schwalm & Matson, 2008).

The first systematic medical accounts of the condition that is now referred to as intellectual disability appear to have emerged in the mid-1600s. Thomas Willis, recognised for his contribution to the neurological field, is credited with one of the first systematic accounts of intellectual disability (Stainton, 2001a; Williams, 2002). Willis described different levels of impairment and made a distinction between acquired and congenital causes, noting a familial pattern but recognising it was not always a hereditary matter (Williams, 2002). In the 19th century, classification and possible causes of intellectual disability started to receive more attention (Manion & Bersani, 1987). John Langdon Down divided severe disability into congenital, accidental, and developmental groups (J. C. Harris, 2010; Williams, 2002). Different degrees of severity were also identified by academics such as Seguin and Esquirol, who noted a group of individuals presented near normal levels of cognitive ability with only some limitations and another group with a level of intellectual functioning too low to adapt to everyday life (J. C. Harris, 2010).

The notion of intellectual disability is present in the first edition of the Diagnostic and Statistical Manual under the term *mental deficiency* with three levels of functioning (mild, moderate, and severe) and separate classifications for familial/hereditary causes and undetermined causes (American Psychiatric Association, 1952). The term *mental retardation* was introduced in the DSM-II with additional functioning levels (borderline, mild, moderate, severe, profound, and unspecified) (American Psychiatric Association, 1968). Mental retardation was first included in the sixth edition of the ICD in 1952 (American Psychiatric Association, 2000; J. C. Harris, 2010).

Attitudes towards intellectual disability (mental retardation) changed over time and influenced how people with the disorder were viewed and treated by society. Some authors believe that during ancient Greek and Roman times, infanticide was common practice when children were born with disabilities and persecution of individuals with handicaps was customary (J. C. Harris, 2010; Manion & Bersani, 1987; Rosen et al., 1976). Later, individuals with disabilities were seen with pity and deserving of charity (Manion & Bersani, 1987). During the middle ages, people with intellectual disabilities were sometimes seen as harmless fools and were cared for by the community, although it was believed they were not teachable (J. C. Harris, 2010; Manion & Bersani, 1987; Stainton, 2001a). During the Renaissance, a greater emphasis was placed on the treatment of people with disabilities (J. C. Harris, 2010; Rosen et al., 1976). During the 19th century, special education teaching methods became more widespread, lead in great part by Jean Itard's work with Victor, the wild boy of Aveyron (Manion & Bersani, 1987; Rosen et al., 1976; Seguin, 1976a; Wolff, 2004) and Edouard Seguin, who continued Itard's research and pioneered special education provisions for children with intellectual disability (Seguin, 1976a; Talbot, 1967). While in France, Seguin established the first school for the education of those with intellectual disability in 1838 (Rosen et al., 1976; Talbot, 1964). His success encouraged work in other parts of Europe and the United States (Richards, 1976; Talbot, 1964). In 1946 Seguin published the earliest known text dealing with the special needs of children with mental disabilities, *The Moral Treatment, Hygiene, and Education of Idiots and Other Backward Children* (Talbot, 1964, 1967). Seguin later became the first president of what is currently known as the American Association on Intellectual and Developmental Disabilities, one of the most prominent organizations supporting research and individuals with intellectual disabilities (Talbot, 1964, 1967; Trent, 1994).

Intellectual disability gradually came to be viewed as a larger societal problem rather than only a family responsibility (Trent, 1994) and various institutions for individuals with intellectual disabilities were established (Rosen et al., 1976). By 1888, 4,000 people were estimated to be institutionalised (Manion & Bersani, 1987). In the early 20th century, the status of these individuals was that of non-productive members of society whose care was an economic burden (Manion & Bersani, 1987). The eugenics movement lead to widespread sterilization practices until the 1930s (Rosen et al., 1976; Scheerenberger, 1987; Trent, 1994), when the movement lost scientific backing (Rosen et al., 1976). By the 1960s, it was recognised that institutions were not meeting the patients' basic human needs and a movement to deinstitutionalise people with intellectual disabilities began (Rosen et al., 1976; Scheerenberger, 1987). By the 1980s, with political, professional, and parental pressure, work was directed at placing individuals with intellectual disability in the community (Scheerenberger, 1987). Currently, the majority of children with intellectual disabilities in the United States, United Kingdom, and other "western" countries live at home with family support systems (Braddock, Emerson, Felce, & Stancliffe, 2001; Rizzolo, Hemp, Braddock, & Schindler, 2009; Seltzer & Krauss, 2001).

The terms used for intellectual disability have changed numerous times in part because of the increased knowledge of the impairment's aetiology and the negative connotation the names acquired over time (American Association on Mental Retardation, 1992; Schalock, Luckasson, & Shogren, 2007; Williams, 2002). For instance, terms such as *feebleminded*, *idiot*, *imbecile* and *moron* were technical and diagnostic terms for people with impairment in intellectual functioning, but are now considered offensive and stigmatizing (Digby, 1996; Scheerenberger, 1987; Trent, 1994). A reflection of this trend is illustrated by the American Association on Mental Retardation's decision to change its name to the American Association on Intellectual and Developmental Disabilities (AAIDD, 2011a) and the proposed change from mental retardation to the term *intellectual developmental disorder* in the next edition of the DSM (American Psychiatric Association, 2011).

Prevalence

Assuming a normal distribution of intelligence with a mean of 100, in theory, 3% of the population would have an IQ of 70 or less and could possibly be considered to have an intellectual disability (C. C. Murphy, Boyle, Schendel, Decoufle, & Yeargin-Allsopp, 1998; Polloway, Lubin, Smith, & Patton, 2010). In reality, reported prevalence rates vary greatly across geographical regions with estimates ranging from 2 to 85 cases per 1000 (Roeleveld & Zielhuis, 1997). This wide discrepancy may be due to, for instance, varying classification systems and diagnostic definitions and different study methodologies (Leonard & Wen, 2002; N. A. Murphy, Carbone, & Council on Children with Disabilities, 2008). Although reported prevalence rates vary, there is some consensus that intellectual disability affects approximately 1 to 3% of the general population (Daily, Ardinger, & Holmes, 2000; McDermott, Durkin, Schupf, & Stein, 2007; Roeleveld & Zielhuis, 1997). The risk of intellectual disability for boys is slightly higher than for girls (Leonard & Wen, 2002; C. C. Murphy et al., 1998). The prevalence of intellectual disability seems to vary across age groups; it has been reported as only 1 in every 1000 children 0 to 4 years old but as many as 97 in every 1000 children 10 to 14 years old (C. C. Murphy et al., 1998; Roeleveld & Zielhuis, 1997).

Diagnostic Criteria and Defining Characteristics

Intellectual disability is characterised by significantly impaired general intellectual and adaptive behaviour functioning that manifests prior to 18 years of age. Individuals with intellectual disability typically show impairment with respect to cognitive, language, motor, and social abilities that significantly limit their ability to function independently in home, school, and community environments (American Psychiatric Association, 2000; World Health Organization, 1992). The person’s score on an individually administered test of general intellectual ability (e.g., an IQ test) has often been used as a guideline for diagnosis and differentiation between degrees of severity, but a diagnosis of intellectual disability is not made on the basis of IQ score alone. Instead, the individual must also present with significant deficits in adaptive functioning (American Psychiatric Association, 2000; World Health Organization, 1992). The American Association on Intellectual and Developmental Disabilities notes the importance of four factors in the definition of mental retardation: (a) assessment considers cultural and linguistic diversity, differences in communication and behavioural factors; (b) limitations in adaptive skills are within the context of the typical environment of same age peers and takes into consideration the individualised need for support; (c) specific adaptive limitations often coexist with strengths in skills; and (d) appropriate support for a sustained period of time can generally improve life functioning (American Association on Mental Retardation, 1992).

The DSM-IV-TR (American Psychiatric Association, 2000) and the ICD-10 (World Health Organization, 1992) classify mental retardation according to four degrees of severity: (a) mild, (b) moderate, (c) severe, and (d) profound mental retardation. When the degree of severity cannot be specified, a classification of ‘mental retardation, severity unspecified’ or ‘other mental retardation’ is available on the DSM-IV-TR and the ICD-10, respectively. The ICD-10 has an additional category (unspecified mental retardation) for cases where there is evidence of mental retardation, but not sufficient information for classification in one of the other categories.

In these classification systems, mild mental retardation is characterised by some delay in development, especially in language, but most individuals in this group are considered to be able to cope with everyday demands with little or no supervision. This group represents about 70-85% of cases of intellectual disability. Moderate mental retardation is characterised by slow development and limited achievement in language, self-care, and motor skills but adaptation to daily life is possible with enough supervision. About 10% of all cases of mental retardation fall in this category. Severe mental retardation is characterised by a marked limitation in communication skills with most individuals acquiring little or no speech. These individuals may learn some self-care skills and can work under close supervision. This group represents 3% to 4% of cases. Profound mental retardation is characterised by considerable impairments in motor and communication skills. Constant help and supervision is required because individuals in the group cannot care for themselves. This category represents 1% to 2% of cases. Table 1.5 provides the diagnostic criteria for mental retardation in the DSM-IV-TR (the criteria in the ICD-10 is very similar).

Table 1.5. Diagnostic Criteria for Mental Retardation

Mental Retardation

A. Significantly subaverage intellectual functioning: an IQ of approximately 70 or below on an individually administered IQ test (for infants, a clinical judgment of significantly subaverage intellectual functioning).
B. Concurrent deficits or impairments in present adaptive functioning (i.e., the person's effectiveness in meeting the standards expected for his or her age by his or her cultural group) in at least two of the following areas: communication, selfcare, home living, social/interpersonal skills, use of community resources, self-direction, functional academic skills, work, leisure, health, and safety.
C. The onset is before age 18 years.

Code based on degree of severity reflecting level of intellectual impairment:
317 Mild Mental Retardation: IQ level 50–55 to approximately 70
318.0 Moderate Mental Retardation: IQ level 35–40 to 50–55
318.1 Severe Mental Retardation: IQ level 20–25 to 35–40
318.2 Profound Mental Retardation: IQ level below 20 or 25

In light of new evidence, the next edition of the DSM is reported to include amendments to the current diagnostic criteria and classification of mental retardation (American Psychiatric Association, 2011). Specifically, the term mental retardation will be replaced with the term intellectual developmental disorder. The criteria of deficits in general mental abilities represented by an IQ of approximately 70, significant impairment in adaptive functioning, and onset during developmental years still remain. However, classification of severity will no longer be based on IQ level, eliminating potential problems with test errors, and the fact that the current classification does not take adaptive behaviours into account. A new edition of the ICD is under revision, but no changes to the category of mental retardation have been announced (World Health Organization, 2011).

Aetiology

A number of biological, social, behavioural, and educational factors have been associated with the aetiology of intellectual disability (American Association on Mental Retardation, 1992; Daily et al., 2000; McDermott et al., 2007). However, in approximately 30 to 50% of all clinical cases, it is still not possible to determine a clear aetiology (Daily et al., 2000; J. C. Harris, 2010;

McDermott et al., 2007). In cases of severe intellectual disability, 43 to 70% do have a known cause, but in cases of mild intellectual disability only 20 to 24% present a clear cause (C. C. Murphy et al., 1998). Prenatal genetic abnormalities appear to account for most of the cases (J. C. Harris, 2010). As many as 750 genetic disorders have been associated with intellectual disability (J. C. Harris, 2010). The possible causes include genetic/chromosomal abnormality such as Down syndrome, Fragile X syndrome, and Rett syndrome; infectious diseases such as rubella, meningitis, and HIV; birth complications such as prematurity, and asphyxia; environmental exposure to lead and mercury; injury such as traumatic brain injury, and child abuse and neglect; and insufficient stimulation (Daily et al., 2000; McDermott et al., 2007; C. C. Murphy et al., 1998; Scheerenberger, 1987).

Educational Needs of Children with Developmental Disability

Children with developmental disabilities have particular educational needs due to their impairments. For example, they may require more intensive and structured instruction than typically developing peers (Davies, Stock, & Wehmeyer, 2002; Duker, Didden, & Sigafoos, 2004; VanBergeijk, Klin, & Volkmar, 2008). However, with appropriate educational, behavioural treatment, and support, data show that children with developmental disabilities can acquire a range of new skills that can enhance their learning outcome and overall quality of life (American Association on Mental Retardation, 1992; Duker et al., 2004; Lovaas, 1987). In light of this evidence, the American Association on Intellectual and Developmental Disabilities emphasises that one of the goals of education and treatment for individuals with intellectual disabilities is to provide supports that will maximise learning in all areas of need and promote greater autonomy, independence, and self-determination (American Association on Mental Retardation, 1992).

Self-determination

The term self-determination refers to people’s ability to make choices and decisions without interference or influence from others (Field, Sarver, &

Shaw, 2003; Stancliffe, 2001). When individuals are provided with a high degree of self-determination, they may gain a greater control over their lives and successfully contribute to society (Field, Martin, Miller, Ward, & Wehmeyer, 1998). In the case of educational interventions, self-determination ensures participants have an active choice by selecting their preferred alternative without coercion (Stancliffe, 2001). Several authors have argued that self-determination is important for a positive quality of life and greater life satisfaction and has been linked with positive outcomes in areas such as school, employment, and independent living (Garcia-Villamisar & Dattilo, 2010; Kennedy, 2001; Wehmeyer, Palmer, Agran, Mithaug, & Martin, 2000; Wehmeyer, Shogren, Zager, Smith, & Simpson, 2010). However, individuals with developmental disabilities do not experience a high degree of self-determination as they have limited opportunities to make choices and express personal preferences (Stancliffe, 2001; Wehmeyer & Palmer, 2003).

Interventions for individuals with developmental disabilities should, therefore, aim in part to promote a greater level of self-determination by giving participants an opportunity to make their own choices, such as what and how they want to learn, and not have to passively accept other people's impositions (American Association on Mental Retardation, 1992; Arthur-Kelly, Bochner, Center, & Mok, 2007; Field et al., 1998; Field et al., 2003; Heward, 2006; Stancliffe, 2001; Wehmeyer & Palmer, 2003; Wehmeyer et al., 2000).

Leisure Skills

Leisure can be defined as activities that individuals voluntarily engage in for amusement or rest (Godbey, 1990). Leisure activities include playing games or sports, watching movies, socialising with friends. Appropriate leisure skills instruction is important because engagement in recreational activities has been reported to have positive effects such as decreasing stress and increasing quality of life (Coyne & Fullerton, 2004; Garcia-Villamisar & Dattilo, 2010, 2011; Kensinger, 2004; McIntyre, Kraemer, Blacher, & Simmerman, 2004; N. A. Murphy et al., 2008; Schleien, Baldwin, & Light, 1989; Schleien, Meyer, Heyne, & Brandt, 1995). Family engagement in leisure activities for instance, has been linked to positive family functioning (Dodd, Zabriskie, Widmer, & Eggett, 2009; Mactavish, Schleien, & Tabourne, 1997; Mactavish & Schleien, 2000). In addition, given that individuals with disabilities should have access to the same opportunities as the general population, it is important to provide them with the necessary skills and opportunities to engage in the same recreational activities available to others (Miller, Schleien, & Lausier, 2009).

Individuals with developmental disabilities however, may lack the necessary skills or the opportunities to engage in age-appropriate leisure activities (American Psychiatric Association, 2000; Matson & Marchetti, 1980). They often tend to spend inordinate amounts of time engaged in solitary and relatively non-productive activities and do not often access community leisure facilities for recreation (Matson & Marchetti, 1980). Surprisingly, a relatively small number of interventions have been conducted to teach leisure skills to children with developmental disabilities (Garcia-Villamisar & Dattilo, 2010). Several studies have attempted to teach play skills to children in this population but in most cases play was a means to increase social and communication skills (e.g., Nikopoulos, 2007; Paterson & Arco, 2007). These studies are important because they provide means for greater socialization (O'Reilly, Lancioni, & Kierans, 2000; Schleien et al., 1989) and could encourage friendships (Kensinger, 2004). However, developing leisure skills that do not require social engagement is also an important goal because some individuals with developmental disabilities are not comfortable interaction with others. These individuals would benefit more from self-sufficient recreational activities that allow them to pass the time and have fun by themselves (Schleien et al., 1989) . Some leisure activities also have the benefit of improving motor skills and physical health, enhancing problem solving skills, and decreasing maladaptive behaviours (Schleien et al., 1989; Schleien et al., 1995).

Given the importance of leisure and recreation activities to the well being of individuals with developmental disabilities and their families, interventions should aim at creating recreation opportunities and teaching leisure skills to individuals with developmental disabilities. In addition, with the increased number of technology-based recreational activities, further research is needed to assess the effects and possible applications of new technology to develop new leisure skills and facilitate leisure engagement for individuals with developmental disabilities.

Academic Skills

Academic skills include reading and writing, arithmetic, and general organisational skills such as taking notes and finishing homework and assignments in time. These skills are important as they give students a better chance at succeeding at school and later in life (Howlin, 2000). Students with developmental disabilities, however, often experience more academic difficulties than their peers (Snell & Luckasson, 2009).

Appropriate academic skills are especially important for children with Asperger syndrome and mild intellectual disability. These children are commonly mainstreamed into inclusive school settings but may still lack the required skills to learn alongside their peers. For instance, organisational abilities are necessary for daily school activities such as recording assignments and completing them in time but students with developmental disabilities may not have these skills (Myles, Ferguson, & Hagiwara, 2007).

Successfully completing school is important for these children because it may improve their long term outcome in life (Howlin, 2000). Unfortunately, the drop-out rate for students with developmental disabilities is high (Polloway et al., 2010). In 2002/2003 for instance, 28.6% of students with intellectual disability and 15.5% of students with autism did not complete school in the United States (Polloway et al., 2010). Students with these disabilities have a higher degree of difficulties, but they can successfully learn academic skills such as reading, maths and geography (Allor, Mathes, Roberts, Jones, & Champlin, 2010; Brockett, 1976). As Polloway and colleagues (2010) describe, the number of students leaving school before completion is decreasing as more emphasis is placed in teaching them relevant academic skills.

Interventions aiming at academic skills are therefore essential for children with developmental disabilities who attend school. They should teach the children skills that will enable them to better learn from lessons in the classroom. Previous research shows systematic instruction can be effective, but as new technology becomes available, new research needs to investigate its effects and applications for developing academic skills in students with developmental disabilities.

Social Communication Skills

Social and communication skills include initiating and maintaining conversations, making appropriate eye contact, reciprocating information and acknowledging the perspectives of others. Effective communication allows individuals to successfully interact with others and transmit information such as their needs, wants, feelings, and knowledge (Arthur-Kelly et al., 2007). Social and communication skills are necessary for a successful community living. However, individuals with developmental disabilities may lack such skills. In fact, social communication deficits are one of the defining characteristics of developmental disabilities, particularly ASD. These skills are not only necessary for a competent social life but are also the skills which individuals with developmental disabilities demonstrate the most impairment in (American Psychiatric Association, 2000; Heward, 2006; Lee & Park, 2007; World Health Organization, 1992). Some children cannot speak, but with appropriate instruction can learn to engage in functional communication (Kaiser, Hester, & McDuffie, 2001). For children who do not develop spoken language, social communication is still possible with the aid of alternative and augmentative communication devices (Rispoli, Franco, van der Meer, Lang, & Camargo, 2010).

Individuals with appropriate language skills and average cognitive and IQ levels may still display a significant impairment in social communication skills (American Psychiatric Association, 2000; Howlin, 1998). Despite appropriate verbal skills, these individuals have difficulties understanding the idiosyncrasies of social interactions. Individuals with ASD may have the knowledge of social rules and expectations but lack the skills to apply it to social situations (Montgomery et al., 2008). Reciprocal conversation is a challenge because these individuals tend to carry monologues about their topic of fixation independent on the listener’s interest (American Psychiatric Association, 2000; Carpenter et al., 2009; S. L. Harris, 1998; Woodbury-Smith

& Volkmar, 2009). Because socialisation is difficult, friendships are not easily developed and individuals with developmental disabilities may become socially isolated (Heward, 2006; O'Reilly et al., 2004).

Theories have been put forward to account for the social deficits of individuals with developmental disabilities, especially ASD. One of the most prevalent, theory of mind, refers to someone's ability to understand that others may have different mental states than one's own and that these states cause actions (Baron-Cohen, 2001; Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997). Individuals with ASD appear to not inherently have this ability (Kremer-Sadlik, 2004) but with instruction, their performance in theory of mind tests can improve, suggesting they can learn other people may have different perspectives to their own (Baron-Cohen et al., 1997; Feng, Lo, Tsai, & Cartledge, 2008).

Giving the importance of social skills in daily life, interventions aiming at giving individuals with developmental disabilities the skills to communicate and interact appropriately with others are paramount. Previous research targeting social and communication skills suggest individuals with developmental disabilities can learn these skills with appropriate instruction. Most of this research, however, has employed traditional, non-technological methods of teaching. As more advanced technology becomes available, future research is needed to examine how this new technology can be beneficial in developing social and communication skills in individuals with developmental disabilities.

Summary

In light of the characteristics and educational needs of individuals with developmental disabilities, providing effective education and training is a challenge. As new technology is being increasingly adopted in classrooms, this challenge increases. The aim of this thesis was to develop and evaluate procedures that incorporate new technology for teaching leisure, academic, and social skills to children with developmental disabilities.

CHAPTER II

TEACHING CHILDREN WITH DEVELOPMENTAL DISABILITIES

Addressing the Educational Needs of Children with Developmental Disabilities

As reviewed in Chapter 1, children with developmental disabilities have various types of impairments that are likely to interfere with their educational achievement and ability to learn adaptive skills. However, there is evidence that, with appropriate instruction, such children can acquire a range of new skills that can significantly increase their academic and social performance and their overall quality of life and level of independence (Duker et al., 2004; Heward, 2006; Kennedy, 2001; Lovaas, 1987, 2002; Seguin, 1976b, 1976c; Snell & Brown, 2006; VanBergeijk et al., 2008).

Over the years, several interventions have been proposed to address the skill deficits of individuals with developmental disabilities across different ages and settings. When considering which one to adopt, 'goodness of fit' should be considered because individuals with developmental disability do not form a homogeneous group and effective interventions for one person might not be successful for others (Howlin, 1998; Ogletree, Oren, & Fischer, 2007).

A large number of reviews have evaluated the many interventions developed for people with developmental disabilities, ranging from psychoeducational and behavioural to psychopharmacological and alternative approaches (Elder, Caterino, Chao, Shacknai, & Simone, 2006; K. Francis, 2005; Goldstein, 2002; Griffin, Griffin, Fitch, Albera, & Gingras, 2006). Interventions aim at a range of social, communication, functional, and academic skills (Christopher, Nangle, & Hansen, 1993; Machalicek et al., 2008). Common procedures employed with children with developmental disabilities include group training (Christopher et al., 1993), early intensive behavioural interventions (Lovaas, 1987, 2002; Reichow & Wolery, 2009), cognitive behaviour therapy (Attwood, 2004), peer-mediated interventions (Charlop & Walsh, 1986; Huang & Wheeler, 2006; Matson et al., 2007; Rogers, 2000), pivotal response training (Stahmer, Ingersoll, & Carter, 2003), priming (Griffin et al., 2006; Scattone, 2007), self-management (Christopher et al., 1993; Huang & Wheeler, 2006), picture schedules (Arthur-Kelly, Sigafoos, Green, Mathisen, & Arthur-Kelly, 2009; Hall, McClannahan, & Krantz, 1995; Martin, Elias-Burger, & Mithaug, 1987), Social Stories™ (Arthur-Kelly et al., 2009; Gray, 1998; Huang & Wheeler, 2006; Matson et al., 2007; Reichow & Sabornie, 2009), modelling (Matson, Matson, & Rivet, 2007; Ogletree et al., 2007), and video modelling (Cihak, Alberto, Taber-Doughty, & Gama, 2006; Scattone, 2007). When selecting which procedure to use, an important consideration is the extent to which the procedure is supported by research (Kratochwill & Stoiber, 2002; Odom et al., 2005). There is growing consensus that educational programs for children with developmental disabilities should be based in the best available evidence of what works (Horner et al., 2005; Kratochwill & Stoiber, 2002). For some new and emerging educational approaches, such as technology-enhanced interventions, there might not yet be sufficient evidence to consider such approaches as evidence-based. An important aim of the research project reported in this thesis is to generate new research evidence evaluating the potential of technology-enhanced interventions for developing the leisure, academic, and social-communication skills of students with developmental disability.

Technology-enhanced interventions

Technology is an integral part of daily life and it has the potential to give individuals with developmental disabilities greater control over their lives and to allow them to participate in and contribute more fully to society (Wehmeyer, Smith, Palmer, Davies, & Stock, 2004). However, these individuals are largely underutilising technology in their daily lives (Wehmeyer, Smith, Palmer, & Davies, 2004; Wehmeyer, Smith, Palmer, Davies et al., 2004). Conversely, technology is being increasingly suggested for people with developmental disabilities as a promising educational tool. Equipment such as computers and video games or simple toys with lights and sound can provide means for recreation and improve motor, social, and cognitive skills (Wehmeyer, Smith, Palmer, & Davies, 2004). A review of technology use by individuals with intellectual disability found a large number of studies employing technology for communication, mobility, community integration, environmental control, self-care, enhancing educational and employment outcomes, and sports and recreation (Wehmeyer, Smith, Palmer, Davies et al., 2004). Such interventions were suggested as having several potential advantages such as increased procedural control when training is recorded and presented in audio or video means (DiGennaro-Reed, Codding, Catania, & Maguire, 2010).

New technologies allow for innovative ways of delivering training with devices such as audio and video equipment, robotics, computers and software (Goodwin, 2008). Audio is one of the simplest forms of technology used in interventions for people with developmental disability. Nonetheless, it has been shown to be an effective strategy. Self-operated auditory prompts have been successfully used to, for instance, decrease inappropriate and off-task behaviour of a boy with autism and moderate mental retardation (Taber, Seltzer, Heflin, & Alberto, 1999).

More advanced technology such as purposely created robots have also been used in interventions (Adaptive Systems Research Group, n.d.). Doll-like robots were used to increase the communication and social skills of children with autism by providing predictable interactions the children were more comfortable being part of. Robins, Dautenhan, Boekhorst and Billard (2005) for instance, employed a toy robot for the participants to interact with and engage in joint attention with an adult. Interestingly, some children not only showed joint attention skills but also used the robot as a mediator for interaction with teachers and carers. These results show technology can, in addition to their primary purpose, be means for social interaction. The equipment itself may be a point of shared interest and could be used to enhance the benefits of the intervention and create opportunities for greater social interaction.

Computers are one of the most significant technological advances to be employed in educational interventions. They enable interactive multimedia with pictures, sounds, text, and videos that can enhance learning (Golan & Baron-Cohen, 2006; Hagiwara & Myles, 1999). Studies have used computers to improve reading and writing, expressive and receptive communication, social interaction, emotion recognition and regulation, and narrative structure (Beaumont & Sofronoff, 2008; Davis, Dautenhahn, Nehaniv, & Powell, 2007;

Mirenda, Wilk, & Carson, 2000; Mitchell, Parsons, & Leonard, 2007). In addition to being a delivery tool for interventions, computers can be used to manipulate media such as editing video and sound clips and creating slideshows to suit the purpose of the intervention.

Portable computerised devices have become increasingly widespread and have also been employed in interventions for individuals with developmental disabilities. A personal digital assistant (PDA) was successfully used to record homework assignments by an adolescent with Asperger syndrome, increasing the chances of homework completion and proving an organisational tool for academic work (Myles et al., 2007). Davies and colleagues (Davies et al., 2002; Davies, Stock, & Wehmeyer, 2004) have used portable computers to provide vocational training and a decision making tool for individuals with intellectual disability. Van Laarhoven and colleagues (2009) have recently used an iPod as a prompting device for an adolescent with developmental disabilities; video prompts were successfully employed to help the participant with job-related tasks. These portable devices can unobtrusively aid task completion and allow for training to be easily carried and delivered in different settings and with different people.

Shane and Albert (2008) surveyed the leisure habits of children with autism and found a predilection for electronic screen media over other activities such as reading books and outdoor play. They also indicated the children had a range of skills related to using these media; for instance, turning on the computer or television, using a mouse, and inserting a DVD in the player and starting a movie. These findings suggest children with developmental disabilities are suitable candidates for technology-enhanced interventions.

Video-based interventions

Video-based interventions have become a popular area of research for individuals with ASD. They have elicited positive results and, with the advancement of technology, videos have become easier to create and implement (Buggey, 2007). Video technology is socially acceptable and easily accessible, making it a suitable teaching tool (Sturmey, 2003). Previous reviews suggest video modelling intervention can be considered an evidence-based strategy for individuals with ASD (Baker, Lang, & O'Reilly, 2009; Bellini & Akullian, 2007). Video-based interventions have been successfully used to teach a variety of social, communication, academic, and functional skills to individuals with ASD (Banda, Matuszny, & Turkan, 2007; Bellini & Akullian, 2007; Huang & Wheeler, 2006; Kinney, Vedora, & Stromer, 2003; L. D. Parsons, 2006; Rayner, Denholm, & Sigafoos, 2009).

Video modelling has not been as widely employed with individuals with intellectual disability. However, the available research supports the use of video-based interventions to teach individuals of different ages and intellectual disability levels. Previous interventions aimed at: community skills such as making a purchase and using the bank (Alberto, Cihak, & Gama, 2005; Cihak et al., 2006) and borrowing items from the library (Taber-Doughty, Patton, & Brennan, 2008); domestic skills such as making and serving coffee (Bidwell & Rehfeldt, 2004) and making sandwiches (Rehfeldt, Dahman, Young, Cherry, & Davis, 2003); leisure skills such as using an iPod for entertainment (Hammond, Whatley, Ayres, & Gast, 2010); employment skills such as furniture assembly (Martin, Mithaug, & Frazier, 1992); and self-help skills such as getting dressed (Norman, Collins, & Schuster, 2001). Video procedures have also been used to improve compliance to dental procedures (Conyers et al., 2004) and to teach fire extinguishing skills (Mechling, Gast, & Gustafson, 2009). These studies were the only examples found on a systematic literature search on the application of video modelling for individuals with intellectual disabilities.

Video based interventions rely on the premise that people learn from observing others (Corbett, 2003). When describing training of individuals with intellectual disabilities, Seguin (1976a) stated "imitation was found one of the most powerful means of progress" and therefore, should have a prominent place in the teaching of individuals with disabilities. Bandura's social learning theory underscores the role of observational learning and behavioural modelling in the process by which individuals acquire new behaviours (Bandura, 1977; Bandura & Walters, 1963). That is, an individual learns by watching a model performing a behaviour or task that he or she can then imitate. The behaviour can be presented in person, on video, be imagined

(Corbett, 2003; Corbett & Abdullah, 2005; Dowrick, 1999), or be presented in static pictures (Alberto et al., 2005; Cihak et al., 2006).

The use of video-based interventions has increased significantly in recent years (Bellini & Akullian, 2007; Mechling, 2005; Rayner et al., 2009). In ASD interventions, video is primarily used in video modelling and video prompting. Based on Bandura's observational learning theory (1977, 1986), video modelling and video prompting present a videotaped model that performs a task the learner can watch and imitate (Corbett, 2003; Mechling, 2005). Video modelling shows the entire sequence of behaviour before the learner has a chance to imitate it. Video prompting, alternatively, presents individual steps of the behaviour that are imitated before the next step is shown (Sigafoos, O'Reilly, & de la Cruz, 2007).

Many advantages have been put forward in favour of video interventions. Bandura (2004) himself has described the influence of video media (e.g., television) in shaping people's behaviour. In addition, video appears to be motivating and reinforcing in itself (Alberto et al., 2005; Cihak et al., 2006; Corbett, 2003; Corbett & Abdullah, 2005). Charlop-Christy, Le, and Freeman (2000) noted that despite in-vivo (i.e. modelling action demonstrated in person) and video (i.e. videotaped model performing the action) interventions were successful in teaching new skills to the participants, video delivery elicited quicker learning and greater generalization. Shane and Albert's (2008) survey of electronic screen media engagement by children with ASD revealed that more than half of the children imitated to some extent what they saw in movies and on television. This provides compelling evidence for the potential of video modelling as children naturally imitate what they see on the screen.

Videos are less time consuming and cheaper than in-vivo interventions (Charlop-Christy et al., 2000; Corbett, 2003; Stahmer et al., 2003). In addition, video delivery enhances control over the procedure because the recordings can be viewed multiple times with the behaviour being presented consistently across participants, settings, and time (Corbett, 2003; DiGennaro-Reed et al., 2010; Hine & Wolery, 2006; LeGrice & Blampied, 1994; Mechling, 2005; Stahmer et al., 2003). Video modelling also has the advantage of focusing the learner's attention to the relevant part of the task (K. Ayres & Langone, 2005). This feature is important because individuals with ASD may present stimulus overselectivity (Lovaas, 1979, 2002), where they tend to focus on only a restricted part of the stimuli that is often irrelevant to the learning task (Schreibman, Koegel, & Craig, 1977). The use of video to show the behaviour to be modelled overcomes the problem by directing the learner's attention to the relevant part of the stimuli (Corbett, 2003; Mechling, 2005).

Video presentation capitalises on the children's audiovisual strengths (McCoy & Hermansen, 2007; Schreibman, Whalen, & Stahmer, 2000) while minimising social contact (Stahmer et al., 2003). Mongillo et al. (2008) demonstrated that, from an early age, autistic children perform better when the task does not involve a social component. In an audio-visual test, children with ASD scored significantly lower than typically developing peers when the stimuli involved human faces but when the stimuli had a non-human component their performance was similar to that of peers. Interventions using video instruction are potentially more beneficial because they eliminate unnecessary social interaction that could be distressing for the participants.

Video interventions require a model to perform the specified behaviour or task to be imitated by the learner. Models can be adults, similar aged peers, or the learners themselves. Additionally, the video instruction can be created from a subjective perspective, that is, as if seen through the learner's eyes (as opposed to watching a model performing the action).

Video self-modelling has been receiving increasing attention in recent years (Dowrick, 1999). With the advancement of video technology, children can watch themselves performing the desired behaviour (Nikopoulos & Keenan, 2006). Similarity between the model and the learner is theorised to be an important part of observational learning (Bandura, Ross, & Ross, 1961; Schunk, 1987) and, as researchers have argued, no model can be as similar to the learners than the learners themselves (Buggey, 2005). Studies have demonstrated that video self-modelling is effective at promoting learning across a range of ages, settings, and disabilities (Buggey, 2007; Buggey, Toombs, Gardener, & Cervetti, 1999; Creer & Milklich, 1970; Dowrick, 1999; Hepting & Goldstein, 1996; Hitchcock, Dowrick, & Prater, 2003; Hosford, 1981; Thiemann & Goldstein, 2001). The disadvantage of self-modelling is the time and effort necessary to produce the video; the learner needs to be recorded for an extensive period of time for enough material to be collected and edited to create a clip showing only the desired behaviour (Buggey, 2007).

Models can also be typical or disabled peers (Nikopoulos & Keenan, 2003; Reeve, Reeve, Townsend, & Poulson, 2007). Interventions with peers as models have been successful in teaching children with ASD new skills such as play, purchasing skills and social skills (Dauphin, Kinney, & Stromer, 2004; Haring, Breen, Weiner, H., & Bednersh, 1995; Nikopoulos & Keenan, 2007). Peer models are normally matched on age and gender to increase similarity because theoretically, it would be easier for the learners to imagine themselves in the models' place (Schunk, 1987). A disadvantage is that it might be difficult to recruit similar peers who are willing and able to perform the task for the video production.

Adults, familiar or otherwise, have also been used as models (Charlop & Milstein, 1989; Murzynski & Bourret, 2007). Interventions using adult models were successfully used in a number of studies (Alcantara, 1994; D'Ateno, Mangiapanello, & Taylor, 2003; Scattone, 2008). In contrast to the disadvantages of using children as models, adults are more willing and capable of understanding and performing the required task (McCoy & Hermansen, 2007).

As mentioned before, self and peer models would theoretically be more effective because of model similarity (Bandura et al., 1961) but empirical studies have demonstrated otherwise. Ihrig and Wolchik (1988) report no differences between peer and adult models in an in-vivo intervention. In addition, a study by Sherer et al. (2001) and a review by Bellini and Akullian (2007) found no difference between self and others as models. In a review of the literature, McCoy & Hermansen (2007) found that peer and self models were only slightly more successful than other model types.

There may be legal and ethical issues associated with recording and keeping material with models, including confidentiality, consent and ethical clearance (McCoy & Hermansen, 2007). A video without visible models would circumvent this problem. The subjective perspective is an alternative to showing a model in the video. Instead, the task is viewed from the performer's perspective, as if he or she is performing the task, and hence, no models are present (Cannella-Malone et al., 2006; Hine & Wolery, 2006). This form of video is highly suitable for task oriented interventions, for instance, a step by step instruction on how to make microwave popcorn (Sigafoos et al., 2005). The subjective perspective is less common than videos with models but it has also been shown to teach new skills to people with various disabilities (Cihak et al., 2006; Norman et al., 2001; Shipley-Benamou, Lutzker, & Taubman, 2002; Sigafoos et al., 2007).

In light of recent and widespread use of video based interventions and their potential for positive results, a systematic review of the video modelling (VM) and prompting research for children with ASD was conducted to establish the current state of research in this field. The results of this review are presented below.

Systematic Review of Video-Based interventions for Children with ASD[1]

Method

A systematic literature review was conducted to identify studies that examined the use of video-based instruction for developing adaptive behaviour functioning in children with ASD. Studies that matched the inclusion criteria were summarized in terms of: (a) participants, (b) setting, (c) model type (d) target skills, (e) intervention type, (f) design, and (g) outcomes.

Search Strategy

A systematic search was conducted on four electronic databases: Eric (Education Resources Information Center), SpringerLink, PsychINFO, and ProQuest. The searches used a combination of free-text keywords: *video, video modeling, video prompting, asperger syndrome, autism, ASD,* and *autism spectrum disorder (wildcard symbols were used to broaden the search to include variations of the search terms, e.g. video* = video, videos, videotape).* No date range was employed on the electronic search, but the search was restricted to English-language peer-reviewed journals. Articles in other languages (e.g., Inoue & Kobayashi, 1992) were not reviewed due to

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1 An article based on this review has been published in *Developmental Neurorehabilitation*. Kagohara, D. M. (2010). Is video-based instruction effective in the rehabilitation of children with autism spectrum disorders? *Developmental Neurorehabilitation, 13,* 129-140. In addition, a poster with the results has been presented at the 26th Annual Pacific Rim International Conference on Disabilities 2010 (see Appendices B and C).

language proficiency limitations. Dissertations and other grey literature were not included to ensure that all included studies had received independent peer review.

In order to locate possibly relevant studies missed by the electronic search, three additional search strategies were used. First, an ancestral search of the relevant articles' reference lists was carried out. Second, an author search was conducted on the electronic databases to identify other articles written by authors of studies that had been identified in the electronic search. Finally, a manual search of the journals that published these articles was done to identify additional studies that might fit the search criteria. The date range for the manual search was from 1989 (the year of the earliest relevant article found) to early 2009 (when the searches were conducted). In addition to these searches, an automatic warning system was set up in the ProQuest database to ensure new articles that fit the search criteria but were not published at the time of the main search could still be examined. One article was identified through this method.

Inclusion and Exclusion Criteria

Studies found on the searches were examined to determine if they met the criteria for inclusion in the review. The criteria for inclusion and exclusion were as follow: first, only studies that examined video modelling and video prompting interventions were included. Videos not showing behaviour to be imitated were excluded (e.g., Baharav & Darling, 2008). Second, the video-based instruction had to focus on developing the child's adaptive behaviour (i.e. video-based instruction was the independent variable and some relevant adaptive behaviour was the dependent variable). Relevant adaptive behaviours included social, communication, daily functional, and behaviour management skills. Studies not adopting video to develop adaptive behaviours were excluded (e.g., Thiemann & Goldstein, 2001). Third, at least one participant in the study had to be identified as having an ASD. Developmental disorders not specified or not falling under the ASD category were excluded. Finally, the participants were children 18 years of age or under.

Data Extraction

All studies that met the inclusion criteria were coded in terms of: (a) participants (e.g. age, gender and number), (b) setting (e.g. school, home or community setting), (c) type of model on the video (e.g. self, same age peer, adult), (d) target skill being taught (e.g. initiation, complement giving, eye contact), (e) experimental design (e.g. multiple-baseline, pre-post test), (f) intervention procedures/strategies (e.g. use of additional techniques – social stories, reinforcement, feedback), (g) follow-up (e.g. timeframe of follow-up), (h) generalization (e.g. across settings, interaction partners), and (i) the results of the video-based instruction.

Inter-rater Agreement

The initial search identified 77 articles for possible inclusion in the review. Examination of the 77 articles lead to a number of these being excluded. Specifically, review articles and studies that did not report original data on the effects of a video-based intervention were excluded (e.g., Bellini & Akullian, 2007; S. Parsons, Leonard, & Mitchell, 2006). This process left a total of 51 articles. Two examiners then independently reviewed each of these 51 articles against the inclusion criteria, resulting in 44 studies for inclusion in this review.

The 44 included articles were then analyzed and coded following the data extraction procedures described previously. If a study reported participants with and without ASD, only the data for the ASD participants were coded. In order to assess agreement on inclusion and data extraction, a second independent examiner extracted data for 22 randomly selected studies (50%). Agreement on the accuracy of data extraction for these 22 studies was 100%.

The studies' results were coded as reported by the authors. That is, if the outcome was described as positive, they were coded as such. To ascertain the certainty of evidence for positive results, the design of each study was analyzed. Studies with non-experimental designs (e.g., A-B, pre-post testing without a control group) were deemed inconclusive. For studies with experimental designs, evidence was conclusive if the data demonstrated a significant intervention effect, the inter-observer agreement was satisfactory (i.e. 80% agreement or more for at least 20% of data), the variables were clearly defined, and the procedure was described in sufficient detail to allow replication.

Results

A total of 49 experiments were reported in the 44 included articles. Table 2.1 presents a summary of the participants, intervention variables (setting, model type, target skill), and reported outcomes with certainty of evidence for each of these 49 experiments.

Participants

A total of 131 participants with ASD were included in the studies. Of these, 109 (83%) were boys and 22 (17%) were girls. The vast majority (*n* = 110, 84%) of participants were reported as having autism. Asperger and high-functioning autism were reported for 17 participants (13%), with three participants (2%) described as having pervasive developmental disorder not otherwise specified (PDD-NOS). One study described the participating child as having an ASD but did not provide diagnostic details.

Ages ranged from 2.6 years to 17.4 years (mean = 7.6). Two studies [22, 31] provided the age range of their participants, but not individual ages. In such cases, the average for the studies' sample was used to calculate the overall average. Over half (*n* = 72, 55%) of the participants were school-aged children between the ages of 6 and 12. The second largest group (*n* = 39, 30%) consisted of preschool children aged 3 to 5. Seven (5%) participants were adolescents between 14 and 18 years. One 2-year-old child participated in the studies. One of the studies [22] that did not provide individual ages included children that ranged from 4 to 6 years, which did not allow for individual allocation to the preschool or the school-aged groups. In this case, the reported mean age of 5.04 was used and the entire sample was counted as one, therefore, the number of participants reported here adds up to 119.

Table 2.1. Summary of the Articles Included in the Literature Review

#	Study	Participants	Intervention Variables	Outcomes and Certainty of Evidence
[1]	Alcantara (1994)	2 boys, 1 girl (8 - 9.11 years)	Intervention targeting purchasing skills conducted in school and community store settings with an adult model	Positive outcome but effects cannot be solely attributed to the VM intervention because in-vivo instruction was also used
[2.1]	Apple, Billingsley, Schwartz (2005) Experiment 1	2 boys (5 years)	Intervention targeting compliment giving skills in a school setting with peer as model	Positive with strong certainty of evidence due to experimental design
[2.2]	Apple, Billingsley, Schwartz (2005) Experiment 2	2 boys, 1 girl (4.1 - 5.9 years)	Intervention targeting compliment giving skills in a school setting with peer as model (later changed to self)	Positive outcome only after model was changed to self
[3]	Ayres & Langone (2007)	3 boys, 1 girl (6.2 - 8.10 years)	Intervention teaching putting away groceries in a school setting with an adult model or a subjective viewpoint	Positive but certainty of evidence weakened due to alternating treatment design
[4]	Bellini, Akullian, Hopf (2007)	2 boys (4.4 - 5.1 years)	Intervention targeting social engagement in a school setting with self as model	Positive with strong certainty of evidence due to experimental design
[5]	Bernard-Ripoll (2007)	1 boy (9.8 years)	Intervention targeting emotional recognition conducted at home with self as model	Positive but certainty of evidence weakened due to A-B design
[6.1]	Buggey (2005) Experiment 1	2 boys (9.11 - 11.3 years)	Intervention targeting social interactions in a school setting with self as model	Positive with strong certainty of evidence due to experimental design
[6.2]	Buggey (2005) Experiment 2	2 boys (6.9 - 8.1 years)	Intervention targeting tantrums in a school setting with self as model	Positive with strong certainty of evidence due to experimental design
[6.3]	Buggey (2005) Experiment 3	1 boy (5.5 years)	Interventions targeting pushing and language production in a school setting with self as model	Mixed outcome - decreased pushing but no improvement in language production. Certainty of evidence strong due to experimental design
[7]	Buggey, Toombs, Gardener & Cervetti (1999)	2 boys, 1 girl (7 - 12 years)	Intervention targeting responding behaviours in a home setting with self as model	Positive with strong certainty of evidence due to experimental design
[8]	Charlop & Milstein (1989)	3 boys (6.10 - 7.10 years)	Intervention targeting conversational speech at school and home settings with a familiar adult as model	Positive with strong certainty of evidence due to experimental design

[9]	Charlop-Christy & Daneshvar (2003)	3 boys (6.1 - 9.5 years)	Intervention targeting perspective taking in an after school behavioural management program with familiar adults as models	Mixed outcome - positive results reported for only two participants. Strong certainty of evidence due to experimental design
[10]	Charlop-Christy, Le & Freeman (2000)	4 boys, 1 girl (7 - 11 years)	Intervention targeting developmental skills (emotions, play, greetings, speech and living skills) in an after school behaviour therapy program with an adult as model	Positive with strong certainty of evidence due to experimental design
[11]	Corbett (2003)	1 boy (8.3 years)	Intervention targeting emotional recognition in a home setting with a peer model	Positive with strong certainty of evidence due to experimental design
[12]	Coyle & Cole (2004)	3 boys (9.1 - 11.7 years)	Intervention to decrease off-task behaviour in a school setting with self as model	Positive but effects cannot be solely attributed to the VM intervention because self-management strategy was also used
[13]	D’Ateno, Mangiapanello & Taylor (2003)	1 girl (3.8 years)	Intervention targeting complex play sequences in a school setting with an adult model	Mixed results - gains in play responses but not for new non-modeled statements. Certainty of evidence strong due to experimental design
[14]	Dauphin, Kinney & Stromer (2004)	1 boy (3.1 years)	Intervention targeting sociodramatic play in a home setting with peer as model	Positive outcome but design not clearly described
[15]	Delano (2007a)	3 boys (13.6 - 17.4 years)	Intervention targeting written language skills with self as model. Setting described as a conference room	Positive outcome but additional self-regulated strategy instruction does not allow positive effects to be attributed to VM
[16]	Gena, Couloura & Kymissis (2005)	2 boys, 1 girl (3.11 - 5.7 years)	Intervention targeting affective behaviour modification in a home setting with a peer model	Positive outcome only after introduction of reinforcement and prompting. Strong certainty of evidence due to experimental design
[17]	Hagiwara & Myles (1999)	3 boys (7.11 - 9.11 years)	Interventions targeting functional skill (washing hand) and off-task behaviour conducted at home and school with self as model	Mixed outcome - improvement reported for some participants in some settings. Effects cannot be attributed to VM because Social Stories were also used
[18]	Haring, Breen, Weiner, Kennedy & Bednersh (1995)	3 boys (10 - 16 years)	Intervention targeting generalized purchasing skills conducted in home, school, community stores settings with peers as models	Positive outcome but in-vivo modelling also used and so, effects cannot be attributed only to the VM condition
[19]	Hine & Wolery (2006)	2 girls (2.6 - 3.7 years)	Intervention targeting play skills in a school setting with a subjective viewpoint video	Positive with strong certainty of evidence due to experimental design
[20]	Keen, Brannigan & Cuskelly (2007)	5 boys (4.5 - 6.9 years)	Intervention targeting toilet training in school and home settings with an animation movie	Very limited improvements reported

[21]	Kinney, Vedora & Stromer (2003)	1 girl (8 years)	Intervention teaching generative spelling in home and school settings with an adult model	Positive outcome but certainty of evidence weakened by non-experimental design
[22]	Kroeger, Schultz & Newsom (2006)	9 boys, 4 girls (4 - 6 years)	Intervention targeting prosocial behaviours with a peer as model. Setting was not disclosed	Positive but certainty of evidence weakened due to pre-posttest design
[23]	Lasater & Brady (1995)	1 boy (14 years)	Intervention targeting daily functioning skills in a home setting with self as model	Positive with strong certainty of evidence due to experimental design
[24]	LeBlanc, Coates, Daneshvar, Charlop-Christy, Morris & Lancaster (2003)	3 boys (7 - 13 years)	Intervention targeting perspective taking in a school setting with an adult model	Positive with strong certainty of evidence due to experimental design
[25]	MacDonald, Clark, Garrigan & Vangala (2005)	2 boys (4 - 7 years)	Intervention targeting pretend play in a school setting with an adult model	Positive with strong certainty of evidence due to experimental design
[26]	MacDonald, Sacramone, Mansfield, Wiltz & Ahearn (2009)	2 boys (5 -7 years)	Intervention targeting reciprocal pretend play in a school setting with an adult model	Positive with strong certainty of evidence due to experimental design
[27]	Maione & Mirenda (2006)	1 boy (5.7 years)	Intervention targeting social language in a home setting with an adult model	Mixed outcome - improvement in 2 tasks but for a third only after feedback and prompting
[28]	Marcus & Wilder (2009)	2 boys, 1 girl (4 - 9 years)	Intervention targeting textual responses in home and school settings with self or peer as models	Mixed outcome - improvements were reported in video self modelling condition for all participants but only in the peer modelling condition. Strong certainty of evidence due to experimental design
[29]	Murzynski & Bourret (2007)	2 boys (8 - 9 years)	Intervention targeting daily living skills in a home setting with an adult as model	Positive with strong certainty of evidence due to experimental design
[30]	Nikopoulos & Keenan (2003)	6 boys, 1 girl (9 - 15 years)	Intervention targeting social initiation skills in a school setting with typical or disabled peers or familiar or unfamiliar adults	Mixed outcome - reported improvements for 4 out of 7 participants. Certainty of evidence weakened by multiple treatment and A-B design
[31]	Nikopoulos & Keenan (2004a)	3 boys (7 - 9 years)	Intervention targeting social initiation skills with a peer as model. Setting not disclosed	Positive but the video in one condition was simplified. Certainty of evidence was strong due to experimental design

[32]	Nikopoulos & Keenan (2004b)	2 boys, 1 girl (7.5 - 10.5 years)	Intervention targeting social initiation and reciprocal play skills in a school setting with peer as model	Positive with strong certainty of evidence due to experimental design
[33.1]	Nikopoulos & Keenan (2007) Experiment 1	3 boys (6.5 - 7 years)	Interventions teaching complex social sequences (social initiations, reciprocal play, imitative response, object engagement) in a school setting with a peer with learning disability	Positive outcome but 2 participants required further training. Certainty of evidence strong due to experimental design
[33.2]	Nikopoulos & Keenan (2007) Experiment 2	1 girl (7.5 years)	Interventions teaching complex social sequences (social initiations, reciprocal play, imitative response, object engagement) in a school setting with a peer with learning disability	Positive outcome but certainty of evidence weakened due to A-B design
[34]	Norman, Collins & Schuster (2001)	1 boy (12.3 years)	Intervention teaching self-help skills in a school setting with a subjective viewpoint video	Mixed outcome- participants did not meet criteria for one of the tasks but certainty of positive results is strong due to experimental design
[35]	Ogletree, Fischer & Sprouse (1995)	1 girl (5.9 years)	Intervention targeting language skills in a clinic setting with Disney movie segments	Mixed outcome - positive results but no improvements in 2 tasks. Certainty of evidence strong due to experimental design
[36]	Paterson & Arco (2007)	2 boys (6 - 7 years)	Intervention targeting play skills in a school setting with a young adult as model	Positive with strong certainty of evidence due to experimental design
[37]	Reagon, Higbee & Endicott (2006)	1 boy (4 years)	Intervention targeting pretend play skills in school and home settings with a sibling as model	Positive outcome but certainty of evidence weakened due to A-B design
[38]	Sansosti & Powell-Smith (2008)	3 boys (6.6 - 10.6 years)	Intervention targeting social communication in a school setting with a peer model	Positive but prompts and confederate peers introduced. Effects cannot be attributed to VM alone because Social Stories were used
[39]	Scattone (2008)	1 boy (9 years)	Intervention targeting conversation skills in a medical centre and home settings with an adult as model	Positive but variable results. Effects cannot be attributed to VM alone because Social Stories were also used
[40]	Sherer, Pierce, Paredes, Kisacky, Ingersoll & Schreibman (2001)	5 boys (3.11 - 11.2 years)	Intervention targeting conversation skills in home and clinic settings with peer or self as model	Mixed outcome - positive for 2 participants, small improvement for 1, but no improvement for 2. Certainty of evidence of positive results is strong due experimental design

[41]	Shipley-Benamou, Lutzer & Taubman (2002)	2 boys, 1 girl (5.1 - 5.5 years)	Intervention targeting functional skills with a subjective viewpoint video. Settings were home and an assessment room	Positive with strong certainty of evidence due to experimental design
[42]	Simpson, Langone & Ayres (2004)	2 boys, 2 girls (5 - 6 years)	Intervention targeting social skills in a school setting with peer as model	Positive outcome but effects cannot be solely attributed to the VM intervention because static pictures were also used
[43.1]	Taylor, Levin & Jasper (1999) Experiment 1	1 boy (6 years)	Intervention targeting play related statements in a home setting with a sibling as model	Positive but no improvement on unscripted statements. Certainty of evidence strong due to experimental design
[43.2]	Taylor, Levin & Jasper (1999) Experiment 2	1 boy (9 years)	Intervention targeting play related statements in a home setting with a sibling as model	Positive but variable results. Certainty of evidence strong due to experimental design
[44]	Wert, & Neisworth (2003)	4 boys (3 - 6 years)	Intervention targeting spontaneous request in home and school settings with self as model	Positive with strong certainty of evidence due to experimental design

Sample size in the studies ranged from 1 to 13 (mean = 2.7 per experiment). Most studies (*n* = 41, 84%) had between 1 and 3 participants with ASD [1-2.2, 4-9, 11-19, 21, 23-29, 31-33.2, 34-39, 41-43.2]. Three experiments (6%) had four participants [3, 42, 44] and another three studies (6%) had five participants [10, 20, 40]. One experiment had 7 participants in the sample [30] while another had 13 participants [22].

Settings

The most common settings for these studies were schools and homes. It should be noted that 11 studies were conducted in multiple settings. In such cases, each setting was counted separately. Almost half of the studies (*n* = 28, 57%) were conducted in a school setting [1-4, 6.1-6.3, 8, 12, 17-21, 24-25, 28, 30, 32-33.2, 34, 36-38, 42, 44]. Twenty studies (41%) were conducted in the participant's home [5, 8, 11, 14, 16, 18, 20-21, 23, 27-29, 37, 39-41, 43.1-44], four (8%) during after school therapy programs [9-10, 13, 24], three (6%) in clinics [34, 39-40] and two (4%) in community settings (e.g. grocery and bookstores) [1,18]. The setting was only identified as a generic room in four (8%) studies [15, 26, 31, 41]. One study [22] did not state where the intervention took place.

Model Types

Models were the "actors" who performed the task or behaviour in the videos. Three experiments [3, 28, 30] employed more than one type of model in separate videos and so, were counted separately. Most (*n*= 47, 88%) videos had a peer, an adult, or the participants themselves as models. Eighteen (34%) models were peers [2.1-2.2, 11, 14, 16, 18, 22, 28, 30-33.2, 37-38, 40, 42-43.2], 15 (28%) were adults [1, 3, 8-10, 13, 21, 24-27, 29-30, 36, 39], and 14 (26%) were the participants themselves [2.2, 4-7, 12, 15, 17, 23, 40, 44]. Four (8%) videos were shot in the subjective viewpoint (i.e. no models are shown, the task is seen thought the eyes of the participant) [3, 19, 34, 44]. Two studies used animated video segments as material for the children to imitate. One of the studies [20] used a purposely produced video to teach toileting skills while the other [35] edited segments from Disney animation movies to illustrate appropriate conversational skills.

Target Skills

Approximately two-thirds (*n*= 34, 69%) of the studies targeted social communication skills [2.1-2.2, 4-6.1, 6.3-11, 13-14, 19, 22, 24-27, 30-33.2, 35-40, 42-44]. In several cases, it was difficult to clearly distinguish social from communication skills. As Ochs, Kremer-Sadlik, Sirota and Solomon (2004) argued, communication is an essential part of social functioning and socialization is necessary for the acquisition of communicative language. In addition, the revised diagnostic criteria in the DSM will no longer make a distinction between social and communication skills. It was deemed appropriate, therefore, to cluster social and communication skills into the same category. The next most targeted skills were daily, functional skills such as washing hands and doing groceries (*n*= 9, 18%) [1, 3, 17-18, 20, 23, 29, 34, 41]. Study 6.3 examined a daily skill and a communication skill therefore, the percentage does not add up to 100. Reduction of problem behaviour was the aim of five (10%) studies [6.2-6.3, 12, 16-17] while only three (4%) studies attempted to teach academic skills [15, 21, 28].

Intervention Procedures

In addition to the use of video-based instruction, 24 studies [1-2.2, 5, 7-8, 11, 14, 16, 18, 20-22, 24, 27-30, 33.1, 34, 36, 41, 43.1-43.2] used reinforcement procedures, such as verbal praise and edibles in the learning program. Of these, nine studies [1, 2.2, 11, 14, 20, 22, 27, 33.1, 34] also used response prompts. Thirteen studies reported additional strategies such as in-vivo modelling [1, 10, 16, 18], Social Stories [5, 17, 38-39], self-management skills [2.2], static pictures [21, 42], strategy instruction [15], operant conditioning [20], dictation [21], and feedback [27].

In terms of how the video-based instruction was delivered, in seven studies [3, 14, 17, 19, 21, 38, 42] the video seen by the children were presented on a computer screen. In the other studies, the video seen by the participants were presented on a television screen using a VCR player.

Study Designs

All but one study evaluated video modelling interventions with single-case experimental designs (Kennedy, 2005). Designs were deemed experimental if they systematically introduced and removed the intervention (e.g. ABAB) [12] or if the independent variable was sequentially introduced following a baseline phase (e.g. multiple baseline or multiple probe designs) [1-2.2, 4, 6.1-11, 13, 15-20, 23-29, 31-33.1, 34-46, 38-44].

Pre-experimental designs included a simple A-B design or an intervention only design [3, 5, 30, 33.2, 37]. Experiments were also deemed non-experimental if they employed pre-post measures with no control group or control condition [22]. The design was not clearly described in two studies [14, 21]. The only study employing a group intervention [22], analyzed pre-post measures for the group as a whole.

Follow-up and Generalization

Twenty-three articles reported follow-up measurements [1, 6.2, 8, 11, 13-15, 19-20, 22-26, 29-33.1, 35, 37, 39-40], ranging from 2 days [6.2] to 15 months [8]. Most studies measured follow-up between one and three months after the intervention terminated [8, 13-15, 19, 23, 25, 29-33.1, 39-40]. Five studies [4, 6.1, 17, 36, 40, 43.2] reported only maintenance data retrieved immediately after the intervention stage.

Twenty-six studies reported generalization data. Fourteen reported on generalization across settings [2.2-3, 8, 10-11, 17-20, 30, 32, 38-40]. Thirteen reported on generalization across people [5, 8, 10-11, 16, 18, 30, 32-34, 37, 40] and 15 reported on generalization across tasks [8-11, 14-15, 18-19, 23-24, 30, 32, 34, 36, 40].

Reliability of Data and Treatment Integrity

Thirty-eight (77%) studies reported inter-observer agreement (IOA) to assess reliability of data collection. All the reported IOA were above the accepted 80% standard [70]. Of these, 11 (22%) also reported on treatment integrity (i.e., procedural reliability) [1-2.2, 4, 12, 19, 27-28, 38-39, 42] and 11 (22%) studies reported on social validity [3-4, 7-8, 19, 30, 32-33.1, 37-38]. External validity was reported in one study [7]. Six (12%) studies [11, 20, 35-36, 43.1-43.2] reported no agreement or validation measures while five (10%) did not clearly report on the measures [5, 9, 22, 24, 31].

Outcomes

Over half of the studies (*n*= 27, 55%) reported positive results [2.1, 4-6.2, 7-8, 10-12, 14-15, 18, 21-26, 29, 32, 33.2, 36-37, 41-42]. A number of studies, however, reported mixed outcomes. In some cases the intervention had to be modified for a positive result (e.g. introduction of reinforcement, different model, further training) (*n*= 7, 14%) [1, 2.2, 16, 27, 31, 33.1, 38], the intervention worked for some but not all participants (*n*= 4, 8%) [9, 30, 40, 44], improvements were reported for some measures but not others, performance did not meet criterion, or the results could not be entirely attributed to the intervention (*n*= 11, 22%) [3, 6.3, 13, 17, 19-20, 28, 34-35, 39, 43.1-43.2].

Certainty of Evidence

Certainty of evidence was analyzed in terms of the positive effects of the video-based instruction. The certainty of evidence was deemed conclusive for almost two-thirds (*n*= 30, 61%) of the studies [2.1, 4, 6.1-11, 13, 16, 19, 23-26, 28-29, 31-33.1, 34-36, 40-41, 43.1-44]. Evidence was inconclusive for the other 19 (39%) studies. Results were rated as inconclusive because the studies relied on pre-experimental designs or did not describe the design with sufficient detail [3, 5, 14, 21-22, 30, 33.2, 37]. Another reason for inconclusive ratings are confounded results, that is, more than one independent variable was introduced in the study and therefore it is not possible to ascertain if the video-based instruction was the reason for the positive effect (reinforcements and prompts were not considered separate independent variables) [1, 2.2, 5, 12, 15, 17-18, 20, 27, 30, 38-39, 42].

Discussion

The purpose of this review was to determine the current state of video modelling research as it applies to the rehabilitation of children with ASD. An additional goal was to identify gaps in the literature in order to guide the research conducted in this thesis. The systematic search identified a total of 44 articles reporting 49 individual experiments published between 1989 and 2009. Interestingly, the collective sample of 131 children would appear to match the general ASD population in terms of gender ratio reported in the literature, that is, four to five boys to every girl (American Psychiatric

Association, 2000; World Health Organization, 1993). Also, the children in the studies were primarily diagnosed with autism, with fewer having Asperger syndrome or PPD-NOS.

Not surprisingly, the majority of studies targeted social/communication skills. Impairments in these areas are key features of ASD and are also commonly present in cases of intellectual disability. In addition, these skills are necessary for successful community living. However, major deficits in adaptive behaviour and academic skills are also prevalent among children with ASD. The small number of studies targeting these areas suggests more research is needed to determine whether video-based instruction can be effective in teaching a broader range of skills to children with ASD. There is, for example, a major gap with respect to the use of video-based instruction for teaching academic skills, such as reading, writing, and arithmetic, which is highly relevant for school-aged children. In addition, no studies attempted to teach leisure skills to the children. Leisure and recreational skills are often neglected but are important for a healthy development and a good quality of life (Iwasaki, 2007; Schleien et al., 1995).

The review identified a predominance of peers, self, and adults as models. The positive results reported support previous findings that a wide range of models can be effectively employed in video-based instructions (Nikopoulos & Keenan, 2003; Rayner et al., 2009). Given the fact that all types of models have been shown to be effective, interventions for children with developmental disabilities could be designed with the most convenient model option available. This approach could minimise the amount of pre-training preparation and it does not require a great level of trainer and model expertise. For task-oriented training, the subjective viewpoint represents not only the easiest option but also perhaps the most suitable as it avoids distractions and directs the learner’s attention to the relevant stimuli.

A limitation that makes it difficult to evaluate the promise of video-based instruction is the fact that most of these interventions supplemented video-based instruction with additional instructional procedures. In addition to video modelling, for example, many studies also used direct error correction procedures involving verbal prompts and provided reinforcement for correct performance. It would be valuable to ascertain the effects of video modelling alone and the influence of these additional strategies on the effects of video-based instruction.

New technologies have been successfully used to teach different skills to children with ASD but despite the advances that make the technology easier to use, this review found only a few studies allowing participants to operate the equipment themselves. The studies reviewed employed simple computer programs where children could advance to the next step by clicking somewhere on the screen with a mouse (e.g., Sansosti & Powell-Smith, 2008). Although reportedly capable of operating the equipment, in most studies the child had no interaction with the technology besides sitting in front of the screen. Portable self-operated devices like cassette players and PDAs were effectively employed in the past, but little research has examined the use of new portable multimedia devices such as iPods and iPads for individuals with developmental disabilities. Such devices might be used for developing age-appropriate leisure activities, such as listening to music or playing games and/or to deliver video-based instructions for teaching new adaptive behaviours.

Overall, the results of this review support the use of video-based instruction in the rehabilitation of children with ASD. Of the 49 experiments, most reported positive effects and the majority were judged to provide conclusive evidence. Given the generally positive outcomes reported in these 44 studies, there is sufficient evidence to conclude that video-based instruction is an empirically supported procedure for teaching a range of adaptive behaviours, particularly, social and communication skills, to children with ASD.

Portable Multimedia Devices for Video Modelling

The latest wave of technological advances is focusing on portable equipment such as laptops, personal digital assistants, and more recently, multimedia devices such as iPods and iPads. Cihak and Bowlin (2009) for instance, used a tablet computer to improve geometry skills of high school students with learning disabilities and Mechling, Gast and Seid (2009) used a personal digital assistant as a self-prompting device to increase independent task completion by students with ASD. The authors of these and similar studies note the advantage of using a portable device as it allows training to be more easily conducted in different settings.

iPods and iPads are highly portable and can be used in different ways and for different purposes. They were originally intended as productivity and recreational tools for the general public but researchers and teachers have also found them useful in the educational setting. Some universities in the United States for instance, have provided iPods and/or iPads to new students with the intention of enhancing the students' learning experience (Dale & Pymm, 2009; Read, 2005). These devices have been widely used to access course material from over 800 universities (Parson, Reddy, Wood, & Senior, 2009) but they have also been used more actively in the teaching process to for instance, produce student-developed multimedia history presentations (Vess, 2006), performing arts productions (Dale & Pymm, 2009), and to provide music and pedagogical material in a dance class (Block, 2008).

Recently, numerous anecdotal reports have shown how these devices can be used to help students with developmental and learning disabilities (e.g., Hager, 2010; Seeton, 2009). These reports suggest iPods and iPads may have numerous advantages over other specialized equipment for people with special educational needs. These portable devices are readily available and their intuitive interface means individuals with disabilities can learn how to operate them more easily. iPods and iPads seem to be highly desirable devices and could be more easily accepted as a learning tool. They are relatively cheap when compared to specialized equipment such as speech-generating devices. The iPods are portable and small enough to not be obtrusive to the user. iPads are larger but can still be easily carried and used in different settings. They also have the advantage of a bigger screen that allows content to be more easily viewed. One of the main advantages of these devices is the large number of software applications available that allow them to be used for productivity, communication, and leisure. A large number of special education applications is also available; they can be used to teach skills such as reading, writing, mathematics, and science. Other applications can be used to generate speech or employ pictures to convey messages.

Although anecdotal reports support the use of iPods and iPads to enhance the learning process of children with developmental disabilities, research in this area is still relatively new (the earliest empirical study was published in 2009). iPods have been previously employed as prompting devices in employment (Burke, Andersen, Bowen, Howard, & Allen, 2010; van Laarhoven et al., 2009), school (Cihak, Fahrenkrog, Ayres, & Smith, 2010), and community settings (Taber-Doughty et al., 2008) and as a speech generating device (Kagohara et al., 2010; van der Meer et al., 2011) for individuals with autism and intellectual disabilities.

In light of the advantages of using portable devices and the positive findings of early research, iPods and iPads appear to be promising tools for teaching children with developmental disabilities.

Purpose of the Present Studies

The research presented in this thesis aimed at teaching children with developmental disabilities a wide range of skills, namely leisure, academic and social. Leisure and academic skills have been largely neglected in the field of video modelling research. Studies in these areas are therefore, essential. Leisure skills are important because they enable age-appropriate recreational activities. With the ability to play socially, children with ASD may have more opportunities to develop social skills and form friendships. Individual activities are also important, especially in cases where children are unable to make friends or prefer to play alone. Being able to operate devices to listen to music or watch videos may be an appropriate alternative when children are not comfortable interacting with others. Academic skills are especially important for children with Asperger because these children are mainstreamed in regular schools. They have difficulties keeping up with the curriculum but with appropriate instruction, these children can learn as well as their peers. A good school experience may lead to higher education and a productive life. As the literature review demonstrated, social skills research is more prominent. Social skills are important for appropriate functioning in society and impairments in this area are key characteristics of developmental disabilities. It is not surprising a large amount of research focuses on these skills and because of their significance they will also be examined in this thesis.

Given the advances in technology and the reported advantages of incorporating it in interventions for individuals with developmental disabilities, the research conducted for this thesis aimed to employ new portable multimedia devices in novel ways to enhance the learning process of the participants in the studies. Unlike previous research, the studies in this thesis provided the participants with an opportunity to operate the equipment themselves and allowed a higher degree of self-determination by giving them a chance to give input into the design and implementation of the interventions.

The literature widely supports the use of video modelling interventions for children with ASD and it can be said to be an evidence-based strategy. Research examining video modelling for individuals with intellectual disabilities is not as extensive. The work conducted for this thesis is important as it adds to the literature and may provide further evidence of the effectiveness of video modelling interventions for individuals with disorders other than ASD. Video modelling interventions have many advantages over other methods such as ease of implementation, relatively quick results, and the children's apparent inherent interest in video technology. The positive outcomes reported and the advantages of video modelling make video-based interventions a suitable option for teaching new skills to children with developmental disabilities and therefore, a suitable method to be used in the studies conducted for this thesis.

Research Questions

This thesis examined the application of technology as an educational tool for children with developmental disabilities. The studies presented in this thesis addressed the following overall question: *Is video modelling combined with portable technology an effective strategy for teaching leisure, academic, and social skills to students with different degrees of developmental disabilities?*

Each study, in turn, addressed the following specific questions:

1. Can students with severe intellectual disabilities learn to operate an iPod for leisure purposes (watching movies and listening to songs)

with video modelling delivered on the iPod itself? (Studies 1 and 2)

2. Can students with Asperger syndrome learn an academic skill (check the spelling of words on a computer) with video modelling delivered on an iPad? (Study 3)
3. Can students with Asperger syndrome learn to greet adults at school with Social Stories and video modelling delivered on an iPad? (Study 4)

CHAPTER III

LEISURE SKILLS INTERVENTIONS

Individuals with developmental disabilities have impairments that may prevent them from learning age-appropriate leisure skills (Bauminger, Shulman, & Agam, 2003; Orsmond, Krauss, & Seltzer, 2004). Such individuals often do not have the necessary skills or opportunities to engage in the same leisure activities as peers (Coyne & Fullerton, 2004; Patterson, 2004; Thompson, Whitmarsh, Southern, Brewster, & Emira, 2009). Leisure and recreation activities are an important part of a person's development and quality of life (Iwasaki, 2007; Schleien et al., 1995). The development of age-appropriate leisure skills of people with developmental disabilities is an important educational goal because leisure engagement has been shown to have a positive impact on a person's social, emotional, physical, and cognitive health (Betz, Higbee, & Reagon, 2008; Caldwell, 2005). In a survey examining the quality of life of individuals with severe intellectual disabilities, most mothers mentioned leisure activities as an important component of their child's quality of life (McIntyre et al., 2004). Age-appropriate leisure activities may promote community inclusion and provide young adults with developmental disabilities with a constructive way to spend their free time (Fennick & Royle, 2003; Schleien, Wehman, & Kiernan, 1981). It is therefore, important for these individuals to have the skills to independently engage in age-appropriate activities widely available to the general population (Jerome, Frantino, & Sturmey, 2007).

The existing literature on leisure skills development for people with developmental disabilities is scarce. Previous studies have mainly focused on providing leisure opportunities to these individuals rather than teaching them the necessary skills to engage in leisure and recreational activities (Coyne & Fullerton, 2004; Schleien & Ray, 1988). Only a few studies have previously attempted to teach leisure skills to individuals with developmental disabilities. For instance, Luyben, Funk, Morgan, Clark and Delulio (1986) taught three adults with severe intellectual disability to play soccer. The participants learned to perform a side-of-the-foot soccer pass through forward chaining and decreasing levels of physical prompts. Follow-up and generalization data demonstrate the skill was successfully learned and maintained over time. Matson and Marchetti (1980) compared different treatment procedures to teach adults with intellectual disability to operate a stereo to listen to music. Participants who received one of the interventions performed significantly better than participants in the control groups. These studies, albeit scarce and dated, provide some evidence that participants with developmental disabilities can learn leisure and recreational skills with appropriate training.

New technology allows people to engage in a range of leisure activities that would also be suitable for people with developmental disabilities (Wehmeyer, Smith, Palmer, & Davies, 2004). Technology has become an integral part of society (Bull, 2005; Farnsworth & Austrin, 2005) and currently, a large proportion of leisure activities involves technology, including television, computers, and more recently, portable multimedia devices such as mp3 players and iPods (Bouck, Okolo, & Courtad, 2007; P. Francis, 2008). Technology such as computers and the Internet have become commonplace and are used not only for work related activities but also for leisure. Given the widespread use of this technology, Jerome, Frantino and Sturmey (2007) examined the ability of three men with developmental disabilities to use a desktop computer to access their preferred Internet sites to play video games and listen to music. The positive results suggest that people with developmental disabilities can successfully use commonplace, off-the-shelf technology and that they are viable sources of leisure and recreational activity.

To date, however, there appears to be a limited number of studies teaching children with developmental disabilities to operate portable devices such as iPods for leisure activities. The first two studies in this thesis aimed to address the lack of empirical research in this area. The first study aimed to teach three children with developmental disabilities to independently use an iPod to watch preferred age-appropriate video clips. The study employed video modelling (VM) and similar to most previous research, an additional strategy, graduated prompting, was also implemented. While the effectiveness of video modelling accompanied with other strategies has been suggested, it would be beneficial to ascertain if video modelling is effective as the only intervention component. The second study, therefore, expanded on the first and employed video modelling alone to teach the same children to operate the iPod to listen to preferred songs. These studies have the unique feature of presenting the video instructions on how to operate the iPod on the device itself.

Study 1: Teaching Students with Developmental Disabilities to Operate an iPod to Access Age-Appropriate Entertainment Videos[2]

Method

Participants

Three adolescents were selected for this study because their teacher indicated they would benefit from learning to independently engage in age appropriate leisure activities. They all attended the same classroom in a specialized school for adolescents and young adults with a range of disabilities.

Sarah was a 19-year-old girl with severe intellectual disability and epilepsy. On the Vineland-II Adaptive Behavior Scales (Sparrow, Cicchetti, & Balla, 2005) with the teacher as the interviewee, Sarah received an overall standard score of 38, which is approximately four standard deviations below the mean on the Vineland and indicative of an extremely low level of adaptive behaviour functioning. She was reported to be capable of understanding simple commands and had a good vocabulary, but was not able to carry an age-appropriate conversation. Her motor skills and visual and hearing abilities appeared to be in the normal range. She had no previous experience with iPods or any other portable media players.

Mary was a 16-year-old girl with cerebral palsy and severe intellectual disability. Her overall Vineland-II standard score was 52, which is approximately three standard deviations below the mean on the Vineland and indicative of a low level of adaptive behaviour functioning. Her teacher

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[2] An article based on this study was published on *Journal of Behavioral Education.* Kagohara, D. M. (2011). Three students with developmental disabilities learn to operate an iPod to access age-appropriate entertainment videos. *Journal of Behavioral Education, 20,* 33-43.In addition, a poster was presented at the ABAI 6th International conference 2011 (see Appendices D and F).

reported she understood simple commands and had a good vocabulary, but her speech was difficult to understand. Her motor skills were somewhat affected by cerebral palsy, but she was able to manipulate small objects effectively. Her visual and hearing abilities were in the normal range. She had no previous experience with iPods or any other portable media players.

Jim was a 15-year-old male with Klinefelter syndrome and severe intellectual disability. His overall standard score on the Vineland-II was 43, which is approximately 3.5 standard deviations below the mean on the Vineland and indicative of low level of adaptive behaviour functioning. He understood simple commands, but had a limited vocabulary and rarely spoke unless prompted to do so by an adult. His motor skill and visual and hearing abilities were in the normal range. Jim had limited experience with iPods. He was previously taught to tap the screen to make simple requests on an iPod programmed as a speech-generating device.

Setting

These three adolescents attended a public school classroom that catered for 5 students with developmental disabilities. The classroom was staffed by a teacher and a teaching assistant. All sessions associated with this study were conducted in the participants' classroom. The participants sat at the table with the primary observer, who also acted as the interventionist, on the adolescent's left. For sessions where reliability data was collected, a second and third independent observers sat opposite the first observer. The observers were not blind to the purpose or phase of the study.

Materials

Stakeholder Questionnaire. A questionnaire was created to give the participants, as stakeholders, an opportunity to consent to their involvement in the study and to identify preferred stimuli for use in the study. Specifically, participants were asked if they: (a) would like to learn how to use the iPod, (b) what they enjoyed watching, and (c) how they would like to learn (i.e. reading instructions, looking at pictures, watching a video, someone showing the steps, someone giving physical prompts). All participants indicated that they were interested in learning how to use the iPod and provided examples of what they liked to watch. They also indicated that watching a video was one of their preferred methods for learning, and so video modelling was deemed an appropriate strategy for the study.

Entertainment Video. The aim of the study was to teach the three adolescents to operate the iPod to watch preferred entertainment videos. Sarah indicated that she preferred animation movies the most but was entertained by any of the videos available. Mary had first indicated the same preference as Sarah, but was more motivated by videos of her classroom and school playground that were added to suit her changed preference. Jim enjoyed videos of sports such as rugby, soccer, and basketball. Several video clips of 30 s duration that corresponded to these preferences were therefore loaded onto the iPods. New videos were added on a regular basis to prevent boredom.

Task Analysis. A task analysis was constructed with the steps necessary to successfully watch a video on the iPod (see Table 3.1). The 7-step task analysis was validated by having 3 iPod-inexperienced users follow the steps in order to validate the task analysis. Once validated, a 38 s video of the steps in the task analysis being completed was made for use as a teaching tool in the video modelling phase of the study. The video was recorded from the subjective viewpoint using an iPhone®, edited on iMovies® and loaded on a 16GB iPod Touch®.

Table 3.1. Task Analysis: How to Watch a Video on the iPod

Steps	Description
1.	*Turn on the iPod*: press the “home” button
2.	*Unlock the screen*: slide the button with the arrow to the right
3.	*Launch the video application:* tap the “video” icon
4.	*Select the video*: find the video you wish to watch and tap on its name/picture
5.	*Watch movie*: when the video starts, turn the iPod horizontally
6.	*Leave the video application*: press “home” button
7.	*Turn off the iPod*: press the “on/off” button on the top left of the iPod

Experimental Design

A delayed multiple baseline design across participants was used in this study (Kennedy, 2005). In multiple baseline designs, the independent variable is sequentially introduced to two or more baselines or tiers (i.e., across participants, settings, behaviours, or stimuli). Once a change in the dependent variable is demonstrated in the first tier, the independent variable is introduced to the following one. This process is repeated with the remaining tiers. A functional relationship between the independent and dependent variables is established when the participant's performance changes only after the intervention is introduced while the subsequent baselines remain stable (Kennedy, 2005). Multiple baseline designs are often employed when the effects of the intervention cannot be reversed or when it may not be ethical to remove a successful intervention (Kennedy, 2005).

This study had a delayed baseline because Mary and Jim were not available when baseline began for Sarah. The study had two baseline phases followed by a video modelling and prompting phase. Video modelling was faded out in the next phase and follow-up sessions were conducted a few weeks later. The order in which participants progressed from baseline to video modelling and prompting was based on their availability. Sarah was the first to receive treatment because Mary was engaged in other classroom activities and Jim was participating in an unrelated study.

Procedures

All sessions started with the researcher giving the iPod Touch, which was turned off, to the participant and saying "Can you turn the iPod on and watch a video?". The only reinforcers were the videos the participants could choose to watch and verbal praise for attending and attempting to perform any of the steps. The independent variable was the video modelling and prompting procedure while the dependent variables were the number of steps in the task analysis performed correctly and the level of prompting used. Sessions were conducted twice a week during morning break. The iPod was only available to the students during the sessions to ensure procedural integrity.

Baseline 1. During the initial baseline phase, if a step was performed within 10 s of the initial request to turn on the iPod or the completion of the previous step, it was recorded as a correct response. If the participants made no correct attempts within 2 min of the initial request the session was terminated. The child was verbally praised for trying and was shown a preferred video on the iPod.

Baseline 2. During baseline 2, the participants were given 10 s to perform each step in the sequence. The timeframe was deemed appropriate, as it would give new learners sufficient time to complete each step. Proficient users were timed performing the entire task in less than 10 s. If the participants did not perform a step, the trainer completed the step out of sight and returned the iPod to the participant. He or she was then asked to perform the subsequent step, but not instructed on how to do it (e.g. "Can you select a video?"). This process continued until the task was completed.

Intervention. For the VM and prompting phase, the participants were shown the instructional video before the session started. A least-to-most prompting procedure was used if participants did not perform a step. After 10 s with no correct attempts, the primary observer verbally instructed the participant (e.g. "Can you push the off button?"), followed by a gestural prompt (e.g. pointing at the button and repeating the question) and finally physical guidance (e.g. taking the participants' hand and pushing the button). During the intervention, if the participant performed a step that was not part of the task analysis or accidentally chose a video they did not want to watch, the iPod was set back to the previous correct step out of the participants' sight and returned to them so they had a chance to make another selection.

Video-fading. In the video-fading phase, the video was no longer shown but the prompting procedure remained the same as in the video intervention phase.

Symbol discrimination. A discrimination test was conducted (from sessions 30, 27, and 28 for Sarah, Mary, and Jim respectively) to investigate if the participants could discern the video icon or were just used to its location. The icon was moved from the centre to the left on the lower part of the screen. The video instruction continued to show the icon in the original position. The videos available also changed position on the list as new options were added.

Follow-up. Two follow-up sessions were conducted 2 weeks and 11 weeks after the last intervention session (Session 34 for Sarah and Session 13 for Jim). The follow-up sessions for Mary were conducted 2 weeks and 10 weeks after her final session (Session 22). The procedures for the follow-up sessions were identical to that of Baseline 1.

Inter-observer Agreement

Inter-observer agreement (IOA) was gathered by an independent observer on 80% of all sessions to ascertain the reliability of the recorded data. IOA was calculated by dividing the smallest number of correctly performed steps recorded by the largest and multiplying the result by 100. IOA ranged from 86% to 100% with an overall mean of 99%.

Treatment Integrity

Treatment integrity (TI) was measured on 79% of sessions using a checklist to record if procedures were followed as specified. Data indicate procedures were followed correctly 100% of times. A second independent observer collected inter-observer data on TI for all 79% of sessions TI was measured with 100% agreement.

Results

The data for Sarah, Mary, and Jim's sessions are depicted in Figure 3.1. During baseline 1, Sarah correctly performed one step in the sequence (14% correct). During baseline 2 she correctly performed a maximum of two correct steps (28%). When VM and prompting was introduced, the number of steps performed independently increased steadily up to 86% correct. When VM was removed, the number of steps performed correctly fluctuated between five (71%) and seven (86%) and reached criterion of three consecutive sessions with 100% correct responses on Session 34. Sarah required some prompting but it seldom increased to the physical level.

Mary correctly completed only one step in the first session and none in the second during baseline 1. During baseline 2, the number of steps performed correctly ranged between 0 and 28%. When intervention was introduced, the number of steps performed correctly increased up to six (86%), but her improvement was variable. On the VM fading phase, the number of steps completed quickly reached criterion. Mary needed physical prompts early in the intervention because she was not used to handling the iPod. Motor difficulties due to cerebral palsy had an influence on the level of prompting but once Mary became familiar with the iPod she could perform the steps with no assistance.

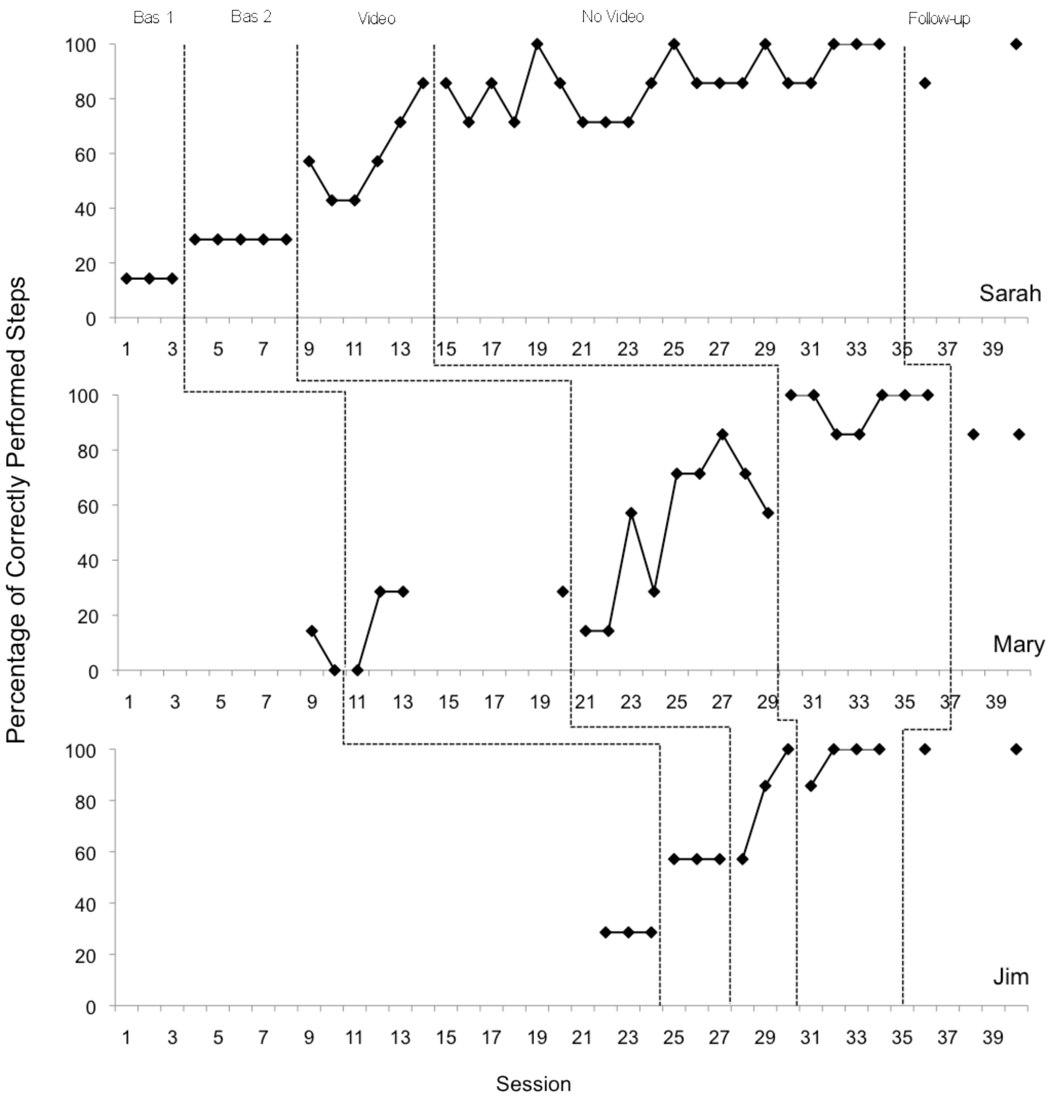

Figure 3.1. Percentage of Correctly Performed Steps in the Video Watching Task Analysis

Jim correctly performed two steps (28%) of the task during baseline 1. During baseline 2, the number of steps performed correctly increased and remained constant at 4 (57%). During the VM and prompting phase, the number of correct steps increased to 100%. On the VM fading phase, Jim reached criterion in 4 sessions. He never required a physical prompt to complete a step.

All participants continued to successfully use the iPod when icon discrimination was tested. Follow-up data shows they could still operate the iPod with at least 86% of steps being performed correctly after intervention was completely removed. Sarah performed 86% of steps on the first follow-up and 100% on the last. Mary performed at the 86% level on both follow-up sessions. Jim was able to perform all steps correctly on both follow-up sessions.

Discussion

The results suggest that the instructional procedures were effective in teaching these three adolescents to independently operate a portable media player to watch entertainment videos. They suggest that functional use of an iPod can be taught relatively quickly and thus such devices would appear to represent a viable technological resource for some adolescents with developmental disabilities. Learning to use such devices may enable the individual to access entertainment videos, which, for adolescents, could be seen as an age-appropriate leisure skill.

Skill acquisition was generally rapid, which suggests that watching the entertainment videos was motivating for the participants. Anecdotally, the participants also appeared to enjoy taking part in the sessions and learning to use the iPod. The stakeholder questionnaire may have had a positive influence in this regard. It allowed participants to indicate how they would like to learn and what they would like to watch. This degree of self-determination may explain the rapid skill acquisition because the participants had an active role in choosing to participate in the study. Also, the stimuli presented via the iPod were likely to be reinforcing because they were selected by the participants themselves. Thus, this approach to assessing stakeholder perspectives seems useful in the design of the intervention.

While acquisition was generally rapid, there were some persisting errors evident in the data. Sarah, for example, consistently made errors related to skipping the second to last step (returning to the home page) before turning off the iPod. It appeared that this error stemmed from her being easily distracted by her surroundings. While this step was not essential for the operation of the iPod, it was an important step in the task analysis because the other applications available on the iPod are only accessible from the home page. Anecdotally, Sarah appeared to be happy (smiling, laughing) while watching the video, but at times was distracted scrolling through the video list and had to be reminded to make a selection.

Mary also appeared to enjoy watching the videos, but at times appeared more motivated to participate in the school's activities with her peers. The sessions were kept short to accommodate her needs. At the beginning of the study Mary appeared to know what was required to complete a step but was not able to physically do it due to her restricted motor skills. She quickly learned how to handle the iPod and was able to perform the steps correctly.

Jim also appeared to enjoy watching the sports videos and would spontaneously say their name before making a selection. At times he would be reluctant to turn the iPod off and would try to watch a new video when told to finish the task. He appeared to be very interested in the device and would navigate through the different applications at the end of the sessions.

A unique feature of this study was that the video showing how to use the iPod to watch movies was presented to the participants on the iPod itself. The study's design allowed the instruction to be easily delivered and rendered external material and reinforcers unnecessary as the iPod also carried the stimuli the participants wanted to access.

One of the limitations of this study is the introduction of VM and response prompting simultaneously. It is possible that VM or prompting alone could account for the demonstrated intervention effects. Another limitation is the limited number of participants and the fact that generalization data were not collected.

Future research should examine if VM alone is effective in teaching new skills to children with developmental disabilities. In this case, interventions could be more efficient because they would not require the constant presence of an adult to provide prompts. Given the positive reaction to the iPod and the importance of leisure skills, future research could target other activities on the iPod, for instance, listening or music or playing games. The iPod could also be used to teach other more complex skills such as spelling and appropriate social interactions.

Despite its limitations, the present study makes a contribution to the literature by showing that adolescents with developmental disabilities quickly learned a new leisure activity on new technology that is becoming a pervasive part of society. It also gave the adolescents the choice of whether or not they would like to participate in the study and what their reinforcers would be. The adolescents were perhaps more motivated to participate because they felt empowered by having a say on their learning experience.

Study 2: Teaching Students with Developmental Disabilities to Operate an iPod to Listen to Music[3]

Method

Participants

The three students from the previous study were recruited for this study. They all still attended the same classroom in a special education school but now had the assistance of an additional teaching aide. In the previous study (Kagohara, 2011), they learned how to use the iPod to watch videos but on later generalisation probes, they did not show the ability to transfer the knowledge they had acquired and could not use the iPod to listen to music. They were therefore, given instruction on how to use the iPod for another common leisure activity engaged by the general population.

Setting

As with the previous study, all sessions were conducted in the participants' classroom. Only the participant taking part in the session was present. The participants sat at the table with the observer to their left. For sessions where reliability data was collected, the second and third observers sat opposite the first observer.

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[3] An article based on this study was published in *Research in Developmental Disabilities.* Kagohara, D. M., Sigafoos, J., Achmadi, D., van der Meer, L., O'Reilly, M., & Lancioni, G. E. (2011). Teaching students with developmental disabilities to operate an iPod Touch® to listen to music. *Research in Developmental Disabilities,* 32, 2987-2992. In addition, a poster was presented at the ABAI 6th International conference 2011 (see Appendices E and F).

Materials

An iPod Touch® (16GB, 2nd generation) was used for video modelling delivery and as the portable multimedia player in which the songs could be selected and listened to. No modifications were made to the software and no additional hardware was used.

Stakeholder questionnaire. A brief assessment questionnaire was created to give the participants, as stakeholders, an opportunity to consent to their involvement in the study and to identify their preferred stimuli to be used in the study. The participants were informally asked: (a) if they would like to learn how to use the iPod, (b) what music they enjoyed listening to, (c) and how they preferred to learn (i.e. reading instructions, looking at pictures, watching a video, someone showing the steps, someone giving physical prompts). All participants indicated they would like to learn how to use the iPod. They had difficulties selecting songs they liked so their teacher was asked for feedback on what they seemed to enjoy in the classroom. The participants then indicated they enjoyed the songs selected. They have also indicated that watching a video of the instructions was a preferred method for learning, confirming video modelling could be incorporated in the study.

Task Analysis. A task analysis was conducted to identify the steps required to operate an iPod to listen to music (see Table 3.2). The 8-step task analysis was validated by three iPod-inexperienced users who successfully followed the steps to operate the iPod.

Table 3.2. Task Analysis: How to Listen to a Song on the iPod

Step	**Description**
1.	*Turn on the iPod:* press the “home” button
2.	*Unlock the screen:* slide button with the arrow to the right
3.	*Launch the music application:* tap the “music” icon
4.	*Select the song:* find the song you wish to listen to and tap its name
5.	*Adjust the volume:* slide the volume control on the screen
6.	*Pause song:* tap the “pause” symbol on the screen
7.	*Leave the music application:* press the “home” button
8.	*Turn off the iPod:* press the “off” button on top of the iPod

Video Instruction. The validated task analysis was used to create a 34 s video instruction for the video modelling phase of the study. The video was recorded from a subjective viewpoint (as if seen by the participant) with an iPhone® and edited with iMovies®. The movie was loaded on the iPod Touch's video list. The video showed a pair of hands operating the iPod to find and start a song by following the steps in the task analysis.

Experimental Design

A delayed multiple-probe design across participants was used in this study (Kennedy, 2005). The independent variable was the video modelling instruction and the dependent variable was the number of steps in the task correctly performed without assistance. The intervention consisted of baseline, intervention (video modelling), fading and follow-up phases. Access to the preferred songs served as the reinforcer. Verbal praise was given for attending and attempts to perform any steps.

Procedures

Baseline. For each baseline session, the participant was given the iPod Touch. The iPod was turned off and the volume was turned to mute. The participant was verbally instructed to operate the iPod to listen to a song (e.g., "Can you turn the iPod on and listen to a song?"). The participant was then observed for the next 30 s and the number of steps completed independently was recorded. After 30 s with no correct attempts, the session was terminated.

Intervention. Sessions in the video modelling (VM) phase started with the presentation of the instructional video depicting the steps necessary to operate an iPod to listen to music. The video was presented on the iPod itself. The participants were asked to attend to the video and were redirected to it if they did not. After the video was shown, the iPod was given to the participants and they were asked if they could turn it on and listen to a song. The participants were given 10 s to perform each step. A response was recorded as correct if the step was independently performed within the 10 s. If the participants did not correctly perform the step in this period, the trainer asked for the iPod back and completed the step out of the participant's sight. The iPod was then returned to the participant and he or she was asked to perform the next step (e.g. "Can you turn the volume up?"). This process continued until opportunities to perform all steps of the task had been provided.

Video fading. In the video-fading phase, the video was not shown at the beginning of the session. The remainder of the procedure was the same as in the intervention phase.

Follow-up. The follow-up phase was conducted 4 and 9 weeks (5 and 10 weeks for Sarah) after the last intervention session. The participants had no access to the iPod during this time. Procedures were the same as in the baseline phase.

Inter-observer Agreement

Inter-observer agreement (IOA) was calculated to ascertain the reliability of the recorded data. A second observer independently gathered data on all sessions. IOA was determined by comparing the data collected during each session by the trainer and independent observer on a step-by-step basis. IOA ranged from 85 to 100% with an overall mean of 99%.

Treatment Integrity

Treatment integrity (TI) was measured by the second observer who used a checklist to ascertain if the procedures were being correctly implemented on each session. Data indicates the procedure was followed correctly on 100% of sessions. The third observer independently collected inter-observer data for TI on 32% of all sessions. The percentage of agreement was 100%.

Results

The data for Sarah, Mary, and Jim's sessions are presented in Figure 3.2. During baseline, Sarah correctly performed only two steps (25%) of the task. When the video modelling intervention was introduced, she steadily learned more steps. On sessions 12 and 13 (conducted on the same day and marked with an arrow in the graph), she did not watch the video because she started performing the task independently before the trainer could start the video model. Her performance improved, reaching 100%, but she expected the video presentation the following week and normal procedure was followed. Interestingly, her performance declined before improving again. When the fading phase started, she consistently performed above 87%. On the follow-up phase she continued to perform seven (87%) of the eight steps.

Mary only completed two (25%) of the steps during baseline. When video modelling was introduced, her performance improved and remained stable. She watched the video twice on the first session but on following sessions watched it once. She attended to the video well and could find and launch it on her own. On session 12 she did not watch the video because she seemed to believe she would miss the music class that was starting after the session and started performing the task before the trainer could show her the video. During the fading phase, she consistently performed above 75%. Follow-up shows she could still perform seven (87%) out of the eight steps.

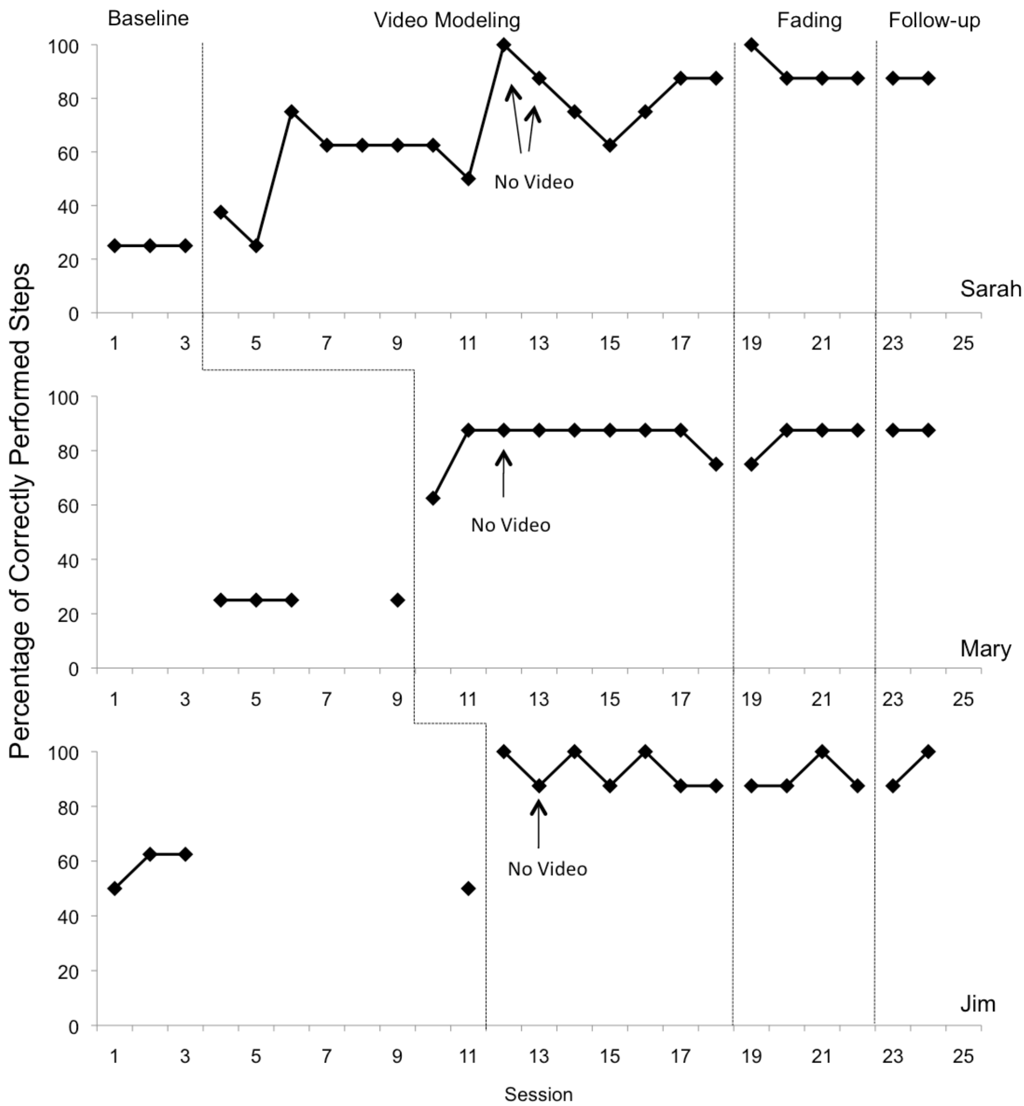

Figure 3.2. Percentage of Correctly Performed Steps in the Song Listening Task Analysis

Jim correctly performed up to five (62%) steps of the sequence during baseline but could not operate the iPod to listen to a song. When the video modelling was introduced, his performance improved to correctly performing 87% or more of the steps. He did not watch a video on session 13 (marked with an arrow) because he started to perform the task prior to the trainer providing the video. He correctly performed above 87% during the fading and follow-up sessions.

Discussion

The percentage of correct steps performed independently increased for all three participants when intervention was introduced. These results suggest the intervention was effective and that age-appropriate use of an iPod Touch for leisure purposes was acquired as a result of the video modelling procedure. As with the previous study, the video instruction on how to operate the iPod was shown on the iPod itself. This unique feature facilitated intervention delivery by including the video instruction and the stimuli in the same device.

The skill taught in this study was selected to enable the participants to engage in an age-appropriate leisure activity that is typically available to the general population. As discussed earlier, giving children an opportunity to engage in such activities can improve their overall quality of life (Iwasaki, 2007; Schleien, Meyer, Heyne & Brandt, 1995). Learning to listen to music on an iPod might also promote greater inclusion by allowing individuals with developmental disabilities to share common interests with others.

This study’s positive findings may have been due to the fact that listening to music seemed to be an effective type of reinforcement for the participants as they readily complied with the request to participate in sessions and accepted the iPod when it was offered to them. The participants also often sang or hummed the songs they were listening to and danced while the music was playing. The participants also seemed to enjoy watching the instructional video. Sarah, for instance, once asked to watch the instructional video another time before she started the session.

The stakeholder questionnaire implemented prior to baseline seemed to provide information that enhanced the intervention. For example, the students may have been more motivated to participate in this learning activity because they were allowed a degree of self-determination with respect to choosing songs and being taught by watching the instructional video on the iPod.

The findings suggest that video modelling alone was sufficient to teach the students how to operate the iPod to listen to songs. This result is encouraging as video modelling instructions can be easily implemented with minimal effort from carers and teachers. It is important to note however, that these participants had previous experience with the iPod and the intervention process. They had already learned how to use the iPod to watch movies and some of the steps are the same for both activities. However, as the baseline data in the present study indicate, the participants did not generalize the skills gained from learning how to operate the iPod to watch movies. The rapid skill gains when the video instruction was introduced seem to indicate that video modelling was responsible for the participants' improved performance.

One of the limitations of the study, as the data show, is that some performance errors persisted. The participants, for the most part, did not pause the song before turning off the iPod. This is an important step as the music keeps playing when the iPod is apparently off. Sarah and Mary appeared to not remember how to pause the song while Jim demonstrated he knew how and was able to but at times refused to do so to listen to his favourite song in its entirety. Mary also had trouble with the step requiring her to turn up the volume. She demonstrated she knew how to but sometimes was not physically able to turn it high enough due to the motor difficulties stemming from the cerebral palsy. The step was recorded as correct when she made an attempt and turned the volume up to any level. Sarah and Mary also had attention problems. While every attempt was made to ensure a quiet work area, outside noise from other students and occasional interruptions in the classroom were unavoidable. Sarah was easily distracted and was sometimes distressed from events that occurred during the morning before the sessions. Mary would become restless when she heard the music class or school assembly starting without her. These issues seem to account for the variability in the data.

Another limitation of the study is the small number of participants and thus, the results cannot be generalised. Future research should aim to replicate the study with other participants. More studies would enhance the validity of the findings and could demonstrate that other populations can also benefit from learning these skills. Future research could also examine the use of iPods and video modelling for more complex tasks like reciprocal playing and sharing.

Despite the aforementioned limitations, this study contributes to the literature by demonstrating that students with severe developmental disabilities can easily and quickly learn a new leisure skill with commonplace technology and simple teaching techniques. This study also suggests that video modelling alone can be employed to efficiently teach a new leisure skill to students with developmental disabilities. The provision of a video modeling intervention delivered via the iPod is a unique aspect of the study that may offer several advantages over teacher-delivered instruction and other types of video-based instruction. The solicitation of the participants' perspectives is also a unique aspect of the study that suggests a possible way for participants to engage in a greater degree of self-determination.

CHAPTER IV

ACADEMIC SKILLS INTERVENTION

Study 3: Teaching Children with Autism Spectrum Disorders to Check the Spelling of Words[4]

Children with ASD often present with social and learning impairments that can interfere with their ability to cope with the demands of academic work (American Psychiatric Association, 2000; Matson & Wilkins, 2008). Nonetheless, many are mainstreamed into regular classrooms (Attwood, 2007; Goodman & Williams, 2007). With the increasing prevalence of ASD in recent years (Matson & Kozlowski, 2011), the number of children with special educational needs in regular schools is likely to increase. While many students with ASD, particularly those with Asperger syndrome, have average to above average cognitive abilities, they may still struggle with the demands of the regular classroom and therefore require additional assistance or different arrangements to enable them to successfully complete schoolwork (Attwood, 2006; Carrington & Graham, 2001).

The need to provide extra support and accommodation to these students may increase demands on staff, disrupt the classroom routine, and negatively impact on students' academic progress. It would, therefore, be advantageous to teach children with ASD to independently perform the academic tasks required of them. Learning such skills would not only give teaching staff more time to complete other duties, but would also promote the students' independence and free them from the need to seek adult assistance. This, in turn, might allow them to work more cooperatively with peers, thereby increasing opportunities for age-appropriate social interactions, increasing academic achievement and ultimately, improving self-esteem (Attwood, 2007; Davies et al., 2002).

One promising way of enabling children with ASD to independently

[4] An article based on this study was published in *Research in Autism Spectrum Disorders.* Kagohara, D. M., Sigafoos, J., Achmadi, D., O'Reilly, M., & Lancioni, G. (2012). Teaching children with autism spectrum disorders to check the spelling of words. *Research in Autism Spectrum Disorders,* 6, 301-310. (see Appendix G).

perform the required academic tasks is to allow them to use technology. Along these lines, computers, laptops, and other portable devices have been employed in interventions aimed at teaching a range of academic skills to children with ASD (Mirenda et al., 2000). For instance, Fergusson, Myles, and Hagiwara (2005) taught an adolescent with ASD to use a personal digital assistant (PDA) for greater independence. The participant used the PDA to help him with school-based tasks, such as remembering what materials he should take out for class and when it was time to transition to another task. Another study (Myles et al., 2007), taught an adolescent with ASD how to use a PDA to improve his recording of homework. The student was able to independently record more complete information about his assignments with the help of the PDA. These findings suggest that computer-based technologies might be useful educational aides for students with ASD.

In terms of emerging technology, devices such as the iPod and iPad can be used in different educational settings and can now be fitted with a wide range of educationally relevant applications. For instance, iPods have been used as a prompting device for a man with developmental disabilities in a work related task (van Laarhoven et al., 2009) and as speech-generating devices for children with developmental disabilities (Kagohara et al., 2010; van der Meer et al., 2011). A particularly useful feature of the devices is that they can show video, which offers the possibility of using video modelling as part of the instructional strategy. Video modelling has been shown to be an effective strategy for teaching children with ASD (Bellini & Akullian, 2007; Delano, 2007b; Kagohara, 2010). While video modelling has been used to teach a range of skills, relatively less research has focused on its use for teaching academic skills (Bellini & Akullian, 2007; Kagohara, 2010). In one relevant study, Kinney, Vedora, and Stromer (2003) used video modelling to teach a girl with ASD to spell words. Delano (2007a) also used video modelling to improve the written language performance of adolescents with ASD. These two studies suggest that video modelling is useful for teaching academic skills to students with ASD.

To successfully participate in academic activities, school-aged children need to gain competence in written language. Students have to be able to read and write to complete homework and assignments. Being able to correctly spell words is, therefore, an important skill. The language learning process will likely involve the use of a dictionary and similar resources, but students with ASD may have difficulties using these materials without assistance. If they learn how to independently check the spelling of words and correct their own work, their academic competence may increase while the demands on the teacher or teacher aid might decrease.

To extend previous research in this area, the present study aimed to teach two students with Asperger syndrome to use the spell-check function on a word processor. The teaching intervention involved the use of video modelling presented on an iPad. No other teaching strategies were employed.

Method

Participants

Two students with Asperger syndrome took part in the study. Both attended mainstream classrooms with an average of 25 other students and were supported by a part-time teaching assistant. Dan was a boy with a diagnosis of Asperger syndrome and Attention Deficit Hyperactivity Disorder (ADHD). He was 12 years and 1 month old at the beginning of the study. He was taking medication for the ADHD and could sit for extended periods of time during the sessions, but had some attention issues. Results of an assessment using the second edition of the Vineland Adaptive Behavior Scales (Vineland II; Sparrow, Cicchetti, & Balla, 2005) indicated a low adaptive level. For the Communication Domain, Dan obtained age equivalencies of 4:7, 5:7, and 8:6 (years:months) on the *Receptive*, *Expressive*, and *Written* subdomains, respectively. For the Socialization Domain, he obtained age equivalencies of 2:2, 5:11, and 7:1 (years:months) on the *Interpersonal Relationships*, *Play and Leisure Time*, and *Coping Skills* subdomains, respectively. Dan had a good vocabulary and could have conversations about topics that interested him (namely technology and speakers). One of the educational goals set for Dan by the teaching staff was for him to be able to correct the spelling of words in his homework. He could use a computer and had some experience writing with a word processor, but his teacher indicated that he did not use the spell check function on the word processor to check the spelling of words.

Jane was a girl with a diagnosis of Asperger syndrome and ADHD. She was 10 years and 7 months old at the beginning of the study. She received medication for the ADHD and could work and attend to tasks. Her scores on the Vineland II (Sparrow et al. 2005) indicated a moderately low adaptive level. Her *Receptive*, *Expressive*, and *Written* subdomains age equivalencies were 2:11, 5:6, and 8:0 (years:months), respectively. Age equivalencies for *Interpersonal Relationships*, *Play and Leisure Time*, and *Coping Skills* were 5:11, 6:7, and 7:6 (years:months), respectively. She could engage in simple conversations about daily activities and things she liked. She reportedly enjoyed reading and had a good vocabulary. She was not proficient in using a word processor according to her teacher.

Setting

Baseline, intervention, and follow-up sessions were conducted in the participants' respective schools. Dan's sessions were conducted in his classroom. Dan had a separate space in the classroom's corner where he would normally work with the teaching assistant. Sessions were conducted in this corner while the other students were having regular lessons. Jane's sessions were run either in her classroom during lesson breaks or in a separate room when the other students were having lessons. Jane was the only student present during sessions. During all sessions, the participants sat at a table with the trainer. When reliability data was collected, a second observer was present.

Materials

Stakeholder Questionnaire. The participants, as stakeholders, had an opportunity to provide input into the study's design via a stakeholder questionnaire. They had an opportunity to consent to their involvement in the study and to identify preferred stimuli. The questionnaire involved asking the students if (a) they would like to work with the computer, (b) what things they liked watching or playing (e.g. cartoons, video games), and (c) if they would like to learn by watching a video on the iPad.

Word processing applications. During the sessions, Dan used *Apple's*

Pages on an iMac and Jane used *Microsoft's Word* on a Windows®-based desktop. These programs and the equipment were selected due to their availability in the students' classrooms.

Task Analysis. A task analysis (see Table 4.1) was constructed with the steps necessary to successfully use the spell-check function on the word processor program (i.e., either *Microsoft's Word* or *Apple's Pages*). The word processor task had five different steps (see Table 4.1), but five words were given to the participants in each session, therefore Steps 2-4 were repeated five times for a total of 17 steps per session. The task analysis was validated by three nondisabled adults who followed the steps in order to complete the task.

Table 4.1. Task Analysis: How to Use Spell-check on a Word Processor

Step	Description
1.	Click the word processor icon on the computer to launch the application.
2.*	Type the word as you think it is spelled.
3.*	If there is a red line under the word, right click with the mouse to find suggestions and select appropriate spelling. If the line is green the word is spelled correctly.
4.*	Show the word to the trainer when you think it is spelled correctly.
5.	Close the application by clicking the "close" button on the page.

* Steps 2, 3, and 4 are repeated five times (one for each word in the session set) before the final step (5).

Instructional video. The task analysis was used to create an instructional video to be shown in the intervention (i.e., video modelling) phase of the study. The instructional video was recorded from a subjective viewpoint (as if from the observer's perspective) with an iPhone®, edited on iMovies® and loaded on a 16GB iPad®. The video was 2 min and 4 s in duration and showed the steps of the task analysis being followed in sequence for checking the spelling of three words. A pair of hands operated a computer and a keyboard to open the word processor, type words, and check for correct spelling using the spell-check function.

Target words. The words used in the sessions were selected from the *Ayres list of most common words used in English* (Ayres, 1915). The list is widely used to teach spelling to school aged children and the words in it were likely to be regularly present in the students' classroom and schoolwork. The words were selected randomly from the list and given to the participants in the order they appear on Table 4.2. The words were not necessarily novel because the aim of the study was not to teach new words. Rather, the study was intended to teach the participants how to check the spelling of words without assistance.

Table 4.2. Target Words for Dan and Jane

Dan **Session. Words**	**Jane** **Session. Words**
1. please, night, good, think, house	
2. other, year, before, next, today	
3. before, morning, three, people, church	
4. work, number, doctor, book, life	
5. time, make, after, today, many	
6. truly, take, great, home, mother	
7. week ,want, girl, fire, paper	
8. nothing, return, Friday, cold, picture	
9. very, hope, first, Sunday, children	
10. eight, nine, long, day, afternoon	
11. about, never, money, under, because	
12. like, street, look, friend, hand	12. house, eight, nine, after, under
13. tomorrow, away, office, most, give	13. other, year, before, next, today
14. sometimes, yesterday, child, ground, best	14. work, number, doctor, book, life
15. late, little, Tuesday, head, business	15. time, make, after, today, many
16. Thursday, party, believe, back, talk	16. nothing, return, Friday, cold, picture
	17. eight, nine, long, day, afternoon
	18. sometimes, yesterday, child, ground, best
	19. week, want, girl, fire, paper
	20. about, never, money, under, because
	21. tomorrow, away, office, most, give
	22. before, morning, three, people, church
	23. please, night, good, think, house
	24. truly, take, greet, home, mother

Experimental Design. A delayed multiple-baseline across participants design was employed in this study with baseline, video modelling, and follow-up phases (Kennedy, 2005). The dependent variable was the number of steps in the task analysis that were performed correctly during each session. For each session, the trainer recorded which steps in the task analysis had been performed correctly within the allocated period of time (see Procedures).

The study had a delayed baseline because Jane was unavailable when the baseline procedures began with Dan. Due to scheduling constraints, Dan had one session a week while Jane had two sessions per week. For both Dan and Jane, only one session was conducted on any given day.

Procedures

Baseline. At the start of each baseline session, Dan and Jane were first asked to start the word processor software. If they did not open the word application within 30 s, the trainer performed the step out of the participants' sight. The trainer then read a word out loud to the participant and asked him or her to type the word, check the spelling of the word, and show the trainer the correct spelling on the computer. For instance, on Jane's first session, the trainer asked her to type the word *house* and then check if it was spelled correctly. A correct response was recorded if the step was independently completed within 5 s, so as to ensure development of proficient and fluent use of the spell-check function. If Dan or Jane did not perform the step correctly within 5 s, he/she was praised for his/her effort and given an instruction to attempt to write and spell-check the next word on the list (e.g., "Can you type the word *eight* and check if the spelling is correct?"). If 30 s elapsed without an attempt to type or check the spelling of a word, the session was terminated. This process was repeated until all five words in the set for that session (see Table 4.2) had been presented. Once all five words had been presented, the trainer asked the participants to close the application. At the end of the session, the participant was given the opportunity to play with the iPad (e.g., play games, watch video clips) for five minutes, independent on their performance on the session.

Intervention. During the intervention phase, the video modelling instruction was presented on an iPad at the beginning of the session. This involved the trainer starting the video clip on the iPad and asking the participant to watch the video. If the participant did not attend to the video, the trainer repeated the request to watch the video and it was shown a second time. After viewing the video, participants were then asked to perform the task as in baseline. As in baseline, a correct response was recorded if the step was correctly performed within 5 s. If the participants completed the step, they were praised for the effort and given the next word in the list. If the participants made incorrect attempts, the trainer praised the participants for their effort and then asked them to think of the video they watched and try to do the same. No other instructions were given. If no attempts were made in 30 s, the session was terminated.

Follow-up. Follow-up sessions for Dan were conducted 4, 5, and 10 weeks after the final instruction session and after 3 and 5 weeks for Jane. The follow-up procedures were the same as in baseline. The participants had no video instruction in the period between the last session of intervention and first follow-up session.

Inter-observer Agreement

A second observer independently gathered data on participants' performance during 34% of all sessions to ascertain the reliability of recorded data. Inter-observer agreement (IOA) was determined by comparing the data collected during each session by the trainer and independent observer on a step-by-step basis. IOA ranged from 41 to 100% and an overall mean of 93%.

Treatment Integrity

Treatment Integrity was measured on 34% of sessions. The second observer used a checklist to record if procedures were followed as specified. The results were that the procedures were implemented correctly on 98% of these checks.

Results

Figure 4.1 shows the percentage of correctly performed steps by Dan and Jane. During baseline, Dan's performance was consistently below 30% correct, on one occasion (Session 5) he correctly checked the spelling of one word. When video modelling was introduced, Dan's performance increased and remained above 75%. At the 4, 5, and 10-week follow-up sessions, Dan performed the task with 100% accuracy.

During baseline, Jane's performance was consistently below 40% correct. Although she did consistently perform several steps in the task analysis (i.e., starting the word processor program, typing the words as she thought they were spelled), she never successfully checked the spelling of a word during baseline. When the intervention started, Jane correctly performed 100% of the steps across her five intervention sessions. During her follow-up sessions at 3 and 5 weeks, Jane performed 100% of steps correctly.

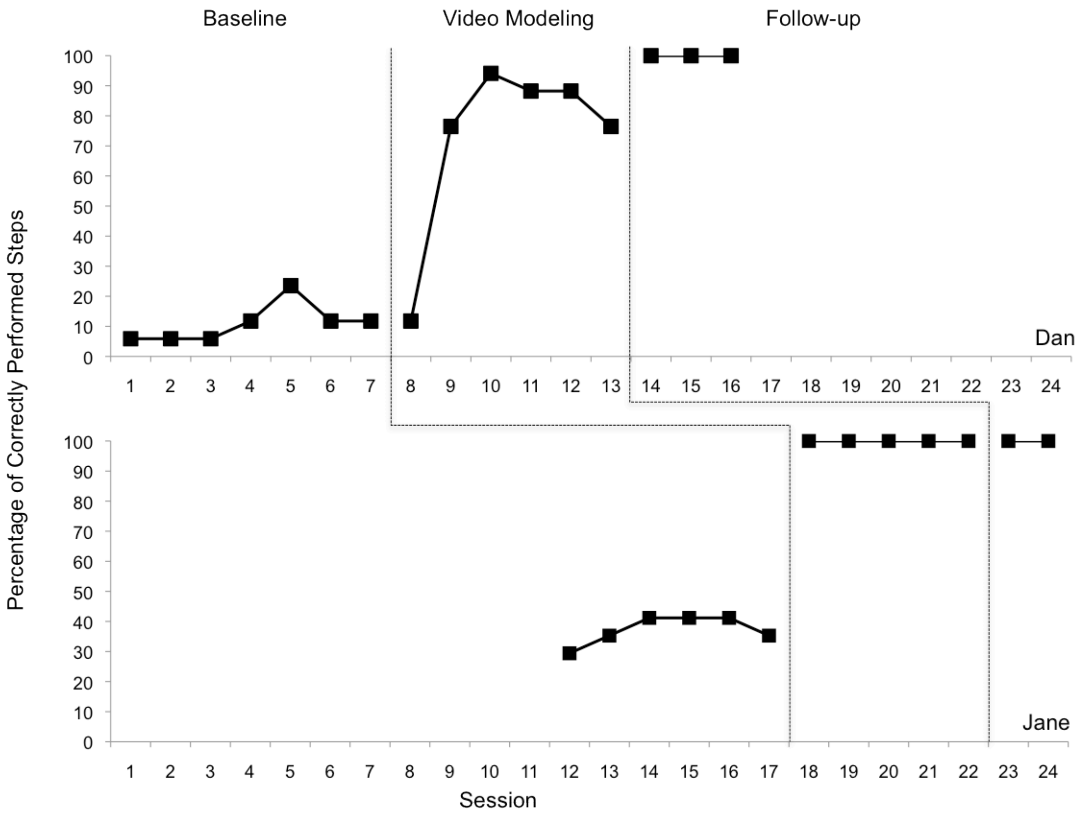

Figure 4.1. Percentage of Correctly Performed Steps in the Spell-check Task Analysis

Discussion

Both students successfully learned how to find the spelling of words using the spell-check function on a word processor. The percentage of correct steps performed by the participants increased when the intervention was introduced and remained at 100% correct at follow-up. This is an important outcome as it suggests the students could now be more independent in this aspect of an important academic task. However, the findings should be viewed with caution because only two participants were involved in the study.

Other limitations include lack of generalization assessment to other words and a relatively short follow-up period.

In addition to demonstrating successful learning of an important academic skill, this study also supports the use of video modelling as an instructional strategy (Bellini & Akullian, 2007; Kagohara, 2010). The use of video modelling in this study allowed the intervention to be easily conducted in different schools and still retain procedural integrity, as the pre-recorded video instruction was always the same. Video modelling can also be seen as relatively inexpensive and perhaps easier to implement than other teaching strategies involving procedures such as response prompting and prompt fading. While video modelling appeared to be an effective intervention, the participants also received praise for the effort, which may have functioned as a reinforcement. In addition, when participants made incorrect attempts during intervention, the trainer asked them to think of the video they watched and try to do the same. Thus it is possible that this use of praise and additional verbal instruction may have been effective and perhaps even necessary components to the intervention. Still, the large and rapid improvement for both Dan and Jane once intervention began suggests that the video modelling procedure was largely responsible for the positive intervention effect.

The video modelling procedure seemed to be well accepted by the participants and the teachers. Dan’s teacher indicated that he was always enthusiastic when informed it was a session day. Indeed, on such days, he was quick to take his place in his working area and sat quietly waiting for the session to begin. Jane also appeared to be happy to participate in the study. She would run to the computer and become talkative, something she seemed to do when she was pleased, whenever it was time for the sessions.

The positive effects of the intervention may have been due to the novelty effect of delivering the video-based instruction on an iPad as the participants seemed interested in this device. Dan and Jane seemed to look forward to watching the video instruction on the iPad prior to the sessions and having access to the iPad after each session. The inclusion of the stakeholder questionnaire may also have had some positive impact on the results of this study. That is, motivation to cooperate and learn may have been increased by soliciting the participants’ assent to participate and giving them choices regarding which games and videos they would like to play or watch on the iPad after each session. This increased level of self-determination may have also have increased the participants' motivation to participate in the study.

Future research could replicate the study with other students and examine the intervention effectiveness with children of other ages. Future research is also needed to extend the use of iPads and video modelling to other academic tasks such as note taking and calculating math problems.

The results of the present study support the use of video modelling and new portable technology (e.g., iPad) to teach an academic skill to two students with Asperger syndrome. These findings are important because while some students with ASD may have adequate cognitive skills, they may still require additional support when mainstreamed into regular classrooms. The strategies used in this study could be useful in giving these students more independence in completing academic tasks.

CHAPTER V

SOCIAL SKILLS INTERVENTION

Study 4: Teaching Children with Autism Spectrum Disorders to Greet Adults Using Social Stories™ and Video Modelling

Children with ASD often have pervasive social skills deficits that may impair their interaction with others (American Psychiatric Association, 2000; Church et al., 2000). Some individuals with ASD have appropriate language and cognitive abilities, but may still not possess the skills necessary to navigate social situations and understand the social norms and expectations that govern interactions with others (Attwood, 2007). Typical deficits include a failure to greet others appropriately or to even acknowledge the presence of a familiar person (Hobson & Lee, 1998).

Because of such deficits, parents of children with ASD have reported the need to rehearse opening lines with their children so as to encourage appropriate social initiations and responses (Church et al., 2000). However, even when social interactions are prompted, individuals with ASD often do not engage in ongoing social interactions such as reciprocal conversational turn-taking (American Psychiatric Association, 2000). Failure to initiate and subsequently maintain social interactions could possibly lead to social isolation and peer rejection (Bellini, Akullian, & Hopf, 2007; Matson, Dempsey, & LoVullo, 2009). There is thus a need to develop social skills in children with ASD so as to promote their social inclusion (Bellini, Akullian, & Hopf, 2007; Church et al., 2000).

Along these lines, Social Story™ is a strategy that has been used to teach social skills to individuals with ASD (Arthur-Kelly et al., 2009; Matson et al., 2007; Reynhout & Carter, 2006). A Social Story intervention involves creating brief stories that describe social situations that may be confusing for people with ASD (Gray, 1998; Sansosti, Powell-Smith, & Kincaid, 2004). In addition to describing the social situation, the story also describes what others are thinking or feeling and includes instruction on how to behave in specific situations. As part of describing how to behave, a good social story would also highlight what social cues the person should look for and how to respond to other people (Attwood, 2000; Gray, 1998). Previous studies examining the effectiveness of Social Story interventions have yielded varying results, but overall, interventions that include Social Stories appear to have a positive effect (Reynhout & Carter, 2006; Sansosti et al., 2004). Social Story interventions have targeted a range of skills including initiating verbal greetings (Reichow & Sabornie, 2009), initiating and responding to interactions (Scattone, Tingstrom, & Wilczynski, 2006), and maintaining appropriate social engagement (Delano & Snell, 2006; Sansosti & Powell-Smith, 2006).

Another strategy that has been used to teach social skills to people with ASD is video modelling (Shukla-Mehta, Miller, & Callahan, 2010). Video modelling has been effectively applied to teach a variety of social skills including social initiation (Nikopoulos & Keenan, 2003), social language in play situations (Maione & Mirenda, 2006), social engagement (Bellini, Akullian et al., 2007), and socially expressive behaviours, such as intonation and facial expressions (Charlop, Dennis, Carpenter, & Greenberg, 2010). Video modelling has traditionally been delivered on televisions and computers, but more recently, portable devices like laptops and iPods® have also been employed (Cihak et al., 2010).

While both Social Stories and video modelling have been shown to be individually effective, there is emerging evidence that these two procedures can be successfully combined to teach social skills to individuals with ASD. Sansosti and Powell-Smith (2008), for example, examined the use of a computer-presented Social Story and video modelling package to teach social skills to children with high-functioning autism and Asperger syndrome. Furthermore, Scattone (2008) combined a Social Story intervention with a video modelling procedure to successfully enhance the conversation skills of a boy with Asperger syndrome. The results of these two studies suggests that the combined use of these procedures was successful in teaching participants with ASD, but because they were employed simultaneously, it was not possible to ascertain what effect each strategy had.

The present study therefore aimed to extend research on the combined use of Social Stories and video modelling presented on portable devices.

Unlike previous research, however, the two interventions were applied sequentially to examine if two students with Asperger syndrome could (a) learn to greet school staff in the morning with a Social Story intervention and then (b) extend the greeting to create an opportunity for further conversation using a video modelling intervention.

Method

Participants

The two participants, Jane and Peter, attended the same classroom in an elementary school. The teacher was responsible for general lessons for 25 students while Jane and Peter had additional assistance from a teacher aid. Once a week, a substitute teacher taught their class. The two students were selected for the study because they had age-level cognitive and language skills, but did not greet or acknowledge the teaching staff or other adults at the school. Their teacher believed it would be appropriate and desirable for them to learn to greet familiar adults at school.

Jane was a 10 years and 7 months old girl with a diagnosis of Asperger syndrome and Attention Deficit Hyperactivity Disorder (ADHD). She was taking medication for the ADHD and could attend to tasks when supervised. Results from the Vineland II (Sparrow et al., 2005) indicated a moderately low adaptive level. Specifically, her age equivalencies on the *Receptive*, *Expressive*, and *Written* subdomains were 2:11, 5:6, and 8:0 (years:months), respectively. Her age equivalencies with respect to *Interpersonal Relationships*, *Play and Leisure Time*, and *Coping Skills* were 5:11, 6:7, and 7:6 (years:months). She could engage in simple conversations about daily activities and things she liked. Jane had a few friends and interacted appropriately with most peers, but was reported to not interact with adults.

Peter was a 10 years and 4 months old boy diagnosed with Asperger syndrome and ADHD. He received medication for the ADHD and could attend to tasks for short periods of time. His scores on the Vineland II (Sparrow et al., 2005) indicated a low adaptive level. His *Receptive*, *Expressive*, and *Written* subdomain age equivalencies were 2:11, 4:10, and 7:9 (years:months), respectively. His *Interpersonal Relationships*, *Play and Leisure Time*, and *Coping Skills* age equivalencies were 2:10, 5:3, and 4:7 (years:months), respectively. Peter had a good vocabulary and could engage in conversation, but did not seem inclined to do so. He interacted with peers appropriately, but was reported to avoid adults.

Setting

Baseline, Social Story, video modelling, and follow-up sessions were conducted in the participants' classroom during lesson breaks or in a separate room when the other students were having lessons. The participants sat at a table with the trainer. For sessions where reliability data was collected, an independent observer sat opposite the trainer.

Materials

Stakeholder questionnaire. A brief assessment questionnaire was created to give the participants, as stakeholders, an opportunity to consent to their involvement in the study and to identify their preferred stimuli to be used in the study. They were also asked if they would like to learn by watching videos on an iPad.

Social Story™. A Social Story was created by the school's ASD therapist and reviewed by two other people with experience in using them. The story was transferred to a power point presentation and presented on the classroom's computer. The story described the social expectation of people greeting each other at school (see Table 5.1). Each slide showed one paragraph and a simple illustration. At the end of the presentation, comprehension questions were presented to gauge the participants' attention and comprehension level.

Instructional Video. The video was created as a cartoon showing two characters meeting and greeting each other at school. The video was presented on the iPad. In the cartoon, a female character walked into the school and met a male student. They greeted each other and then explained it was polite to greet people (see Table 5.2). Comprehension questions were included at the end of the cartoon to ascertain if the participants had attended to the video and understood the material.

Table 5.1. Transcript of the Social Story

Social Story
Whenever people meet for the first time or when they meet for the first time in the day they greet each other. There are many ways to greet people. People might say… Good morning!; Hello, how are you?; Hi, what's new? Everyone does this because it is polite. All people like being greeted nicely. Children greet their teacher and other adults at school. We greet adults politely. We can try to say, "hello" or "hi" or "good morning". I will remember to greet my teacher when I arrive at school. Sometimes I might forget to greet people but that is OK because they can greet me first and I can reply to them nicely. 1. What do people do when they first see each other? 2. What can I try to say to adults at school?

Table 5.2. Transcript of the Video Modelling Cartoon

Video modelling
Student 1: This is my school. When I see people at school I try to greet them nicely. *Student 1:* Hi, how are you? *Student 2:* I'm good, thanks. How are you? *Student 1:* I'm fine, thank you. *Student 1:* Time to check what we learned. What can I say to someone when I first see them? *Student 2:* You can say: Hi, how are you? *Student 1:* That's right! People like it when you ask them how they are. It's polite.

Experimental Design. A multiple-baseline across participants design was used in this study (Kennedy, 2005). The study consisted of four phases, baseline, social story, video modelling, and follow-up. Training sessions occurred two to three times a week with one session per day. The dependent variable was the number of independently initiated greetings to teachers and trainer/observer. The nature of the skill meant data collection was conducted through naturalistic observation every morning. The teaching staff collected greeting data most days of the week with the exception of days when the participants were absent or school activities prevented them from having a greeting opportunity. The trainer and observer collected data two to three times a week before training sessions. During the Social Story phase, the expected greeting was a simple greeting such as "hello" or "good morning".

During the video modelling phase, full greetings were expected (e.g. “hello, how are you?”). The presence/absence and level of greeting was recorded. The independent variables were the Social Story intervention and the video modelling procedure.

Procedures

The general data collection procedure involved the teaching staff and trainer/observer waiting 5 s for a greeting initiation from the participants when they first met in the morning. The 5 s period began when the child was within a few meters from the greeting partner and eye contact was made. For teachers, the greeting opportunity was usually as the participants arrived at school. For the trainer/observer, it was when they arrived for the training session during a morning break time.

Baseline. During baseline, when the teachers and trainer met the participants, they waited for 5 s and if the participants offered no greetings, the teacher/trainer initiated the greeting (e.g., “Good morning, [*child’s name*]”) and waited for a reply. After all sessions with the trainer, the participants were given an opportunity to watch videos and play games on the iPad, which was independent of their performance.

Social Story™. During the Social Story phase, the power point presentation was shown on the computer by one of the teacher aides. Because Peter showed resistance to watching the presentation on the computer, the iPad was used instead as it appeared to be more engaging to him. At the end of the presentation, two comprehension questions were asked to assess if the participants had paid attention and how much of the material they understood. During the Social Story phase, the teacher/trainer continued the data gathering procedure as in baseline by giving students 5 s to initiate a greeting. If the participants did not initiate a greeting, the teacher/trainer greeted them (e.g., “Good morning, [*child’s name*].”) and waited for a reply.

Video Modelling. During the video modelling phase, the participants were given the iPad at the start of the session so they could operate it themselves. They turned the iPad on, found the relevant instructional video, and watched it without prompting. Three comprehension questions were asked to assess the students understanding. When the video modelling phase started, the teacher/trainer continued with the standard data gathering procedure, but if the participants did not initiate a greeting, the teacher/trainer used a full greeting (i.e., “Good morning, [*child’s name*]. How are you?”).

Follow-up. During follow-up, the greeting procedure remained the same as in the previous phase, but no training (i.e., neither Social Story nor video modelling) was given to the participants. For Peter, a verbal prompt (e.g., “Can you ask ‘How are you?’”) was introduced by the teachers because he did not consistently greet them. The trainer and observer did not prompt Peter.

Inter-observer Agreement

Inter-observer data (IOA) for the greetings to teachers were collected by other teaching staff (e.g., teacher aids, substitute teacher). The trainer and independent observer collected each other’s IOA data on training session days. Overall, IOA was measured on 46% and 41% of observations for Jane and Peter respectively. Agreement was 100%.

Treatment Integrity

A checklist was used to verify if the Social Story and video modelling training procedures were followed correctly. The independent observer was present on 70% of sessions and confirmed the procedures were followed 100% correctly.

Results

Figure 5.1 shows the frequency and level of greeting initiations made by Jane and Peter. A greeting was recorded as *partial* if the participant initiated a simple greeting (e.g. “Good morning” or “Hi”). A greeting was recorded as *full* if the participants used a more complex greeting (e.g. “Hello. How are you?”). If the participants did not initiate a greeting, it was recorded as *none*.

During baseline, Jane initiated a greeting once. Interestingly, she spontaneously greeted the substitute teacher, but not the other teaching staff or the trainer. When the Social Story intervention was introduced, Jane began to consistently greet adults from the fourth day of training (e.g., “Hello Mrs D.”). When the video modelling phase began, her performance was variable, but she greeted her teacher on the majority of days (e.g., “Good morning Mrs

D."). However, she only started using the full greeting (e.g., "Hello Mrs D., how are you?") after eight video modelling sessions. At the follow-up phase, which started two weeks after the final training session, Jane greeted adults on the majority of days. She greeted the trainer and observer with the full greeting (e.g., "Hello, how are you?"), but on most follow-up sessions, used only the partial greeting with the teaching staff (e.g., "Hello Mrs D.").

Peter did not greet anyone during the baseline phase. When the Social Story intervention was introduced, Peter showed an increase in greeting to his teacher (e.g., "Hello"), but he did not greet the trainer/observer or other teaching staff. When video modelling was introduced, he began to greet the trainer and observer with a full greeting (e.g., "Hello, how are you?"), but did not extend this full greeting to the teacher or other teaching staff. Throughout most of the video modelling phase, he did not greet any of the teaching staff. During follow-up observations, Peter consistently used the full greeting with the trainer and observer. He greeted the teaching staff less often and usually with a partial greeting, despite the teacher giving him a verbal prompt every day (e.g., "Can you ask 'How are you?'"). Only once he initiated a full greeting to his teacher (e.g., "Hello, how are you?") when he overheard another adult greeting his teacher.

Discussion

Results suggest both students learned to greet familiar adults at school, albeit with different degrees of success. Both students started greeting the teaching staff when the Social Story intervention was introduced. Peter was not always consistent in doing so, but the number of greetings he made was higher during the Social Story phase than during baseline. The results also suggest that the video modelling instruction seemed to have some additional beneficial effect by increasing the complexity of greetings initiated by the participants. After 11 video modelling sessions, Jane started using the full greeting with the trainer and observer and subsequently the teachers. Peter started using the full greeting with the trainer and observer after only three video modelling sessions. The increased incidence observed with Social Story and video modelling intervention also seemed to maintain at follow-up without training or prompts.

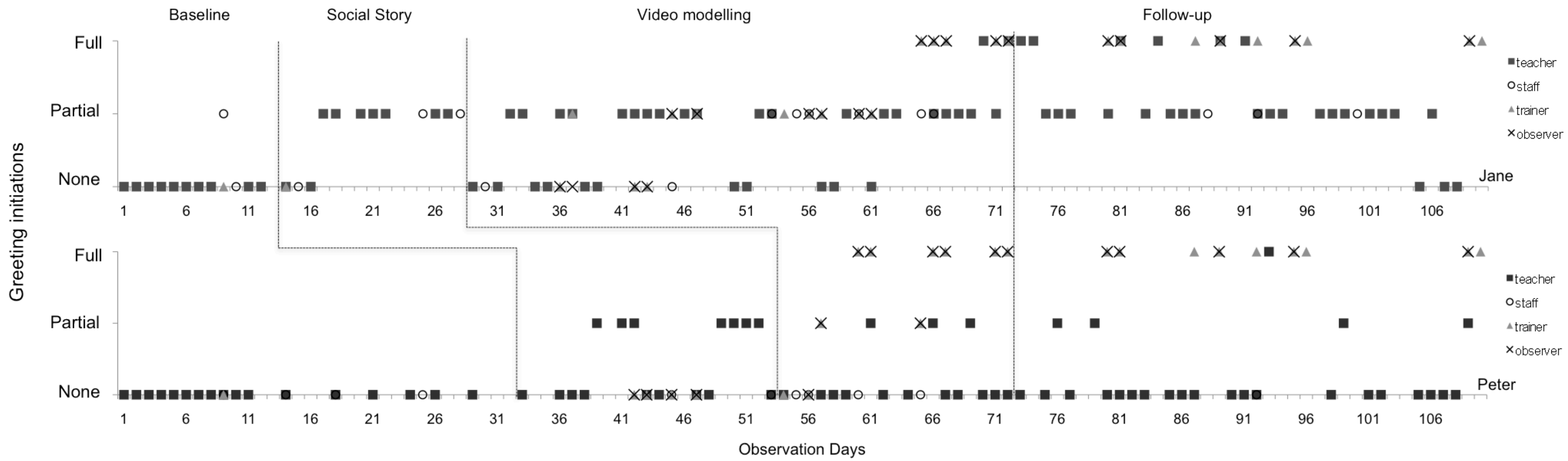

Figure 5.1. Level of Greetings Initiated by the Students

In addition to initiating more greetings with intervention, the participants consistently replied to greetings from others and answered the comprehension questions correctly. This suggests they understood the social norms and expectations of greeting people. However, they did not consistently greet the teaching staff. When asked, Jane and Peter said they forgot to greet the teacher when they first arrived in the morning. In fact, the days when they did not offer any greeting often coincided with Mondays, when the children had been out of the school routine or when they did not take the ADHD medication.

A number of factors could have influenced the results. The inclusion of the iPad in the intervention may have motivated the participants to be part of the study. Both seemed to enjoy using it to watch the instructional videos during the video modelling phase and then playing games or watching entertaining videos after the sessions. The stakeholder questionnaire may have also had an influence as it afforded the participants some degree of self-determination by giving them an opportunity to assent to their participation and a choice of what games and videos they could play or watch after sessions.

The participants' motivation to interact with adults possibly had the largest influence on results. Jane seemed eager to engage with people and started greeting adults fairly quickly but Peter did not seem as interested in interacting with adults and was perhaps not as motivated to approach them. In fact, on one occasion, the teacher reported Peter seeing her and running in the other direction, actively avoiding meeting her. During follow-up, the teacher started prompting Peter to use the full greeting if he did not initiate one, but the number of initiations remained low. He did once use the full greeting without any prompting. It is interesting to note that he consistently greeted the trainer and observer and on the few occasions he forgot to use the full greeting he completed it after hearing the trainer's initial greeting.

The participants' failure to generalize the greetings to the teaching staff presents a limitation in this study. The lack of generalization and overall limited results are perhaps not surprising given the fact that social skills are difficult for people with ASD to master (Matson et al., 2007). In fact, social skills deficit is a fundamental characteristic of ASD (American Psychiatric

Association, 2000; Matson et al., 2007). As Bellini, Peters, Benner, and Hopf (2007) have demonstrated, school-based social skills interventions seem to have, overall, a positive but limited effect. Generalization seems especially difficult.

Another limitation was the limited control over some extraneous variables. For instance, it was not possible to control the participants' morning schedule before they arrived at school or how other students interacted with them as they arrived. In addition, greeting opportunities did not occur every day because participants missed school or did not meet the teacher before classroom activities started. The timing of the training sessions was possibly a limitation as well. Due to time constraints, it was not possible to present the training before the participants had a chance to greet the teacher or the trainer and observer every morning. Nevertheless, it may not have been desirable to provide the training immediately before the greeting opportunity as it could become a prompt that participants relied on to perform the target modelling.

Future research could extend this study with other students and focus on generalizing skills to other people. More research is also needed to examine the efficacy of Social Stories and video modelling as strategies to teach different social skills. Because the intervention was delivered on an iPad, it could be conducted in different settings without additional equipment. Future research could examine the use of iPads to teach skills in the settings they are expected to happen. For instance, individuals with ASD could carry the iPad with them and read or watch instructions on how to perform tasks in different places, such as buying groceries in the supermarket or initiating a conversation with a peer.

Social skills are important for successful community living. Knowing how to interact with people is a valuable skill as it creates opportunities for development in all areas of life. It would be advantageous for children with ASD to learn skills to effectively navigate social situations. This study attempted to teach two students with ASD to greet adults at school and possibly engage in further conversation. The participants did begin to greet adults, but were not consistent in using a greeting that invited further conversation. The study's findings suggest Social Stories and video modelling may be effective strategies to teach social skills to children with ASD, but learning may require a long-term commitment and additional motivational strategies to encourage the children to participate.

CHAPTER VI

GENERAL DISCUSSION

Individuals with developmental disabilities often present with learning and behavioural impairments that may negatively impact on their ability to acquire social, communication, academic, and leisure skills. These skills are important for a healthy development and good quality of life (Caldwell, 2005; McIntyre et al., 2004; Seltzer & Krauss, 2001). Research to develop new and more effective interventions to address these skill deficits in persons with developmental disabilities, such as the research reported in this thesis, would therefore seem critical (American Association on Mental Retardation, 1992). In light of the particular educational needs of individuals with developmental disabilities, the four studies in this thesis provide an empirical evaluation of a new type of intervention approach involving video modelling and new portable technological devices. The new intervention approach was applied to teach leisure, academic, and social skills to students with developmental disabilities. Because the specific portable devices used in this study had been anecdotally reported to be useful in improving learning in students with developmental disabilities, one of the aims of the thesis was to provide timely empirical evidence to examine the integrity of such anecdotal reports.

The first two studies involved presenting video instructions on an iPod Touch to teach three participants with severe intellectual disability how to operate the same iPod to watch videos and listen to music. The third study presented video modelling on an iPad to teach two participants with Asperger syndrome how to use the spell-check function on a computer's word processor. The fourth study employed a Social Story and video modelling presented on an iPad to teach two participants with Asperger syndrome how to greet adults at their school in the morning.

Overall, the results of the four studies presented in this thesis had generally positive outcomes. In the first and second studies, the three participants with severe intellectual disability quickly learned how to use the iPod to watch videos and listen to songs by watching the video instruction in the iPod itself. In the third study, the two participants successfully learned how to use a computer's word processor to check the spelling of words. In the final study, the results were more variable. The two participants demonstrated they learned the social expectations of morning greeting at school and one of the participants quickly began to reliably greet her teachers and other adults. The other participant, however, despite reliably greeting the researchers, did not always greet his teachers.

These latter findings are consistent with the general observations that social skills are often difficult for individuals with developmental disabilities to learn (American Psychiatric Association, 2000; Church et al., 2000; World Health Organisation, 1992). This could be due to the fact that social skills involve interaction with others, something that can be difficult for some individuals with developmental disabilities. It is possible that the specific social skill selected for instruction in Study 4 was comparatively more complex than the task-oriented leisure and academic skills in the previous three studies. This discrepancy in task difficulty may account for the comparatively less successful outcome in the fourth, social skills, study.

Still, the collective findings from these four studies suggest that children with developmental disabilities can effectively learn new skills via video modelling and new portable technology (i.e. iPod/iPad). These findings are in accordance with previous research supporting the effectiveness of video modelling for children with ASD and intellectual disability (Alberto, Cihak, & Gama, 2005; Bellini & Akullian, 2007; Kagohara 2010; Mechling, Gast, & Gustafson, 2009). The findings also add to the recent body of research supporting the use of portable technology to teach individuals with developmental disabilities (Mechling, Gast, & Seid, 2009; Taber-Doughty et al., 2008).

This thesis has a number of characteristics that warrant consideration. First, the strategies employed in this thesis not only seem to be effective but also allowed for efficient intervention delivery that might be easily employed by teachers and carers. For instance, the portable technology employed was readily available and required no modification for use in these studies. In the case of the leisure studies, using the iPod to deliver the video instruction on how to use the iPod could be seen as one way to increase the efficiency of instruction because no additional materials were necessary. In addition, instruction could be carried out in different settings while maintaining high experimental control because the video instruction remained the same across participants. The off-the-shelf devices had the additional advantage of being relatively low in cost when compared to some other specialised assistive technology equipment for children with special needs. The devices could also be viewed as highly versatile in that they can be used for a number of educational and leisure activities.

Another factor that could be seen as having potential to increase the efficiency of the interventions was the choice of models for the video modelling segments. Theoretically, in interventions that require the learner to observe a model, the more similar the model is to the learner, the more effective the learning and teaching (Bandura, 1971, 1977; Buggey, 2005). In the case of video modelling, the models would be either similar peers or the learners themselves. However, videos with these models normally require more time and technical expertise to create. Other model types may be more practical in terms of video production and previous research has shown them to also be effective (Ayres & Langone, 2005; Delano, 2007a; Hine & Wolery, 2006; Kagohara, 2010).

The first three studies in this thesis employed the subjective viewpoint where only the model's hands are shown in the video. This model type circumvents the need for similar models and as such, video production is relatively easy to complete. The video can be used with a number of participants without the need to match the model and the focus on the hands avoids irrelevant features that may distract the learners such as furniture in the room or the model's clothes. This could be useful for individuals who show stimulus overselectivity, a learning characteristic that is common in children with developmental disabilities (Lovaas, 2002; Lovaas, Koegle, & Schreibman, 1979; Schreibman, Koegle, & Craig, 1977).

The final study employed another model type that has received little attention in previous research, as shown by the systematic review of the literature (see Chapter II). Specifically, the social greeting video was created as a cartoon. The children seemed to be attracted to the cartoon and the use of animated characters may mean that there is no need to match the learners' characteristics to that of the model as suggested by Ogletree, Fisher, and

Sprouse, (1995). Cartoons, if shown to have general effectiveness, could render live models unnecessary. This could be an advantage because it may be easier to create a cartoon than find an appropriate human model who can perform the required tasks for the video. Still, creating a cartoon model will require different types of technical expertise than would be required for creating an instructional video with human models.

Researchers have noted that many individuals with developmental disabilities appear to be more visually-oriented, as compared to auditory, learners and appear to learn well by imitation (Seguin, 1976a). As with many people, many such individuals also appear to be highly interested in technology (Peterson-Karlan & Parette, 2005). Anecdotally, all of the participants in these four studies seemed to learn well by watching the video models and also seemed to eagerly want to use the portable devices. Their relatively rapid learning in most cases could thus be attributed to use of an efficient learning modality (visual learning) and the use of highly motivating materials. The use of video modelling delivered on portable devices seems therefore, to be a good fit for this population.

Video modelling has been shown to be effective for children with ASD (Bellini & Akulian, 2007; Kagohara, 2010), but little research has focussed on other developmental disabilities. This thesis adds to the limited literature regarding the use of video modelling for individuals with intellectual disability and shows this strategy can also be useful for participants with severe intellectual disabilities. A potential advantage of video modelling intervention is that the videos can be created to match the participant's abilities. For instance, the videos for the participants with severe intellectual disability were simple visual presentations with no written information. The videos for the participants with Asperger syndrome on the other hand, included written instruction before each step in the task to provide additional relevant information.

A final characteristic of this thesis that deserves mention is the fact that the studies included procedures that were intended to afford the participants with a degree of independence and self-determination, which might have also increased their level of self-esteem. That is, participants learned how to self-deliver the video instruction and had the opportunity to provide input on various aspects of the study design. Self-determination should be considered an essential feature of interventions for individuals with developmental disabilities because of benefits such as increasing the participants' self-esteem and creating more opportunities for them to contribute to society (American Association on Mental Retardation, 1992; Garcia-Villamisar & Dattilo, 2011).

Research questions

This thesis sought to answer the following research question: *Is video modelling combined with portable technology an effective strategy for teaching leisure, academic, and social skills to students with different degrees of developmental disabilities?*

Each study presented in this thesis was designed to answer specific parts of this question. Namely:

1. Can students with severe intellectual disabilities learn to operate an iPod for leisure purposes (watching movies and listening to songs) with video modelling delivered on the iPod itself?
2. Can students with Asperger syndrome learn an academic skill (check the spelling of words on computer) with video modelling delivered on an iPad?
3. Can students with Asperger syndrome learn to greet adults at school with Social Stories and video modelling delivered on an iPad?

The findings from all studies suggest video modelling combined with portable technology may be an effective strategy for teaching a range of skills to some students with different degrees of developmental disabilities. Studies 1 and 2 addressed the first question. Chapter III described how the three participants with severe intellectual disabilities learned how to independently operate the iPod to watch movies and listen to songs by watching video instructions on the iPod itself. Study 3, presented in chapter IV, addressed the second question. The results suggest the two participants with Asperger syndrome learned to use the computer to check the spelling of words by watching the video instruction on an iPad. Study 4 addressed the third research question. Chapter V presents how two students with Asperger syndrome learned to greet adults at school by reading and watching Social Stories and video modelling on an iPad.

Theoretical framework

The overall teaching principles followed in the studies were based on the principles of applied behaviour analysis (Baer, Wolf, & Risley, 1987). In line with this framework, the primary goal of special education practice is to allow individuals with developmental disabilities to function more adequately in typical environments (Lovaas, 2002). Lovaas (2002) proposed that individuals with developmental disabilities/delays might not learn very well in typical environments because there is a mismatch between the environment and the individual’s abilities. Applied behaviour analysis attempts to create a better match between the environment and individual’s abilities by implementing more precise, systematic, and deliberate instruction. The actual instructional techniques (e.g. task analysis, reinforcement, response prompting) make use of the well established instructional strategies that have been empirically validated through applied intervention research (Snell & Brown, 2006). All of the studies included in this thesis provided systematic instruction to the participants and employed evaluation and instructional strategies that could be seen as consistent with the principles of applied behaviour analysis (Baer et al., 1987; Lovaas, 2002) and systematic instruction (Snell & Brown, 2006).

The theoretical framework underlying video modelling is further based on principles of observational learning described by Bandura (1977, 1986) as part of his Social Learning Theory (later expanded and renamed Social Cognitive Theory). Bandura posited that “human behaviour is learned by observation through modelling” and that without this guidance, much effort would be wasted as each individual tries to learn by trial and error (Bandura, 1986, p. 47). There are four fundamental processes involved in observational learning: (a) attentional processes, (b) retention processes, (c) production processes, and (d) motivational processes. Figure 6.1 illustrates the processes and their subcomponents.

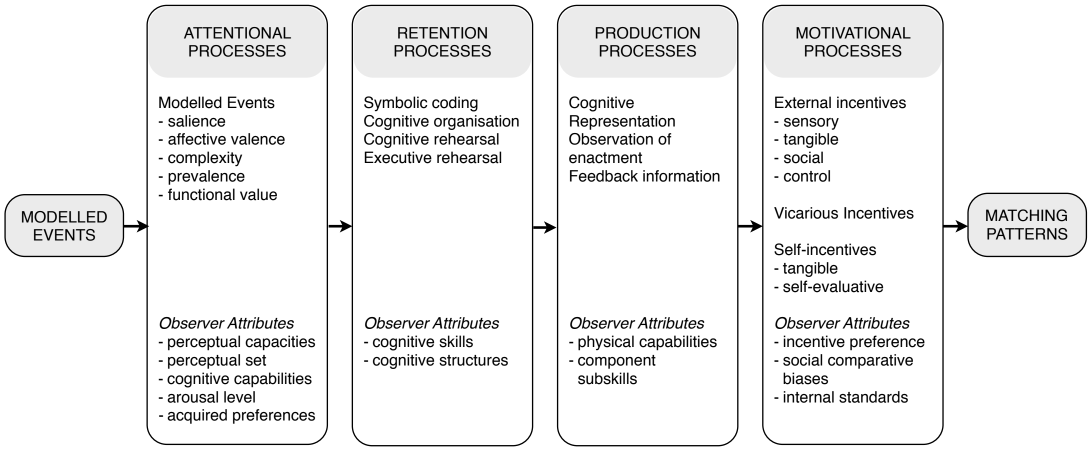

Figure 6.1. Subprocesses Governing Observational Learning. Adapted from "Social foundations of thought and action: A social cognitive theory" by Bandura, A., 1977, p.52. Englewood Cliffs, NJ: Prentice-Hall Inc.

According to Bandura (1986), when a learner observes an event, he or she first engages in attentional processes. These processes determine what the learner attends to and which information he or she extracts from the event. Therefore, discriminative or selective attention is crucial for observational learning. The learner needs to pay attention to the relevant elements of the model's behaviour and accurately code the information. A number of attentional factors influence the level and rate of observational learning including modelled activities' properties such as salience, functional value, and complexity and observer's characteristics such as cognitive abilities and perceptual capabilities, and observer preferences. Learning may be delayed due to attentional deficits resulting from factors such as impaired cognitive abilities, low motivation, or extraneous distractions. However, attention levels can be enhanced. In the studies presented in this thesis for instance, the videos were created to match the participants' cognitive abilities and were shown on a device the participants had demonstrated an interest in. These factors may have acted to retain the participants' attention to a greater extent than traditional modelling strategies.

The second stage in observational learning involves retention processes. The learner needs to retain a symbolic representation of the modelled event in order to be able to later reproduce the modelled behaviours in the absence of the external modelling cues. Events can be verbally or visually represented and will more likely be remembered if the learner uses meaningful symbols (verbal or visual) and rehearses the modelled event after watching it. In the studies presented in this thesis, the retentional processes the participants employed were not examined, but one might speculate that participants with severe intellectual disability and limited verbal ability are perhaps more likely to have employed only visual representations while the participants with Asperger syndrome, who had higher cognitive skills, might be expected to employ verbal and visual representations.

In terms of rehearsal, the studies provided the participants with a chance to replicate the behaviour after watching the video modelling instruction, perhaps increasing the likelihood of the behaviour being retained in memory. In fact, the follow-up data suggests the participants effectively coded the information and could perform the behaviours after a long period without instruction.

The third stage in observational learning involves production processes. Once the learner attends to the event and retains the relevant information, he or she can recall the symbolic representation of the event and then overtly perform the behaviour. Practice can improve observational learning by allowing learners to identify aspects of the modelled event that he or she cannot perform correctly. Learners can then be given opportunities to observe the modelled event again and concentrate on parts that were not accurately learned and performed. The studies in this thesis provided participants with multiple opportunities to view the modelled event. The data seem to illustrate how the participants gradually learned the parts of the behaviour that were initially incorrect or absent.

An important aspect of Bandura's (1986) view of observational learning is that it recognises learners may not perform all they have learned. The degree of learning can be measured in different ways including verbal production tests, recognition tests, and comprehension tests. The behavioural pattern of Peter, one of the participants in the final study, illustrates how individuals can acquire the knowledge but not necessarily perform the behaviour. A comprehension test was incorporated into the study design to ascertain the level of observational learning that occurred during sessions. Peter correctly answered all the comprehension questions and demonstrated he understood he was expected to greet adults at school but he did not consistently translate the learned behaviour into overt action.

Another reason for the absence of correct overt behaviours may be due to the learners' motor deficits. It is possible that the modelled event is too complex for the learner's motor abilities. The learner may have an accurate representation of the behaviour but may be too young to perform it or may have motor skill deficits that could prevent overt performance. Mary, one of the participants in the leisure studies presented in this thesis, had limited motor skills as a consequence of cerebral palsy, which hindered her performance to a certain degree. It was apparent from the beginning she knew how the task should be performed but some of the steps were difficult for her to perform because they required fine motor skills. Mary quickly adapted and performed the task competently but her case illustrates how the participant's motor abilities may affect overt performance of behaviours that have nonetheless being learned.

The final component of observational learning involves motivational processes. In social cognitive theory, acquisition and performance are distinct concepts; as explained before, individuals do not perform all they have learned. According to Bandura (1986), incentives (reinforcers) influence the degree in which a learned behaviour is translated into action. Learners are more likely to perform a behaviour if it has valued outcomes such as enjoyable sensory stimulation, material benefits, and positive social reactions. In terms of the studies presented in this thesis, the rapid learning rate demonstrated by the participants in the leisure skills study may be due to the access to their preferred videos and songs. The participants may have been more motivated to learn the task because they could watch or listen to what they liked if they could successfully operate the iPod. Motivational processes may also explain the discrepancy between Peter's demonstrated knowledge and his performance in the social skills study. It is possible he did not view the positive social responses from his teachers as a reinforcer. The fact that he appeared to actively avoid his teachers suggests a lack of motivation to interact with them. Jane, on the other hand, seemed highly motivated by the positive responses from the teaching staff and according to the teachers, greeted them enthusiastically after intervention was introduced.

Modelling information can be transmitted directly (in person), verbally, or through images. Verbal modelling is extensively used once language is fully developed but for individuals with linguistic deficits, images may be more effective. Bandura (1986) described visual media such as television and films as highly influential sources of social learning because children and adults seem to find them more compelling than written or oral modes of information transmission. He also predicted an increased influence of new technologies such as computers and advocated their utility in observational learning (1986, 2004). The studies in this thesis followed on Bandura's belief in new technology and employed new portable multimedia devices as aids for observational learning.

Implications for Research and Practice

The findings presented in this thesis have a number of implications for research and practice. In terms of research, this thesis provides timely empirical evidence on the applicability and effectiveness of portable devices in interventions for children with developmental disabilities. When work for this thesis was first conceptualised in 2009, virtually no research had been conducted examining the use of new portable multimedia devices in interventions for children with developmental disabilities, but a number of anecdotal reports were available. In 2011, portable devices appear to be increasingly used for educational purposes. This is also a growing area of research that is starting to now provide empirical evidence to support the anecdotal reports. The four studies in this thesis could thus be seen as among the first to provide empirical evidence for the use of portable devices to support learning of leisure, academic, and social skills among students with developmental disabilities.

Still, one of the main contributions of this thesis to the field is the provision of rigorous empirical demonstrations of how new portable technology and video modelling can be successfully used to teach a range of skills to students with developmental disabilities. This is an important finding because the strategies employed in the studies are potentially more effective and easier to implement than previously researched instructional strategies involving direct prompting from a teacher (Duker, Didden, Sigafoos, 2004). Another contribution is the finding that the same teaching strategies were successfully used with students with different diagnoses, ability levels, and ages. This suggests the procedures have some participant generality. The implication here is that teachers may be able to successfully teach a wide range of participants using the same general instructional approach, which would seem to make the teachers' task easier.

As technology advances, new devices are likely to be integrated into teaching practices. As a consequence, teachers and parents may benefit from becoming proficient with the technology so as to better utilise it to help their students and children. In such cases, instruction on how to use the technology and how to teach its use may be needed. However, with the increased presence of technology in daily life it is likely that soon most people will be able to effectively use new technology without formal instruction. In fact, some of the young people who participated in the studies easily adapted to the new technology and quickly learned how to use devices with no training.

Limitations

The studies in this thesis have some limitations that should be considered. First, generalisation of results is difficult because the studies employed included only a small number of participants. Another limitation was the fact that, because of the availability of participants, the target skills previously selected did not always fit the participants' characteristics. Instead, the studies had to fit the participants' abilities. For instance, although the participants with Asperger syndrome had no previous experience with portable devices, they were able to operate the iPod/iPad competently before any instruction was given and therefore, were not included in the first studies targeting the operation of the iPod/iPad. In another example, the academic skills study was designed to teach the two participants how to check the spelling of words with three different strategies (paper dictionary, iPod's electronic dictionary, and word processor), but during baseline it became apparent that Jane, one of the participants, was able to use the dictionary and the iPod to check the spelling of words. The other participant, Dan, received intervention for all three strategies, but because the design was no longer a multiple baseline across the two participants, it was not possible to confidently determine if Dan's results were due to the intervention. Only the data with a stronger certainty of evidence (the computer's word processor task) was therefore presented.

Another factor that may be seen as a limitation is the fact that the instruction was not individualised for each participant. It is possible, however, that this was in fact a strength of the design as the standardised instruction required less preliminary preparation and could be more practical for teachers and researchers. In fact, Gray (1998), when describing Social Stories, advocated for individualised instruction but later created DVDs with standardised video versions of her Social Stories that parents could use with their children. The findings in this thesis support the view that the systematic instructional strategies implemented do not necessarily have to be completely individualised to be effective.

Future research

In light of the positive results and the advantages of the instructional strategies used, a number of directions for future research are suggested. The studies in this thesis demonstrated video modelling and portable technology can be used to teach a range of skills. Future intervention studies could identify the range of adaptive behaviours and academic skills that can be successfully taught. For instance, future studies could target community-based and self-help skills such as safely crossing the street, getting dressed, and making snacks. These studies could take advantage of the portability of the devices and deliver instruction in the setting where the activities are to take place. The skills targeted could also be more complex. The studies presented in this thesis focused on teaching relatively simple skills to the participants but it may be possible to teach participants to perform increasingly more difficult tasks such as preparing meals or collaborating with other students on school assignments.

In relation to the portable technology, future studies could examine the different ways the devices can be used to aid individuals with developmental disabilities. Also, future research could examine the utility of different devices. The studies in this thesis employed iPods and iPads but other portable devices are available and their different designs and configuration may impact interventions differently. Further investigation is also warranted with regards to the efficiency of other instructional strategies used in conjunction with portable technology devices. This thesis successfully utilised video modelling as the main instructional strategy but other strategies may also be effective when combined with portable technology.

The studies in this thesis allowed participants a higher degree of self-determination by incorporating their input into the design. This level of self-determination could be further increased by giving participants even greater control over their learning. For instance, a video library could be available with different skill instructions so individuals with developmental disabilities can choose what they want to learn and when. The first study demonstrated the participants had the ability to operate an iPod to select and watch videos. It may be possible that, with time and instruction, children with developmental disabilities could learn to select videos showing other specific tasks and could, therefore, learn new skills independently. This type of self-directed learning would give the children a higher degree of self-determination and possibly increase motivation for learning skills they are interested in.

Video modelling has been extensively used with individuals with ASD (Bellini & Akullian, 2007) but less often with other disabilities (e.g., Alberto, Cihak, & Gama, 2005). Therefore, future research could extend the literature examining video modelling interventions for individuals with other diagnoses. Video modelling instruction can be created to suit the ability level of the participants and the purely visual presentation makes learning easier for participants who have difficulties with written instruction. Given the positive results in the two studies involving children with severe developmental disabilities, it is possible individuals with other disabilities such as Down syndrome, and learning disabilities such as dyslexia could effectively learn with video modelling.

Future research could focus on developing teachers' and parents' expertise to create the videos and carry out the teaching themselves. Parents and teachers spend the most time with the children and are more likely to understand their children's needs but they may not have the necessary skills to successfully employ video modelling procedures and new technology to teach the children.

Conclusion

This thesis aimed at developing and evaluating procedures that incorporate new technology for teaching leisure, academic, and social skills to children with developmental disabilities. The studies conducted for this thesis employed video modelling and new portable technology to successfully teach new skills to the participants. These procedures have the advantage of simple and flexible instruction delivery and future research should examine their applicability for other functional skills and individuals with other disabilities. It would be beneficial for parents and carers to learn how to implement these procedures in order to teach their own children. One important aspect of this thesis is the increased level of self-determination it afforded the participants and the possible positive effects it had on the results. Future research should take into consideration the participants' preferences because an increased chance for self-determination may increase the likelihood of positive intervention outcomes and overall quality of life.

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APPENDICES

APPENDIX A

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

5th August 2009

Jeff Sigafoos and Vanessa Green
Professor and Associate Professor
Victoria University of Wellington Faculty of Education
C/- School of Educational Psychology and Pedagogy
Donald Street
Wellington

Dear Jeff and Vanessa

RE: Ethics application SEPP/2009/43: RM 16778

I am pleased to advise you that your ethics application **'Enhancing the communication, leisure and social skills of children with developmental disabilities'** with the requested amendments, has been approved by the Victoria University of Wellington Faculty of Education Ethics Committee. Please note that the approval for your research to commence is from the date of this letter.

Good luck with your research.

Yours Sincerely

Dr Hazel Phillips

Co-Convener
Victoria University of Wellington Faculty of Education Ethics Committee

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TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

VICTORIA
UNIVERSITY OF WELLINGTON

7th October 2009

Professor Sigafoos / Assoc. Prof Green
Victoria University of Wellington Faculty of Education
C/- School of Educational Psychology and Pedagogy
Donald Street
Wellington

Dear Jeff and Vanessa

RE: Ethics application ADDENDUM SEPP/2009/64: RM 16986

Original application: SEPP/2009/43 RM 16778

I am pleased to advise you that your ethics application ADDENDUM for **'Enhancing the communication, leisure and social skills of children with developmental disabilities'** with the requested amendments, has been approved by the Victoria University of Wellington Faculty of Education Ethics Committee. Please note that the approval for your research to commence is from the date of this letter.

Good luck with your research.

Yours Sincerely

Dr Sue Cornforth

Co-Convener
Victoria University of Wellington Faculty of Education Ethics Committee

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TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

24th November 2009

Jeff Sigafoos and Vanessa Green
Professor and Associate Professor
Victoria University of Wellington Faculty of Education
C/- School of Educational Psychology and Pedagogy
Donald Street
Wellington

Dear Jeff and Vanessa

RE: Ethics application: ADDENDUM SEPP/2009/82: RM 17103

Original application: SEPP/2009/43 RM 16778

I am pleased to advise you that your ethics application **'ADDENDUM: Enhancing the communication, leisure and social skills of children with developmental disabilities'** with the requested amendments, has been approved by the Victoria University of Wellington Faculty of Education Ethics Committee. Please note that the approval for your research to commence is from the date of this letter.

Good luck with your research.

Yours Sincerely

Dr Sue Cornforth

Co-Convener
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APPENDIX B

Developmental Neurorehabilitation, April 2010; 13(2): 129–140

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SUBJECT REVIEW

Is video-based instruction effective in the rehabilitation of children with autism spectrum disorders?

DEBORA M. KAGOHARA

School of Educational Psychology and Pedagogy, Victoria University of Wellington, Karori, Wellington, New Zealand

(Received 10 August 2009; accepted 10 September 2009)

Abstract
Objective: To review intervention studies on the use of video-based instruction for teaching adaptive behaviours to children with autism spectrum disorders (ASD).
Review process: Electronic and hand searches were conducted to identify intervention studies that focus on using video-based instruction to teach adaptive behaviours to children with ASD. Studies that met the inclusion criteria were summarized in terms of: (a) participants, (b) setting, (c) model type, (d) target skills, (e) intervention type, (f) design and (g) outcomes.
Outcomes: Forty-four studies encompassing 49 experiments met the inclusion criteria. The studies targeted a range of adaptive behaviours and academic skills. Most studies reported positive results, but the certainty of evidence was not strong for all of the studies due to reliance on pre-experimental designs.
Conclusion: The results from this review support the use of video-based instruction in the rehabilitation of children with ASD.

Keywords: *autism spectrum disorders, video-based instruction, adaptive behaviour functioning*

Resumen
Objetivo: Realizar una revisión de estudios de intervención en el uso de video instrucción en la enseñanza de conductas adaptativas a niños con trastornos del espectro autista (ASD).
Proceso de revisión: Se realizaron búsquedas electrónicas y manuales con el objetivo de identificar estudios de intervención con enfoque en el uso de video-instrucción en la enseñanza de conductas adaptativas a niños con ASD. Los estudios que cumplieron con los criterios de inclusión se resumieron según los siguientes términos: (a) participantes, (b) entorno, (c) tipo de modelo de investigación, (d) habilidades diana, (e) tipo de intervención, (f) diseño, y (g) resultados.
Resultados: Cuartenta y cuatro estudios que incluyen 49 experimentos cumplieron con los criterios de inclusión. Estos estudios se enfocaron en múltiples conductas adaptativas y habilidades académicas. La mayoría de los estudios reportaron resultados positivos, pero la certeza de la evidencia no era lo suficientemente fuerte en la mayoría de los estudios debido a la dependencia en diseños pre-experimentales.
Conclusión: Los resultados de esta revisión apoyan el uso de video-instrucción en la rehabilitación de niños con ASD.

Palabras clave: *Trastornos del espectro autista, instrucción, video, conducta adaptativa*

Introduction

A significant amount of research [1–44] has explored the use of video-based instruction in the rehabilitation of children with autism spectrum disorders (ASD). In fact, the present systematic search identified 44 such studies reporting on a total of 49 separate experiments. The aim of this paper is to review these 44 studies and 49 experiments. A review of this type may offer guidance in the clinical use of video-based instruction in the rehabilitation of children with ASD.

ASD are a class of neurodevelopmental disorders characterized by significant impairments in social and communication development and the presence of aberrant behaviours, such as a markedly restricted and repetitive repertoire of activities and interests [45]. Given the types and severity of impairments in adaptive behaviour functioning associated with

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ASD, these children have particular rehabilitation needs. Not only do children with ASD often need to be explicitly taught many social, communication and self-care skills that typically-developing children learn incidentally [46], but they also often have difficulties learning new skills because they tend to focus on a restricted set of input when presented with multiple stimuli [47]. The term stimulus over-selectivity refers to this tendency to attend only to part of the stimuli. Individuals with ASD are often unable to distinguish what is relevant and what is not and may attend to an irrelevant cue [48].

Various technological advances may assist children with ASD in learning academic, social, communication and other adaptive behaviours. Several technological advances have been introduced in an effort to promote improved rehabilitation outcomes for children with ASD. One such innovation is the use of video-based instruction. Researchers have reported that video-based instruction can be effective in enhancing development in a variety of adaptive behaviour domains, including social, communication and academic skills of individuals with developmental disabilities [21, 49–53].

Compared to more direct therapist delivered instruction, numerous advantages have been put forward in favour of video-based instruction. Specifically, video-based instruction is claimed to be highly motivating [11, 38, 54, 55]. In addition, video-based instruction is seen as one way of exploiting a child's existing tendency to imitate models. Shane and Albert [56], for example, showed that a significant percentage of children with ASD could imitate what they saw in movies and on television. Similarly, evidence suggests that video-based instruction can produce rapid learning and generalization when teaching children with ASD [10]. A further potential advantage of video-based instruction could be cost savings, given that once the instructional videotapes are produced they can be used repeatedly with less need for specialist interventionist input [10, 11, 57]. Video-based instruction may be one way to capitalize on visual learning processes, which are a reported strength of children with ASD in particular [58, 59], while at the same time minimizing social contact, which may be aversive to children with ASD [57, 60].

Given reports of positive outcomes and the potential advantages of video-based instruction, a review of studies involving video-based instruction for teaching adaptive behaviours to children with ASD is timely. Previous reviews have been published on this topic [15, 50, 61–64], but there is a need for a more up-to-date review as many new studies have been published on this topic in the past several years. In addition, previous reviews tended to focus on a limited range of domains (e.g. social, play or communication skills) rather than attempting a more comprehensive review across a wider range of adaptive behaviour and academic skill domains. Given the need for an update and the limitations of previous reviews, the present review was undertaken to update and provide a more comprehensive review on the use of video-based instruction in the rehabilitation of children with ASD.

Method

The present subject review involved a systematic search to identify studies that examined the use of video-based instruction for enhancing academic skills and improving the adaptive behaviour functioning of children with ASD. Studies that matched the inclusion criteria were summarized in terms of: (a) participants, (b) setting, (c) type of video model, (d) target skills, (e) type of intervention, (f) experimental design and (g) outcomes and certainty of evidence.

Search strategy

A systematic search was conducted on four electronic databases: Eric (Education Resources Information Center), SpringerLink, PsychINFO and ProQuest. The searches used a combination of free-text keywords: *video*, *video modelling*, *video prompting*, *Asperger syndrome*, *autism*, *ASD* and *autism spectrum disorder* (wildcard symbols were used to broaden the search to include variations of the search terms, e.g. *video** = *video*, *videos*, *videotape*). No date range was employed for the electronic search, but the search was restricted to English-language peer-reviewed journals. Articles in other languages [65] were not reviewed due to language proficiency limitations of the author and the reliability coders. Dissertations and other grey literature were not included to ensure that all included studies had received independent peer review.

In order to locate possibly relevant studies missed by the electronic search, three additional search strategies were used. First, an ancestral search of the relevant articles' reference lists was carried out. Secondly, an author search was conducted on the electronic databases to identify other articles written by authors of studies that had been identified in the electronic search. Finally, a manual search of the journals that published these articles was done to identify additional studies that might fit the search criteria. The date range for the manual search was from 1989 (the year of the earliest relevant article found) to early 2009. In addition to these searches, an automatic warning system was set up in the

ProQuest database to ensure new articles that fit the search criteria, but which were not published at the time of the main search, could still be examined. One article was identified through this method.

Inclusion and exclusion criteria

Studies retrieved from the searches were examined to determine if they met the criteria for inclusion in the review. The criteria for inclusion and exclusion were as follows: First, only studies that examined video modelling and video prompting interventions were included. Videos that did not include content involving a behaviour or skill that the person was to model were excluded [66]. Secondly, the video-based instruction had to focus on developing the child's adaptive behaviour or academic skills (i.e. video-based instruction was the independent variable and some relevant adaptive behaviour or academic skill was the dependent variable). Relevant adaptive behaviours included social, communication, daily functional, behaviour management objectives and academic skills, such as completing math problems of checking homework. Studies that did not include the use of video-based instruction to develop adaptive behaviours or academic skills were excluded [67]. Thirdly, at least one participant in the study had to be identified as having an ASD. Other types of developmental disorders (e.g. Down syndrome) or unspecified developmental disorders that did not fall under the ASD category were excluded. Finally, the participants were children 18 years of age or under.

Data extraction

All studies that met the inclusion criteria were coded in terms of: (a) participants (e.g. age, gender and number), (b) setting (e.g. school, home or community setting), (c) type of model on the video (e.g. video self-modelling or use of a same age peer or adult as the model), (d) target skill being taught (e.g. initiation, complement giving, eye contact), (e) experimental design (e.g. multiple-baseline, pre–post), (f) intervention procedures (e.g. use of additional techniques—social stories, reinforcement, feedback), (g) follow-up (e.g. timeframe of follow-up), (h) generalization (e.g. across settings, interaction partners) and (i) the results of the video-based instruction.

Inter-rater agreement

The initial search identified 77 articles for possible inclusion in the review. Examination of these 77 articles resulted in a number of these being excluded. Specifically, review articles and studies that did not report original data on the effects of a video-based intervention were excluded [50, 52]. This process left a total of 51 articles. Two examiners then independently reviewed each of these 51 articles against the inclusion criteria, resulting in 44 studies for inclusion in this review. (A list of the included and excluded articles is available from the author.)

The 44 included articles were then analysed and coded following the data extraction procedures described previously. If a study reported participants with and without ASD, only the data for the ASD participants were coded. In order to assess agreement on inclusion and data extraction, a second independent examiner extracted data for 22 randomly selected studies (50%). Agreement on the accuracy of data extraction for these 22 studies was 100%.

The studies' results were coded based on the conclusions reached by the authors. That is, if the outcomes of the study were described as positive by the authors, then the results for that study were coded as such. To ascertain the certainty of the evidence for positive results, however, an independent check was made of the results to determine the confidence with which the authors' conclusions were justified. For this, the design of each study was analysed. Studies with non-experimental designs (e.g. A–B, pre–post testing without a control group) were deemed to be capable of providing only inconclusive evidence. For studies with experimental designs, evidence was conclusive if the data presented in the Results section demonstrated a significant intervention effect, data on inter-observer agreement was satisfactory (i.e. 80% agreement or more for at least 20% of data), the dependent variables were clearly defined and the intervention procedures were described in sufficient detail to allow replication.

Results

A total of 49 experiments were reported in the 44 included articles. Table I presents a summary of the participants, a brief description of the study (setting, model type, target skill) and the reported outcomes with an assessment regarding the certainty of evidence for each of the 49 experiments.

Participants

A total of 131 participants with ASD were included in the studies. Of these, 109 (83%) were boys and 22 (17%) were girls. The vast majority ($n = 110$, 84%) of participants were reported as having autism. Asperger syndrome and high-functioning autism were reported for 17 participants (13%), with three participants (2%) described as having pervasive

Table I. Summary of the 44 studies and 49 experiments included in the review.

#	Study	Participants	Description	Outcomes and certainty of evidence
[1]		2 boys, 1 girl (8–9.11 years)	Video modelling and *in-vivo* modelling were used to teach children to purchase 10 grocery items. The intervention was conducted in school and community store settings with an adult model.	Positive outcome but effects cannot be solely attributed to the VM intervention because *in-vivo* instruction was also used.
[2]	Experiment 1	2 boys (5 years)	Video modelling was used to teach compliment giving initiations and responses. The intervention was conducted in a school setting with a peer model.	Positive with strong certainty of evidence due to experimental design.
	Experiment 2	2 boys, 1 girl (4.1–5.9 years)	Video modelling was used to teach compliment giving initiations and responses. The intervention was conducted in a school setting with a peer model (later changed to self-model).	Positive outcome only after model was changed to self. Strong certainty of evidence due to experimental design.
[3]		3 boys, 1 girl (6.2–8.10 years)	Video modelling was used to teach children to put away groceries. The intervention was conducted in a school setting with an adult model or a subjective viewpoint.	Positive but certainty of evidence weakened due to alternating treatment design.
[4]		2 boys (4.4–5.1 years)	Video self-modelling was used to teach unprompted social engagement (active participation in an activity or play sequence with a peer). The intervention was conducted in a school setting.	Positive with strong certainty of evidence due to experimental design.
[5]		1 boy (9.8 years)	Video-self-model was used to teach emotional recognition and appropriate associated actions. The intervention was conducted in a home setting.	Positive but certainty of evidence weakened due to A-B design.
[6]	Experiment 1	2 boys (9.11–11.3 years)	Video self-modelling was used to teach social initiations. The intervention was conducted in a school setting.	Positive with strong certainty of evidence due to experimental design.
	Experiment 2	2 boys (6.9–8.1 years)	Video self-modelling was used to decrease tantrums. The intervention was conducted in a school setting.	Positive with strong certainty of evidence due to experimental design.
	Experiment 3	1 boy (5.5 years)	Video self-modelling was used to decrease pushing and increase language production. The intervention was conducted in a school setting.	Mixed outcome—decreased pushing but no improvement in language production. Certainty of evidence strong due to experimental design.
[7]		2 boys, 1 girl (7–12 years)	Video self-modelling was used to teach responding behaviours (appropriate verbal responses). The intervention was conducted in a home setting.	Positive with strong certainty of evidence due to experimental design.
[8]		3 boys (6.10–7.10 years)	Video modelling was used to teach conversational speech. The intervention was conducted in school and home settings with familiar adults as models.	Positive with strong certainty of evidence due to experimental design.
[9]		3 boys (6.1–9.5 years)	Video modelling was used to teach perspective taking (theory of mind). The intervention was conducted in an after school behavioural management programme with familiar adults as models.	Mixed outcome—positive results reported for only two participants. Strong certainty of evidence due to experimental design.
[10]		4 boys, 1 girl (7–11 years)	Video modelling was used to teach each child different developmental skills (labelling of emotions, independent play, spontaneous greetings, conversational speech and self-help skills). The intervention was conducted in an after school behavior therapy programme with familiar adults as models.	Positive with strong certainty of evidence due to experimental design.
[11]		1 boy (8.3 years)	Video modelling was used to teach emotional recognition. The intervention was conducted in a home setting with a peer model.	Positive with strong certainty of evidence due to experimental design.

[12]	3 boys (9.1–11.7 years)	Video self-modelling and COMPIC (picture communication cards) were used to decrease off-task behaviour. The intervention was conducted in a school setting.	Positive but effects cannot be solely attributed to the VM intervention because self-management strategy was also used.
[13]	1 girl (3.8 years)	Video modelling was used to teach complex play sequences. The intervention was conducted in a school setting with an adult model.	Mixed results—gains in play responses but not for new non-modelled statements. Certainty of evidence strong due to experimental design.
[14]	1 boy (3.1 years)	Video modelling was used to teach socio-dramatic play. The intervention was conducted in a home setting with a peer model.	Positive outcome but design not clearly described.
[15]	3 boys (13.6–17.4 years)	Video self-modelling and self-regulated strategies were used to teach written language skills. Setting described as a conference room.	Positive outcome but additional self-regulated strategy instruction does not allow positive effects to be attributed to VM.
[16]	2 boys, 1 girl (3.11–5.7 years)	Video modelling was used to teach contextually appropriate affective responses. The intervention was conducted in a home setting with a peer model.	Positive outcome only after introduction of reinforcement and prompting. Strong certainty of evidence due to experimental design.
[17]	3 boys (7.11–9.11 years)	Video self-modelling and Social Stories were used to teach children to wash their hands or to increase on-task behaviour (e.g. reading, writing, making eye contact with teachers). The intervention was conducted in home and school settings.	Mixed outcome—improvement reported for some participants in some settings. Effects cannot be attributed to VM because Social Stories were also used.
[18]	3 boys (10–16 years)	Video modelling and *in-vivo* modelling were used to teach generalized purchasing skills. The intervention was conducted in home, school and community stores settings with peer models.	Positive outcome but *in-vivo* modelling also used and so effects cannot be attributed only to the VM condition.
[19]	2 girls (2.6–3.7 years)	Video modelling was used to teach children to play with gardening and cooking toys. The intervention was conducted in a school setting with a video in the subjective viewpoint.	Positive with strong certainty of evidence due to experimental design.
[20]	5 boys (4.5–6.9 years)	Video modelling was used to teach children daytime urinary control (toilet training). The intervention was conducted in school and home settings with an animation movie.	Very limited improvements reported.
[21]	1 girl (8 years)	Video modelling was used to teach generative spelling. The intervention was conducted in home and school settings with an adult model.	Positive outcome, but certainty of evidence weakened by non-experimental design.
[22]	9 boys, 4 girls (4–6 years)	Video modelling was used to teach play and social skills. Setting was not disclosed. The model was a peer.	Positive, but certainty of evidence weakened due to pre–post-test design.
[23]	1 boy (14 years)	Video self-modelling was used to teach shaving, making the bed and hanging up a shirt and a pair of pants. The intervention was conducted in a home setting.	Positive with strong certainty of evidence due to experimental design.
[24]	3 boys (7–13 years)	Video modelling was used to teach perspective taking. The intervention was conducted in a school setting with an adult model.	Positive with strong certainty of evidence due to experimental design.
[25]	2 boys (4–7 years)	Video modelling was used to teach pretend play and increase play-related statements. The intervention was conducted in a school setting with an adult model.	Positive with strong certainty of evidence due to experimental design.
[26]	2 boys (5–7 years)	Video modelling was used to teach reciprocal pretend play and increase play-related statements. The intervention was conducted in a school setting with an adult model.	Positive with strong certainty of evidence due to experimental design.

(*Continued*)

Table I. Continued.

#	Study	Participants	Description	Outcomes and Certainty of Evidence
[27]		1 boy (5.7 years)	Video modelling was used to teach social language. The intervention was conducted in a home setting with an adult model.	Mixed outcome—improvement in two tasks but for a third only after feedback and prompting.
[28]		2 boys, 1 girl (4–9 years)	Video modelling with a peer and video self-modelling were used to teach children to name Greek and Arabic letters. The intervention was conducted in home and school settings.	Mixed outcome—improvements were reported in video self modelling conditions for all participants, but only one in the peer modelling condition. Strong certainty of evidence due to experimental design.
[29]		2 boys (8–9 years)	Video modelling was used to teach children to fold shirts and pants and make juice and sandwiches. The intervention was conducted in a home setting with an adult model.	Positive with strong certainty of evidence due to experimental design.
[30]		6 boys, 1 girl (9–15 years)	Video modelling was used to teach social initiation skills in a play situation. The intervention was conducted in a school setting with typical or disabled peers or familiar or unfamiliar adults.	Mixed outcome—reported improvements for four out of seven participants. Certainty of evidence weakened by multiple treatment and A-B design.
[31]		3 boys (7–9 years)	Video modelling was used to teach social initiation and play. The peer was a model. The setting was not disclosed.	Positive, but the video in one condition was simplified. Certainty of evidence was strong due to experimental design.
[32]		2 boys, 1 girl (7.5–10.5 years)	Video modelling was used to teach social initiation and reciprocal play skills. The intervention was conducted in a school setting with a peer model.	Positive with strong certainty of evidence due to experimental design.
[33]	Experiment 1	3 boys (6.5–7 years)	Video modelling was used to teach complex social sequences (social initiations, reciprocal play, imitative response, object engagement). The intervention was conducted in a school setting with a peer model with learning disability.	Positive outcome, but two participants required further training. Certainty of evidence strong due to experimental design.
	Experiment 2	1 girl (7.5 years)	Video modelling was used to teach complex social sequences (social initiations, reciprocal play, imitative response, object engagement). The intervention was conducted in a school setting with a peer model with learning disability.	Positive outcome but certainty of evidence weakened due to A-B design.
[34]		1 boy (12.3 years)	Video modelling was used to teach a child to clean sunglasses, put on a wristwatch and zip a jacket. The intervention was conducted in a school setting with a subjective viewpoint video.	Mixed outcome—participants did not meet criteria for one of the tasks but certainty of positive results is strong due to experimental design.
[35]		1 girl (5.9 years)	Video modelling was used to teach efficient gaze, responding without delay and topic maintenance. The intervention was conducted in a clinic setting with Disney movie segments.	Mixed outcome—positive results but no improvements in two tasks. Certainty of evidence strong due to experimental design.
[36]		2 boys (6–7 years)	Video modelling was used to teach generalized independent toy play. The intervention was conducted in a school setting with a young adult model.	Positive with strong certainty of evidence due to experimental design.

[37]		1 boy (4 years)	Video modelling was used to teach a child to engage in four pretend play scenarios. The intervention in school and home settings with a sibling as model.	Positive outcome but certainty of evidence weakened due to A-B design.
[38]		3 boys (6.6–10.6 years)	Video modelling and Social Stories were used to teach children to join others and maintain conversations. The intervention was conducted in a school setting with a peer model.	Positive, but prompts and confederate peers introduced. Effects cannot be attributed to VM alone because Social Stories were used.
[39]		1 boy (9 years)	Video modelling and Social Stories were used to teach conversation skills (eye contact, smiling and initiation). The intervention was conducted in a medical centre and home settings with an adult model.	Positive but variable results. Effects cannot be attributed to VM alone because Social Stories were also used.
[40]		5 boys (3.11–11.2 years)	Video modelling with a peer and video self-modelling were used to teach children to correctly engage in conversation. The intervention was conducted in home and clinic settings with peer or self as model.	Mixed outcome—positive for two participants, small improvement for one, but no improvement for two. Certainty of evidence of positive results is strong due experimental design.
[41]		2 boys, 1 girl (5.1–5.5 years)	Video modelling was used to teach children to make orange juice, prepare a letter to mail, mail a letter, clean a fish bowl and set the table. The intervention was conducted in home and assessment room settings with a subjective viewpoint video.	Positive with strong certainty of evidence due to experimental design.
[42]		2 boys, 2 girls (5–6 years)	Video modelling and static pictures were used to teach sharing, following teacher directions and social greetings. The intervention was conducted in a school setting with a peer model.	Positive outcome but effects cannot be solely attributed to the VM intervention because static pictures were also used.
[43]	Experiment 1	1 boy (6 years)	Video modelling was used to teach a child to make play-related statements. The intervention was conducted in a home setting with a sibling as model.	Positive but no improvement on unscripted statements. Certainty of evidence strong due to experimental design.
	Experiment 2	1 boy (9 years)	Video modelling was used to teach a child to make play-related statements. The intervention was conducted in a home setting with a sibling as model.	Positive but variable results. Certainty of evidence strong due to experimental design.
[44]		4 boys (3–6 years)	Video self-modelling was used to teach children to make spontaneous requests for objects or actions. The intervention was conducted in home and school settings with self as model.	Positive with strong certainty of evidence due to experimental design.

developmental disorder not otherwise specified (PDD-NOS). One study described the participating child as having an ASD.

Ages ranged from 2.6–17.4 years (mean = 7.6). Two studies [22, 31] provided the age range of their participants, but not individual ages. In such cases, the average for the studies' sample was used to calculate the overall average. Over half ($n = 72, 55\%$) of the participants were school-aged children between the ages of 6–12. The second largest group ($n = 39, 30\%$) consisted of pre-school children aged 3–5. Seven (5%) participants were adolescents between 14–18 years. One 2-year-old child participated in the studies. One of the studies [22] that did not provide individual ages included children that ranged from 4–6 years, which did not allow for individual allocation to the pre-school or the school-aged groups. In this case, the reported mean age of 5.04 was used and the entire sample was counted as one, therefore, the number of participants reported here adds up to 119.

Sample sizes in the studies ranged from 1–13 (mean = 2.7 per experiment). Most studies ($n = 41$, 84%) had between 1–3 participants with ASD [1, 2, 4–9, 11–19, 21, 23–29, 31–39, 41–43]. Three experiments (6%) had four participants [3, 42, 44] and another three studies (6%) had five participants [10, 20, 40]. One experiment had seven participants in the sample [30] while another had 13 participants [22].

Settings

The most common settings for these studies were schools and homes. It should be noted that 11 studies were conducted in multiple settings. In such cases, each setting was counted separately. Almost half of the studies ($n = 28, 57\%$) were conducted in a school setting [1–4, 6, 8, 12, 17–21, 24, 25, 28, 30, 32–34, 36–38, 42, 44]. Twenty studies (41%) were conducted in the participant's home [5, 8, 11, 14, 16, 18, 20, 21, 23, 27–29, 37, 39–41, 43, 44], four (8%) during after school therapy programmes [9, 10, 13, 24], three (6%) in clinics [34, 39, 40] and two (4%) in community settings (e.g. grocery and bookstores) [1, 18]. The setting was only identified as a generic room in four (8%) studies [15, 26, 31, 41]. One study [22] did not state where the intervention took place.

Model types

Models were the 'actor' who performed the task or behaviour that the participants were to learn or imitate. Three experiments [3, 28, 30] employed more than one type of model in separate videos and were counted separately. Most ($n = 47, 88\%$) videos had a peer, an adult or the participants themselves as models. Eighteen (34%) models were peers [2, 11, 14, 16, 18, 22, 28, 30–33, 37–38, 40, 42, 43], 15 (28%) were adults [1, 3, 8–10, 13, 21, 24–27, 29, 30, 36, 39] and 14 (26%) were the participants themselves (i.e. video self-modeling) [2, 4–7, 12, 15, 17, 23, 40, 44]. Four (8%) videos were filmed from the subjective viewpoint (i.e. no models are shown, the task is seen as if though the eyes of the participant) [3, 19, 34, 44]. Two studies used animated video segments as material for the children to imitate. One of the studies [20] used a purposely produced video to teach toileting skills, while the other [35] edited segments from Disney movies to illustrate appropriate conversational skills.

Target skills

Approximately two-thirds ($n = 34, 69\%$) of the studies targeted social or communication skills [2, 4–11, 13, 14, 19, 22, 24–27, 30–33, 35–40, 42–44]. In several cases, it was difficult to clearly distinguish social from communication skills. As Ochs et al. [68] argued, communication is an essential part of social functioning and socialization is necessary for the acquisition of communicative language. It was deemed appropriate, therefore, to cluster social and communication skills into the same category. The next most targeted skills were daily living skills such as hand washing and putting away groceries ($n = 9, 18\%$) [1, 3, 17, 18, 20, 23, 29, 34, 41]. Buggey ([6], experiment 3) examined a daily skill and a communication skill; therefore, the percentage does not add up to 100. Reduction of problem behaviour was the aim of five (10%) studies [6, 12, 16, 17] while only three (4%) studies attempted to teach academic skills [15, 21, 28].

Intervention procedures

In addition to the use of video-based instruction, 24 (49%) studies [1, 2, 5, 7, 8, 11, 14, 16, 18, 20–22, 24, 27–30, 33, 34, 36, 41, 43] used reinforcement procedures, such as verbal praise and edibles in the learning programme. Of these, nine (18%) studies [1, 2, 11,14, 20, 22, 27, 33, 34] also used response prompts. Thirteen studies reported additional strategies such as *in-vivo* modelling [1, 10, 16, 18], social stories [5, 17, 38, 39], self-management skills [2], static pictures [21, 42], strategy instruction [15], operant conditioning [20], dictation [21] and feedback [27].

In terms of how the video-based instruction was delivered, in seven (14%) studies [3, 14, 17, 19,21, 38, 42] the video seen by the participants were presented on a computer screen. In the other studies, the video seen by the participants were presented in a television screen using a VCR player.

Study designs

All but one study evaluated video modelling interventions with single-case experimental designs [69, 70]. Designs were deemed experimental if they systematically introduced and removed the intervention (e.g. ABAB design) [12] or if the independent variable was sequentially introduced following a baseline phase (e.g. multiple baseline or multiple probe designs) [1, 2, 4, 6–11, 13, 15–20, 23–29, 31–36, 38–44].

Pre-experimental designs included a simple A-B design or an intervention only design [3, 5, 30, 33, 37]. Experiments were also deemed non-experimental if they employed pre–post measures with no control group or control condition [22]. The design was not clearly described in two studies [14, 21]. The only study employing a group intervention [22] analysed pre–post measures for the group as a whole.

Follow-up and generalization

Twenty-three (47%) articles reported follow-up measurements [1, 6, 8, 11, 13–15, 19–20, 22–26, 29–33, 35,37, 39, 40], ranging from 2 days [6] to 15 months [8]. Most (28%) studies measured follow-up between 1–3 months after the intervention terminated [8, 13–15, 19, 23, 25, 29–33, 39, 40]. Six (12%) studies [4, 6,17, 36, 40, 43] reported only maintenance data retrieved immediately after the intervention stage.

Twenty-six (53%) studies reported on generalization. Fourteen (28%) reported on generalization across settings [2, 3, 8, 10, 11, 17–20, 30, 32, 38–40]. Thirteen (26%) reported on generalization across people [5, 8, 10, 11, 16, 18, 30, 32–34, 37, 40] and 15 (30%) reported on generalization across tasks [8–11, 14, 15, 18, 19, 23, 24, 30, 32, 34, 36, 40].

Reliability of data and treatment integrity

Forty (81%) studies reported inter-observer agreement (IOA) to assess reliability of data collection. All the reported IOA were above the accepted 80% standard [70]. Of these, 11 (22%) also reported on treatment integrity (i.e. procedural reliability) [1, 2, 4, 12, 19, 27, 28, 38, 39, 42] and 11 (22%) studies reported on social validity [3, 4, 7, 8, 19, 30, 32,33, 37, 38]. External validity was reported in one study [7]. Nine (18%) studies [5, 9, 11, 20, 22, 35,36, 43] reported no agreement or validation measures.

Outcomes

Over half of the studies ($n = 27, 55\%$) reported positive results [2, 4–8, 10–12, 14, 15, 18, 21–26, 29,32, 33, 36, 37, 41, 42]. A number of studies, however, reported mixed outcomes. In some cases the intervention had to be modified for a positive result (e.g. introduction of reinforcement, different model, further training) ($n = 7, 14\%$) [1, 2, 16, 27, 31, 33, 38]. In addition, the intervention worked for some, but not all participants in four studies (8%) [9, 30, 40, 44]. For other studies, improvements were reported for some dependent measures but not others or participants did not meet criterion or the gains could not be entirely attributed to the intervention ($n = 11, 22\%$) [3, 6, 13, 17, 19, 20, 28, 34, 35, 39, 43].

Certainty of evidence

The certainty of evidence was deemed conclusive for 30 (61%) studies [2, 4, 6–11, 13, 16, 19, 23–26, 28, 29, 31–36, 40, 41, 43, 44]. The evidence was considered inconclusive for the other 19 (39%) studies. Results were rated as inconclusive because the studies relied on pre-experimental or insufficiently described designs [3, 5, 14, 21, 22, 30, 33, 37]. Another reason for inconclusive findings is that in some studies more than one independent variable was introduced and therefore it is not possible to ascertain if the video-based instruction alone was responsible for the positive changes in the dependent variables.

Discussion

The purpose of this review was to provide an overview of the current state of video modelling research as it applies to the rehabilitation of children with ASD. An additional goal was to identify gaps in the literature in order to guide future research. The systematic search identified a total of 44 articles reporting 49 individual experiments published between 1989–2009. The collective sample of 131 children would appear to match the general ASD population in terms of gender ratio reported in the literature, that is, four-to-five boys to every girl [45, 71]. These children were primarily diagnosed with autism, with fewer having Asperger syndrome or PPD-NOS.

Several trends can be identified in these 44 studies, including: (a) focus on social/communication skills; (b) implementation in school or home settings; (c) similar numbers of videos that used self modelling or used peers and adults as models; and (d) use of small-*n* single-case experimental designs with only one group study and no randomized control trials. These trends have several implications for research and evidence-based practice in the use of video-based instruction for the rehabilitation of children with ASD.

In relation to the first trend, the large number of interventions targeting social/communication skills is not surprising. These skills are important for functioning in society and impairments in these areas are key features of ASD. Major deficits in adaptive behaviour and academic skills are also prevalent among children with ASD. However, the predominance of studies focused on communication skills suggests a need for more research to determine whether video-based instruction can be effective in teaching a broader range of adaptive behaviours and academic skills to children with ASD. There is, for example, a major gap with respect to the use of video-based instruction for teaching academic skills, such as reading, writing and arithmetic, which is highly relevant for school-aged children.

The second trend shows that most interventions were conducted in school and home settings; community-based interventions were the minority. Given the importance of being able to function in the community, more work needs to be conducted to teach community relevant skills, such as shopping, independent travelling and learning to act appropriately in the community. It may be possible to provide this instruction across a range of community environments by using portable devices to deliver videos. Doing so may help to improve generalization and maintenance of acquired skills [18].

The third trend identified a predominance of peers, self and adults as models. The positive results reported support previous findings that a wide range of models can be effectively employed in video-based instructions [30, 53]. However, further research should examine the role that different models might have on the outcomes of video-based instruction. There were few such comparison studies among these 44 studies. Knowledge of whether certain model types are more effective and appropriate for various types of learners and situations may enable researchers to develop more efficient video-based instructional programmes.

A limitation that makes it difficult to evaluate the promise of video-based instruction is the fact that most of these interventions supplemented video-based instruction with additional instructional procedures. In addition to video modelling, for example, many studies also used direct error correction procedures involving verbal prompts and provided reinforcement for correct performance. It would be valuable to better understand the influence of these additional strategies on the effects of video-based instruction.

New technologies have been successfully used to teach different skills to children with ASD but, despite the technological advances, this review found only a few studies that included enabling participants to self-operate the equipment. The studies reviewed employed simple computer programs where children could advance to the next step by clicking somewhere on the screen with a mouse [38]. Although reportedly capable of operating the equipment, in most studies the participants had no interaction with the technology, but were merely supposed to passive view the video. Portable self-operated devices, such as cassette players and personal digital assistants (PDAs), were effectively employed in the past, but no studies have examined the use of new portable multimedia devices (e.g. iPods). Such devices might be used for developing age-appropriate leisure activities, such as listening to music or playing games and/or to deliver video-based instructions for teaching new adaptive behaviours.

Despite these limitations, the overall results of this review would seem to support the use of video-based instruction in the rehabilitation of children with ASD. Of the 49 experiments, most reported positive intervention effects and the majority of these provided conclusive evidence for the positive intervention effects. Given the generally positive and conclusive outcomes reported in these 44 studies, there is sufficient evidence to conclude that video-based instruction is an empirically supported procedure for teaching a range of adaptive behaviours, particularly social and communication skills, to children with ASD.

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APPENDIX C

Watch and Learn

A systematic literature review of video modeling for children with ASD

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Children with Autism Spectrum Disorders (ASD) have significant developmental impairments in important areas of functioning including social, communication and academic skills (APA, 2000). Their special educational needs may not be met by traditional means of instruction. Technological advances such as video recordings are providing innovative ways of effectively teaching children with ASD.

Video modeling involves learners watching an instructional video depicting a desired task or behavior that they can then imitate (Sigafoos, O'Reilly, & Cruz, 2007). Video modeling has been successfully used to teach a range of skills to children with ASD such as initiating conversations, grocery shopping, and spelling (Bellini & Akullian, 2007).

Video modeling uses resources and time efficiently and effectively (Corbett & Abdullah, 2005; McKoy & Hermansen, 2007; Sturmey, 2003):

- it is socially acceptable and highly motivating;
- focuses on the relevant part of the stimulus and avoids distractions;
- produces faster learning and greater generalization;
- promotes greater independence by decreasing reliance on prompting;
- provides repeated and consistent delivery of instructions;
- is portable, providing time and setting flexibility;
- costs less to implement and is less time consuming for instructors.

Methodology

An extensive and systematic search was conducted on four electronic databases: Eric (Education Resources Information Center), SpringerLink, PsychINFO, and ProQuest. The reference list of identified articles and the journals in which they were published were manually searched. The electronic databases were further searched with the names of the authors of the articles included in the review.

Inclusion criteria:
Articles were included if at least one participant was diagnosed with ASD, participants were under 18 years of age, and video modeling was used to teach adaptive skills such as social, communication, and functional, or academic skills.

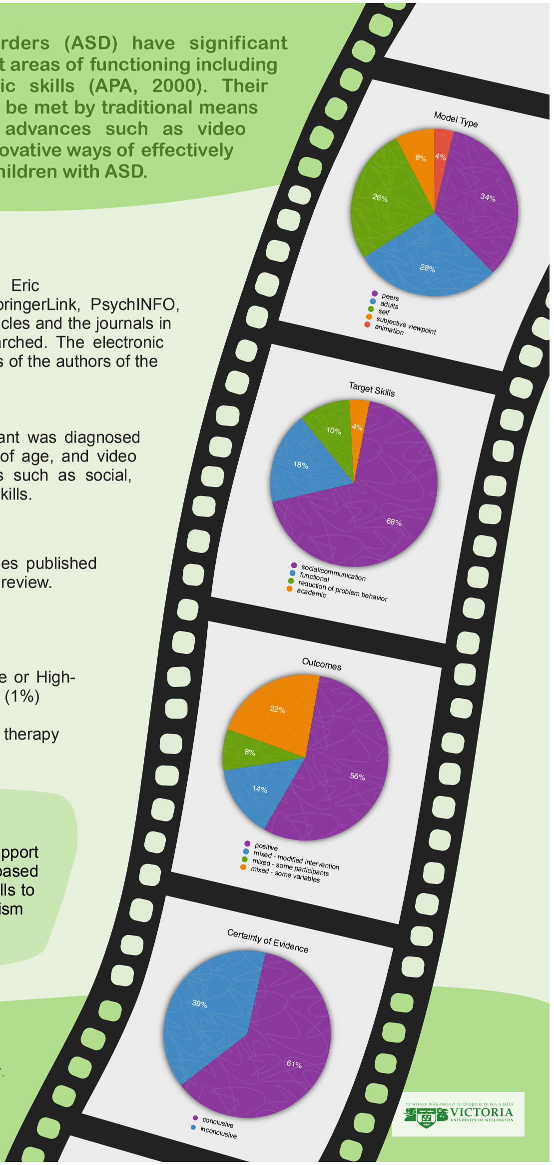
Results

Forty-nine experiments reported in 44 articles published between 1989 and 2009 were included in the review.

- *participants*: 131 children
- *gender*: 83% boys, 17% girls
- *age*: 2.6 to 17.4 (mean = 7.6)
- *diagnosis*: autism (84%), Asperger syndrome or High-functioning autism (13%), PDD-NOS (2%), ASD (1%)
- *sample size*: 1 to 13 participants (mean = 2.7)
- *setting*: school (57%), home (41%), after school therapy program (8%), clinic (6%), community (4%)

Discussion

The overall positive results found in the review support the application of video modeling as an evidence-based intervention for teaching adaptive and academic skills to children with different cognitive abilities in the autism spectrum.



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ORIGINAL PAPER

Three Students with Developmental Disabilities Learn to Operate an iPod to Access Age-Appropriate Entertainment Videos

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Abstract Students with developmental disabilities may not have the necessary skills or the same opportunities to access multimedia-based leisure materials as their typical peers. Portable multimedia devices such as the iPod Touch® may provide them with a useful tool for accessing age-appropriate leisure material. The present study examined the feasibility of teaching 3 students with developmental disabilities to independently operate an iPod to watch age-appropriate entertainment videos. A delayed multiple-probe design across participants was implemented with baseline, intervention, fading, and follow-up phases. Video modeling and least-to-most response prompting were successfully used to teach these 3 students to operate an iPod Touch® to watch preferred videos without adult assistance. The results complement previous findings supporting the use of video modeling as an instructional strategy and add to the literature by using portable multimedia devices as assistive technology for teaching an age-appropriate leisure skill.

Keywords Assistive technology · Developmental disability · Portable multimedia device · iPod Touch · Leisure · Video modeling

Introduction

Students with developmental disabilities have impairments that may prevent them from learning age-appropriate leisure skills when compared to their typically developing peers. Such students often do not have the necessary skills or

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opportunities to engage in the same leisure activities as typically developing peers (Coyne and Fullerton 2004; Patterson 2004; Thompson et al. 2009). Leisure and recreation activities are an important part of a person's development and quality of life (Iwasaki 2007; Schleien et al. 1995). Caldwell (2005) reviewed evidence suggesting that leisure engagement can have a positive effect on a person's social, emotional, physical, and cognitive health. Consistent with this conclusion, in a survey examining the quality of life of young adults with severe intellectual disabilities, most mothers mentioned leisure activities as an important component of their child's quality of life (McIntyre et al. 2004). Therefore, the development of age-appropriate leisure skills could be seen to be an important educational objective for many young people with developmental disabilities.

A few studies have attempted to teach leisure skills to individuals with developmental disabilities. For instance, Luyben et al. (1986) taught three adults with severe intellectual disability to play soccer. The participants learned to perform a side-of-the-foot soccer pass through forward chaining and decreasing levels of physical prompts. Follow-up and generalization data demonstrate the skill was successfully learned and maintained over time. Matson and Marchetti (1980) compared different treatment procedures to teach adults with intellectual disability to operate a stereo to listen to music. Participants who received one of the interventions performed significantly better than participants in the control groups. These studies provide evidence that participants with developmental disabilities are able to learn leisure skills. Overall, however, existing literature has tended to focus more on the provision of leisure opportunities to this population than on teaching them the necessary skills to engage in leisure activities (Coyne and Fullerton 2004; Schleien and Ray 1988, p. 1).

Given the benefits of recreation, it is important to provide young people with developmental disabilities the skills to independently engage in age-appropriate leisure activities that would be available to the general population (Jerome et al. 2007). Age-appropriate leisure skills are important because they have the potential to promote community inclusion while providing individuals with developmental disabilities with a constructive way of spending their free time (Schleien et al. 1981).

Currently, a large proportion of people's leisure time involves technology including television, computers, and more recently, portable multimedia devices such as mp3 players and iPods. With respect to this new technology, Jerome et al. (2007) taught three men with developmental disabilities to access their preferred Internet sites to access video games and listen to music on a desktop computer. Given the promising results of Jerome et al., it would seem that off-the-shelf technology such as iPods could enable students with developmental disabilities to access a range of age-appropriate leisure content, such as enabling them to listen to music and watch entertainment videos.

To date, however, there appears to be no studies that have attempted to teach students with developmental disabilities to use iPods to access age-appropriate entertainment videos. The present study examines whether students with developmental disabilities can learn to self-operate an iPod Touch® to watch entertaining videos with video modeling and response prompting.

Methods

Participants and Setting

Three students were selected for this study. They all attended the same classroom in a specialized school for adolescents and young adults with a range of disabilities. This convenience sample was chosen because their teacher indicated they would benefit from learning to independently engage in age-appropriate leisure activities and they were all of comparable cognitive abilities. Age and gender were not expected to influence their learning.

Sarah was a 19-year-old girl with severe intellectual disability and epilepsy. On the Vineland-II Adaptive Behavior Scales (Sparrow et al. 2005) with the teacher as the interviewee, Sarah received an overall standard score of 38, which is approximately four standard deviations below the mean on the Vineland and indicative of an extremely low level of adaptive behavior functioning. She was said to be capable of understanding simple commands and had a good vocabulary, but was not able to carry an age-appropriate conversation. Her motor skills and visual and hearing abilities appeared to be in the normal range. She had no previous experience with iPods or any other portable media players.

Mary was a 16-year-old girl with cerebral palsy and severe intellectual disability. Her overall Vineland-II standard score was 52, which is approximately three standard deviations below the mean on the Vineland and indicative of a low level of adaptive behavior functioning. She understood simple commands and had a good vocabulary, but her speech was difficult to understand. Her motor skills were somewhat affected by cerebral palsy, but she was able to manipulate small objects effectively. Her visual and hearing abilities were in the normal range. She had no previous experience with iPods or any other portable media players.

Jim was a 15-year-old boy with Klinefelter syndrome and severe intellectual disability. His overall standard score on the Vineland-II was 43, which is approximately 3.5 standard deviations below the mean on the Vineland and indicative of low level of adaptive behavior functioning. He understood simple commands, but had a limited vocabulary and rarely spoke unless prompted to do so by an adult. His motor skill and visual and hearing abilities were in the normal range. Jim had limited experience with iPods. He was previously taught to tap the screen to make simple requests on an iPod programmed as a speech-generating device.

These three students attended a public school classroom that catered to 5 students with developmental disabilities. The classroom was staffed by a teacher and a teaching assistant. All sessions associated with this study were conducted in the participants' classroom. The participants sat at the table with the primary observer, who also acted as the interventionist, on the participant's left. For sessions where reliability data were collected, a second and third independent observer sat opposite the first observer. The observers were not blind to the purpose or phase of the study. They were trained on how to complete the datasheets and how behaviors should be recorded.

Stakeholder Questionnaire

A questionnaire was created to give the participants, as stakeholders, an opportunity to consent to their involvement in the study and to identify preferred stimuli for use in the study. Specifically, participants were informally interviewed and asked a set of questions: (a) would you like to learn how to use the iPod, (b) what do you enjoy watching, and (c) how would you like to learn (i.e. reading instructions, looking at pictures, watching a video, someone showing the steps, someone giving physical prompts). All participants indicated that they were interested in learning how to use the iPod and provided a list of what they liked to watch. They also indicated that watching a video was one of their preferred methods for learning, and so this method of teaching was incorporated into the intervention phase of the study.

Entertainment Video

The aim of the study was to teach the three students to operate the iPod to watch preferred entertainment videos. Sarah indicated that she preferred animation movies the most but was entertained by any of the videos available. Mary had first indicated the same preference as Sarah, but was more motivated by videos of her classroom and school playground added to suit her changed preference. Jim enjoyed videos of sports such as rugby, soccer, and basketball. Several video clips of 30-s duration that corresponded to these preferences were therefore loaded onto the iPods. New videos were added on a regular basis to prevent boredom.

Task Analysis

A task analysis was constructed of the steps necessary to successfully watch a video on the iPod (see Table 1). The 7-step task analysis was validated by having three iPod-inexperienced users follow the steps in order. Once validated, a 38-s video of a person completing the steps of the task analysis was made for use as a teaching tool in the video modeling phase of the study. The video was recorded from the subjective viewpoint (as if seen by the participant) using an iPhone®, edited on iMovies®, and uploaded on a 16 GB iPod Touch®.

Table 1 Task analysis: how to watch a video on the iPod

1. Turn on the iPod—press the "home" button
2. Unlock the screen—slide the button with the arrow to the right
3. Launch the video application—tap the "video" icon
4. Select the video—find the video you wish to watch and tap on its name/picture
5. Watch movie—when the video starts, turn the iPod horizontally
6. Leave the video application—press "home" button
7. Turn off the iPod—press the "on/off" button on the top left of the iPod

Design

A delayed multiple-probe design across participants was used in this study (Kennedy 2005). In this design, the independent variable is sequentially introduced across participants. A functional relation is demonstrated if the behavior changes occur when the intervention starts while the baseline for the subsequent participants remains low and stable. The baseline phase was followed by a video modeling (VM) and prompting phase. VM was faded out in the next phase, and follow-up sessions were conducted a few weeks later. The order in which participants progressed from baseline to VM and prompting was based on their availability. Sarah was the first to receive treatment because Mary was engaged in other classroom activities and Jim was participating in an unrelated study.

Configuration of Sessions

All sessions started with the interventionist giving the iPod Touch®, which was turned off, to the participant and saying "Can you turn the iPod on and watch a video?" The only reinforcers were the videos the participants could choose to watch and verbal praise for attending and attempting to perform any of the steps. The independent variable was the VM and prompting procedure, while the dependent variables were the number of steps in the task analysis performed correctly and the level of prompting used. Sessions were conducted twice a week during the morning break. The students had access to the iPod only during the sessions to ensure they did not learn by trial and error or from external instruction between training sessions.

Data Collection

Data were collected on the number of steps in the task analysis that were completed independently by the participants. To be counted as independent, a step had to be performed correctly without prompts.

Procedures

Baseline 1

During the initial baseline phase, if a step was performed within 10 s of the initial request to turn on the iPod or the completion of the previous step, it was recorded as a correct response. If the participants made no correct attempts within 2 min of the initial request, the session was terminated. The child was verbally praised for trying and was shown a preferred video on the iPod.

Baseline 2

During Baseline 2, the participants were given 10 s to perform each step in the sequence. The timeframe was deemed appropriate as it would give new learners sufficient time to complete each step. Proficient users were timed performing the entire task in less than 10 s. If the participants did not perform a step, the trainer completed the step out of sight and returned the iPod to the participant. He or she was then asked to perform the subsequent step, but not instructed on how to do it (e.g. "Can you select a video?"). This process continued until the task was completed.

Intervention

For the VM and prompting phase, the participants were shown the instructional video before the session started. A least-to-most prompting procedure was used if participants did not perform a step. After 10 s with no correct attempts, the primary observer verbally instructed the participant (e.g. "Can you push the off button?"), followed by a gestural prompt (e.g. pointing at the button and repeating the question) and finally physical guidance (e.g. taking the participants' hand and pushing the button). During the intervention, if the participant performed a step that was not part of the task analysis or accidentally chose a video they did not want to watch, the iPod was set back to the previous correct step out of the participants' sight and returned to them so they had a chance to make another selection.

Video Fading

In the video-fading phase, the video was no longer shown but the prompting procedure remained the same as in the video intervention phase. The video was removed when participants did not seem interested in watching it any longer or when they appeared to have learned what they could from it.

Symbol Discrimination

A discrimination test was conducted (from sessions 30, 27, and 28 for Sarah, Mary, and Jim, respectively) to investigate whether the participants could discern the video icon or were just used to its location. The icon was moved from the center to the left on the lower part of the screen. The video instruction continued to show the icon in the original position. The videos available also changed position on the list as new options were added.

Follow-Up

Two follow-up sessions were conducted 2 and 11 weeks after the last intervention session (Session 34 for Sarah and Session 13 for Jim). The follow-up sessions for Mary were conducted 2 and 10 weeks after her final session (Session 22). The procedures for the follow-up sessions were identical to those of Baseline 1.

Interobserver Agreement

Interobserver agreement (IOA) was gathered independently by the second observer on 80% of all sessions to ascertain the reliability of the recorded data. IOA was calculated by dividing the smallest number of correctly performed steps recorded by the largest and multiplying the result by 100%. IOA ranged from 86 to 100% with an overall mean of 99%.

Treatment Integrity

Treatment integrity was measured on 79% of sessions using a checklist to record if procedures were followed as specified. Data indicate procedures were followed correctly 100% of times. The third observer independently collected interobserver data on treatment integrity for all 79% of sessions where treatment integrity was measured with 100% agreement.

Results

The data for Sarah, Mary, and Jim's sessions are depicted in Fig. 1. During Baseline 1, Sarah correctly performed one step in the sequence (14% correct). During Baseline 2, she correctly performed a maximum of two correct steps (28%). When VM and prompting was introduced, the number of steps performed increased steadily up to 86% correct. When VM was removed, the number of steps performed correctly fluctuated between five (71%) and seven (86%) and reached criterion of three consecutive sessions with 100% correct responses on Session 34. Sarah required some prompting but it seldom increased to the physical level.

Mary correctly completed only one step on the first session and none on the second during Baseline 1. During Baseline 2, the number of steps performed correctly ranged between 0 and 28%. When intervention was introduced, the number of steps performed correctly increased up to six (86%), but her improvement was variable. On the VM fading phase, the number of steps completed quickly reached criterion. Mary needed physical prompts early in the intervention because she was not used to handling the iPod. Motor difficulties due to cerebral palsy had an influence on the level of prompting, but once Mary was used to the iPod, she could perform the steps with no assistance.

Jim correctly performed two steps (28%) of the task during Baseline 1. During Baseline 2, the number of steps performed correctly increased and remained constant at 4 (57%). During the VM and prompting phase, the number of correct steps increased to 100%. On the VM fading phase, Jim reached criterion in 4 sessions. He never required a physical prompt to complete a step.

All participants continued to successfully use the iPod when icon discrimination was tested. Follow-up data show they could still operate the iPod with over 80% of steps being performed correctly after intervention was completely removed. Sarah performed over 80% on the first follow-up and 100% on the last. Mary performed at

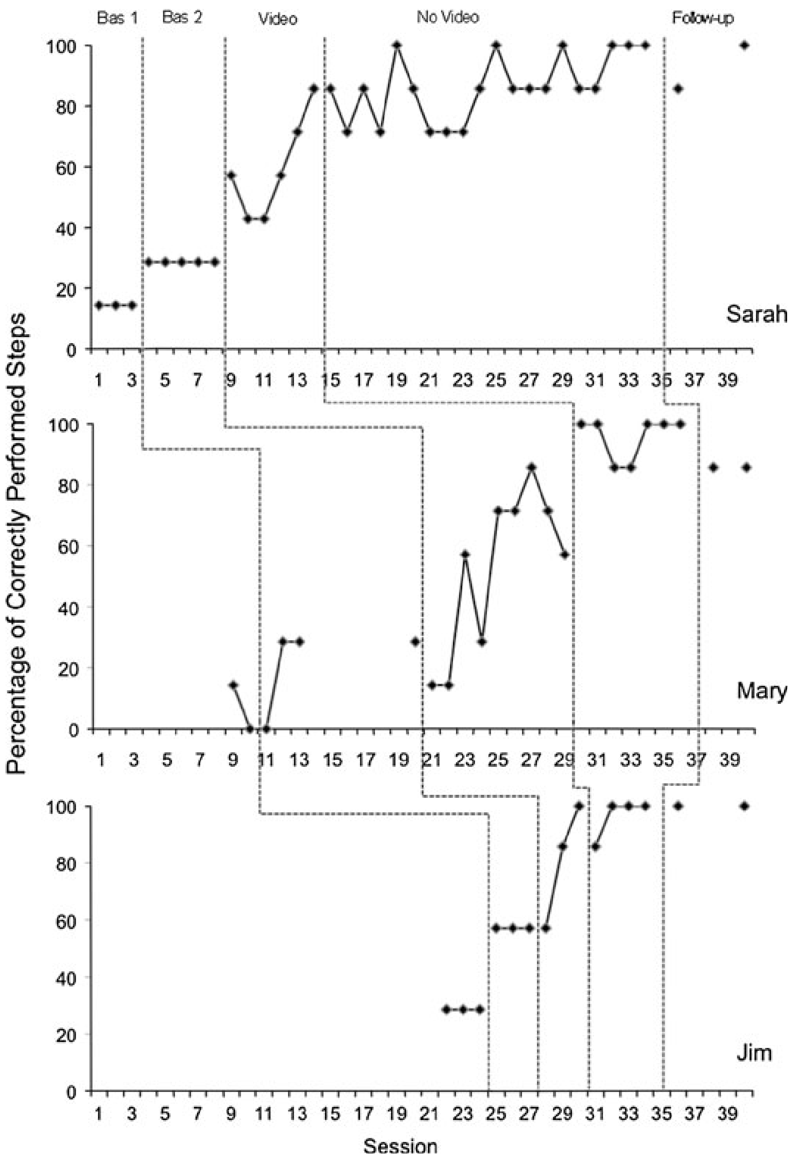

Fig. 1 Percentage of correctly performed steps

over 80% on both follow-up sessions. Jim was able to perform all steps correctly on both follow-up sessions.

Discussion

The results suggest that the instructional procedures were effective in teaching these three students to independently operate a portable media player to watch entertainment videos. These results suggest that functional use of an iPod can be taught relatively quickly and thus such devices would appear to represent a viable technological resource for some students with developmental disabilities. Learning to use such devices may enable the individual to access entertainment videos, which, for young people, could be seen as an age-appropriate leisure skill.

Skill acquisition was generally rapid, which suggests that watching the entertainment videos was motivating for the participants. Anecdotally, the participants also appeared to enjoy taking part in the sessions and learning to use the iPod. The stakeholder questionnaire may have had a positive influence in this regard. It allowed participants to indicate how they would like to learn and what they would like to watch. This degree of self-determination may explain the rapid skill acquisition because the participants had an active role in choosing to participate in the study. Also, the stimuli presented via the iPod were likely to be reinforcing as they were selected by the participants themselves. Thus, this approach of assessing stakeholder perspectives seems useful in the design of the intervention.

While acquisition was generally rapid, there were some persisting errors evident in the data. Sarah, for example, consistently made errors related to skipping the second-to-last step (returning to the home page) before turning off the iPod. It appeared that this error stemmed from her being easily distracted by her surroundings. While this step was not essential for the operation of the iPod, it was an important step in the task analysis because the other applications available on the iPod are only accessible from the home page. Anecdotally, Sarah appeared to be happy (smiling, laughing) while watching the video, but at times was distracted scrolling through the video list and had to be reminded to make a selection.

Mary also appeared to enjoy watching the videos, but at times appeared more motivated to participate in the school's activities with her peers. To accommodate her needs, the sessions were kept short and only essential probe sessions were conducted during the baseline phase. She did not miss the school activities she enjoyed but the fear of missing them was apparent in the variability of her data throughout the sessions. At the beginning of the study, Mary appeared to know what was required to complete a step but was not able to physically do it due to her restricted motor skill. She quickly learned how to handle the iPod and was able to perform the steps correctly.

Jim also appeared to enjoy watching the sports videos and would say their name before choosing the appropriate videos. At times, he would be reluctant to turn off the iPod and would try to watch a new video before being told to finish the task. He appeared to be very interested in the device and would navigate through the different applications at the end of the sessions.

One of the limitations of this study is the introduction of VM and response prompting simultaneously. It is possible that either VM or prompting alone could account for the demonstrated intervention effects. The participants had severe intellectual disabilities and were not familiar with intervention studies. The two techniques were introduced together to maximize learning for this sample. The participants were possibly more motivated to work and enjoyed the process more by learning the new skills quickly. Another limitation is the small number of participants and the fact that generalization data were not collected.

Future research should aim to determine whether participants might be differentially sensitive to direct response prompting versus VM when learning other iPod-based leisure skills, such as playing video games or listening to music.

Future research could also examine the use of VM or direct response prompting on the use of portable media players for teaching other more complex skills. This study assessed a relatively easy skill but VM has been shown suitable for a range of skills that can be more complex. These skills could benefit from the flexibility iPods provide. Portability means participants could have access to the required instruction when and where it is needed. The material could be reviewed in the setting where the task or behavior is to be performed, possibly making transference of skills easier. Participants could, for instance, use the iPod in their community library to watch a video instruction on how to find and borrow a book. Future research could also examine if VM alone is effective in teaching new skills to children with developmental disabilities. In this case, interventions could be more efficient because they would not require the constant presence of an adult to provide prompts.

Despite its limitations, the present study makes a contribution to the literature by showing that students with developmental disabilities quickly learned a new leisure activity that is suited to their age on new technology that is becoming a pervasive part of society. It also gave the students the choice of whether or not they would like to participate in the study and what their reinforcers would be. The students were perhaps more motivated to participate because they felt empowered by having a say in their learning experience. For teachers or care providers, it demonstrates that students with developmental disabilities can successfully learn appropriate leisure skills with techniques that are easy to implement.

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APPENDIX E

Research in Developmental Disabilities 32 (2011) 2987–2992

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Teaching students with developmental disabilities to operate an iPod Touch® to listen to music

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ABSTRACT

We evaluated an intervention procedure for teaching three students with developmental disabilities to independently operate a portable multimedia device (i.e., an iPod Touch®) to listen to music. The intervention procedure included the use of video modeling, which was presented on the same iPod Touch® that the students were taught to operate to listen to music. Four phases (i.e., baseline, intervention, fading, and follow-up) were arranged in accordance with a delayed multiple-probe across participants design. During baseline, the students performed from 25 to 62.5% of the task analyzed steps correctly. With intervention, all three students correctly performed 80–100% of the steps and maintained this level of performance when video modeling was removed and during follow-up. The findings suggest that the video modeling procedure was effective for teaching the students to independently operate a portable multimedia device to access age-appropriate leisure content.

1. Introduction

The ability to engage in age-appropriate leisure activities can have a positive impact on a person's social, emotional, physical, and cognitive health (Caldwell, 2005) and ultimately on their overall development and quality of life (Iwasaki, 2007; Schleien, Meyer, Heyne, & Brandt, 1995). However, individuals with developmental disabilities often lack the skills and opportunities to engage in age-appropriate leisure activities (Coyne & Fullerton, 2004; Patterson, 2004). The development of age-appropriate leisure skills in such persons is thus an important rehabilitative priority as it provides individuals with developmental disabilities with a constructive way to spend their free time and may also promote social and community inclusion (Schleien, Wehman, & Kiernan, 1981). It is therefore, important for individuals with developmental disabilities to learn skills that will enable them to independently engage in age-appropriate activities (Jerome, Frantino, & Sturmey, 2007).

Several studies have focused on teaching individuals with developmental disabilities to engage in age-appropriate leisure activities (Coyne & Fullerton, 2004; Schleien & Ray, 1988). For instance, adults with intellectual disabilities were taught how to perform a side-of-foot soccer pass (Luyben, Funk, Morgan, Clark, & Delulio, 1986), and how to operate a stereo to listen to

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music (Matson & Marchetti, 1980). An important future direction for this type of research is the development of technology-based leisure skills.

This is an important future direction because technology is an integral part of society today (Bull, 2005; Farnsworth & Austrin, 2005) and is often used for leisure purposes. Along these lines, Jerome et al. (2007) taught three men with developmental disabilities to access their preferred Internet sites to play video games and listen to music on a desktop computer. In another relevant study, Edrisinha, O'Reilly, Choi, Sigafoos, and Lancioni (2011) taught four adults with developmental disabilities how to take digital photographs and print them out using a laptop computer and a printer. These positive results suggest that people with developmental disabilities can successfully learn to use commonplace, off-the-shelf technology for leisure and recreational activities.

In line with these results, new portable devices, such as the iPod Touch®, might enable people with developmental disabilities to access age-appropriate leisure material, such as listening to music and watching entertainment videos. In a previous study, three students with developmental disabilities were taught to independently operate an iPod Touch® to watch preferred age-appropriate entertainment videos (Kagohara, 2011). The instructional procedures in the Kagohara study included video modeling and least-to-most prompting. Because both video modeling and least-to-most prompting were employed it is not clear if video modeling alone was an effective component of the intervention.

Video modeling is a procedure in which the participant watches a short video of a desired behavior or task being performed and then has an opportunity to perform the same behavior or task (Bellini, Akullian, & Hopf, 2007). Video modeling has potential advantages over the traditional methods of instruction including greater independence from carers and a more efficient and effective use of resources and time (Sigafoos, O'Reilly, & Cruz, 2007).

Given the potential benefits of video modeling, the present study aimed to extend the previous research of Kagohara (2011) by focusing on three students with developmental disabilities to engage in a new leisure skill using an iPod Touch®. It appears no studies have yet attempted to teach students with developmental disabilities how to listen to music on portable multimedia devices. The present study, therefore, examined if participants could learn how to independently operate an iPod Touch® to listen to music with video modeling as the only instructional procedure. A study of this type is important as the evaluation of video modeling alone may enable professionals to design more efficient instructional strategies when teaching students to use technology, such as an iPod Touch®, to access age-appropriate leisure materials.

2. Methods

2.1. Participants

Three students participated in the study. They all attended the same classroom in a special education school for students with disabilities. The participants' classroom was composed of five students, a teacher, and two teaching assistants. The participants had been part of a previous study where they learned how to independently operate an iPod Touch® to watch preferred movie clips (Kagohara, 2011). On generalization probes, they did not show the ability to use the iPod Touch® to listen to music, hence they were recruited for the present study.

Sarah was a 20-year-old female with severe intellectual disability and epilepsy. On the Vineland-II Adaptive Behavior Scales (Sparrow, Cicchetti, & Balla, 2005), Sarah received an overall standard score of 38, which is approximately four standard deviations below the mean and indicative of an extremely low level of adaptive behavior functioning. She presented visual and motor skills in the normal range according to school reports.

Mary was a 16-year-old female with cerebral palsy and severe intellectual disability. Her overall Vineland-II standard score was 52, which is approximately three standard deviations below the mean and indicative of a low level of adaptive behavior functioning. Her motor skills were somewhat affected by the cerebral palsy, but she was able to manipulate small objects effectively. Her visual skills were in the normal range according to school reports.

Jim was a 15-year-old male with Klinefelter syndrome and severe intellectual disability. His overall standard score on the Vineland-II was 43, which is approximately 3.5 standard deviations below the mean and indicative of a low level of adaptive behavior functioning. He presented with visual and motor skills in the normal range according to school reports. Besides previous experience using iPods to watch videos reported in Kagohara (2011), Jim was part of another study where he was taught to make simple requests on an iPod Touch® that was programmed as a speech-generating device (van der Meer et al., in press).

2.2. Setting

All sessions were conducted in the participants' classroom. The participants sat at the table with the trainer to their left. For sessions where interobserver and procedural integrity data were collected, a second and third observers were present in the classroom.

2.3. Materials

An iPod Touch® (16GB, 2nd generation) was used for video modeling delivery and as the portable multimedia player in which the songs could be selected and listened to. No modifications were made to the software and no additional hardware was used.

2.4. Stakeholder questionnaire

A questionnaire was created to give the participants, as stakeholders, an opportunity to consent to their involvement in the study and to identify their preferred music stimuli to be used in the study. The participants were asked: (a) if they would like to learn how to use the iPod, (b) what music they enjoyed listening to, (c) and how they preferred to learn (i.e., reading instructions, looking at pictures, watching a video, someone showing them the steps, or someone giving them physical prompts). All participants indicated by verbalizing that they would like to learn how to use the iPod. They had difficulties identifying music that they liked so their teacher was asked to list songs that they appeared to enjoy listening to in the classroom. The participants then indicated by verbalizing that they did in fact like the songs nominated by the teacher. They also indicated that watching a video was their preferred method for learning.

2.5. Task analysis

A task analysis was undertaken to identify the steps required to operate an iPod to listen to music (see Table 1). The 8-step task analysis was validated by three iPod-inexperienced users without disabilities who successfully followed the steps to operate the iPod.

2.6. Video model

The validated task analysis was used to create a 34 s video instruction for the video modeling phase of the study. The video was recorded from a subjective viewpoint (as if seen by the participant) with an iPhone® and edited with iMovies®. The movie was loaded on the iPod Touch's video list. The video showed a pair of hands operating the iPod to find and start a song by following the steps in the task analysis.

2.7. Experimental design

A delayed multiple-probe across participants design was used in this study (Kennedy, 2005). The independent variable was the video modeling instruction and the dependent variable was the number of steps in the task correctly performed without assistance. The intervention consisted of baseline, intervention (video modeling), fading, and follow-up phases. Verbal praise was given for attending and attempts to perform any steps. The order in which participants received the intervention was based on their availability.

2.8. Baseline

For each baseline session, the participant was given the iPod Touch®. The iPod was turned off and the volume was turned to mute. The participant was verbally instructed to turn the iPod on and listen to a song. The participant was then observed for the next 30 s and the number of steps completed independently was recorded. After 30 s with no correct attempts, the session was terminated.

2.9. Video modeling

The video modeling phase started with the presentation of a video depicting the steps necessary to operate an iPod to listen to music. The video was presented on the iPod itself. The participants were asked to watch the video. The video was shown up to three times depending on the participants' level of attention. After the video was shown, the iPod was given to the participants and they were asked if they could turn it on and listen to a song. The participants were given 10 s to perform each step. A response was recorded as correct if the step was independently performed within the 10 s. If the participants did not correctly perform the step in this period, the trainer asked for the iPod back and completed the step out of the participant's sight. The iPod was then returned to the participant and he or she was asked to perform the next step (e.g., "Can you turn the volume up?"). This process continued until opportunities to perform all steps of the task had been provided.

Table 1
Task analysis of listening to a song on the iPod.

Step	Description
1.	Turn on the iPod – press the "home" button
2.	Unlock the screen – slide button with the arrow to the right
3.	Launch the music application – tap the "music" icon
4.	Select the song – find the song you wish to listen to and tap its name
5.	Adjust the volume – slide the volume control on the screen
6.	Pause song – tap the "pause" symbol on the screen
7.	Leave the music application – press the "home" button
8.	Turn off the iPod – press the "off" button on top of the iPod

2.10. Fading

In the fading phase, the video was not shown at the beginning of the session. The rest of the procedure was the same as in the video modeling phase.

2.11. Follow-up

The follow-up phase was conducted 4 and 9 weeks (5 and 10 weeks for Sarah) after the last intervention session. The participants had no access to the iPod during this time. Procedures were the same as in baseline.

2.12. Inter-observer agreement

A second observer independently gathered data on participants' performance during all sessions. Inter-observer agreement (IOA) was determined by comparing the data collected during each session by the trainer and independent observer on a step-by-step basis. IOA was calculated with the following formula: agreements/(agreements + disagreements) $\times$ 100%. IOA ranged from 75 to 100% with an overall mean of 98%.

2.13. Procedural integrity

The second observer used a checklist to ascertain if the procedures were correctly implemented by the trainer during each session. The baseline, intervention, fading, and follow-up procedures were followed correctly during 100% of the sessions. The third observer independently collected inter-observer data on the procedural integrity checks for 32% of all sessions. The resulting percentage of agreement was 100%.

3. Results

Fig. 1 shows the percentage of steps performed independently during each session and phase of the study for Sarah, Mary, and Jim. During baseline, Sarah correctly performed only two steps (25%) of the task. When the video modeling intervention was introduced, she steadily learned more steps. On sessions 12 and 13 (conducted on the same day and marked with an arrow in the graph), she did not watch the video because she started performing the task independently before the trainer could start the video model. Her performance improved, reaching 100%, but she asked and was shown the video presentation the following week. Interestingly, her performance declined before improving again. When the fading phase started, she consistently performed above 87%. On the follow-up phase, she continued to correctly perform seven (87%) out of the eight steps.

Mary only completed two (25%) of the steps of the task during baseline. When video modeling was introduced, her performance improved and remained stable. She watched the video twice on the first session, but on following sessions watched it once. She attended to the video and could find and launch it on her own. On session 12 (marked with an arrow) she did not watch the video because she seemed to believe she would miss the music class that was starting after the session and started performing the task before the trainer could show her the video. During the fading phase, she consistently performed above 75%. Follow-up shows she could still perform seven (87%) out of the eight steps.

Jim's correctly performed up to five (62%) steps of the sequence during baseline, but he was not successful in listening to music. When video modeling was introduced, his performance improved to correctly performing 87% or more of the steps. He did not watch a video on session 13 (marked with an arrow) because he started to perform the task prior to the trainer providing video prompting. He correctly performed at 87% or above when the video was removed during the fading phase and during follow-up.

4. Discussion

The percentage of correct steps performed independently increased for all three participants when intervention was introduced. These results suggest that the intervention was effective and that age-appropriate use of an iPod Touch® for leisure purposes was acquired as a result of the video modeling procedure. A unique feature of this study was that the video showing how to use the iPod Touch® to listen to music was presented to the participants on the iPod Touch® itself. The iPod Touch® also carried the stimuli the participants wanted to access, making external materials and reinforcers unnecessary.

As noted in section 1. Introduction, video modeling has potential advantages over traditional teaching strategies. The iPod Touch® is portable and thus would allow video models to be carried out in any setting. All the teaching materials and reinforcers were in the iPod Touch® itself so conducting the intervention was essentially a matter of giving the iPod Touch® to the students in an appropriate setting. Another possible advantage is that video modeling intervention can be easily implemented with minimal effort from parents and teachers. Video modeling employs previously recorded instructions and they can be watched numerous times and in different places without additional equipment or effort. In addition, if video modeling is used with no other strategies, participants could learn how to start the instructional video themselves and as a

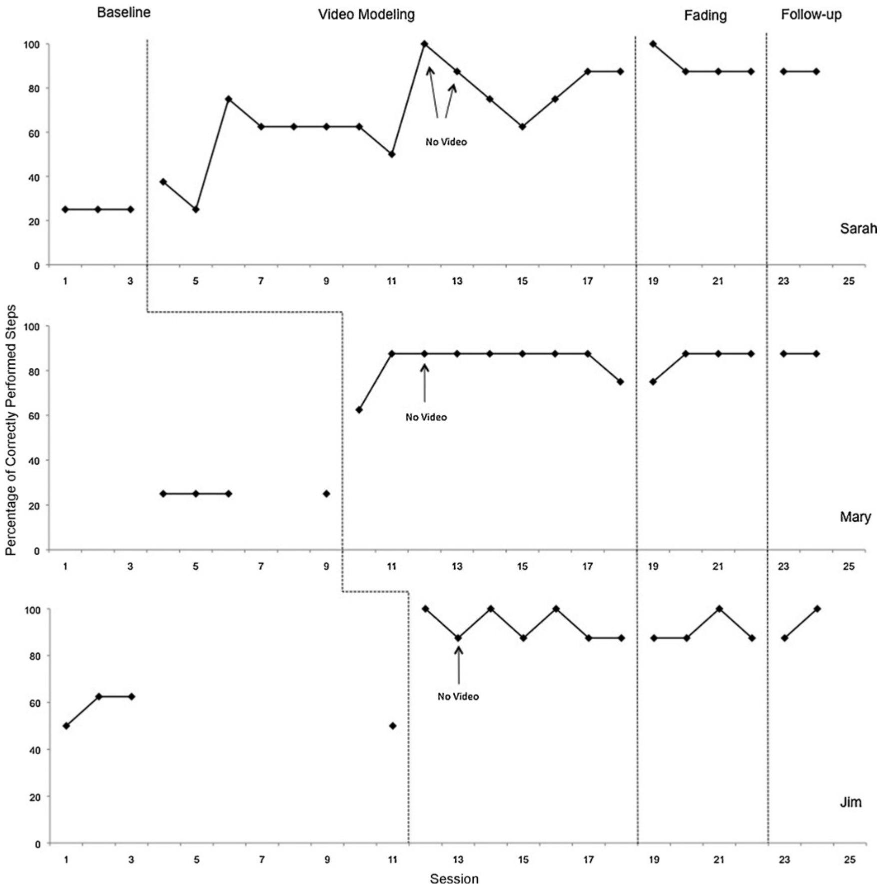

Fig. 1. Percentage of correctly performed steps.

result may become more independent. Individuals with developmental disabilities could potentially learn new skills mostly unsupervised because there is no need for further instructions from adults or additional reinforcement.

The skill taught in this study was selected to enable the participants to engage in an age-appropriate leisure activity that is typically available to the general population. As discussed earlier, giving children an opportunity to engage in such activities can improve their overall quality of life (Iwasaki, 2007; Schleien et al., 1995). Learning to listen to music on an iPod Touch® might also promote greater inclusion by allowing individuals with developmental disabilities to share common interests with others.

This study's positive findings may have been due to the fact that listening to music seemed to be an effective type of reinforcement for the participants as they readily complied with the request to participate in sessions and accepted the iPod Touch® when it was offered to them. The participants also often sang or hummed the songs they were listening to and danced while the music was playing. The participants also seemed to enjoy watching the instructional video. Sarah, for instance, once asked to watch the instructional video another time before she started the session.

The stakeholder questionnaire implemented prior to baseline seemed to provide information that enhanced the intervention. For example, the students may have been more motivated to participate in this learning activity because they were allowed a degree of self-determination with respect to choosing songs and being taught by watching the instructional video on the iPod Touch®.

While video modeling alone appeared to be effective in teaching the participants to use to iPod Touch® to listen to music, it is possible, that the participants improved performance with intervention could have been due to observing the trainer completing steps of the task analysis, which occurred at times during the video modeling phase of the study. This is unlikely, however, because the trainer completed each step out of the participant's sight.

Another factor that may explain the positive results could be the participants' previous exposure to the iPod Touch® to watch entertainment videos as reported in Kagohara (2011). This prior experience may have made it easier to teach the participants to use the iPod Touch® to listen to music because some of the steps needed for listening to songs were the same as for watching an entertainment video. However, as the baseline data in the present study indicate, the participants did not generalize completely from the previous learning of using the iPod Touch® to watch entertainment videos to the current study of using the iPod Touch® to listen to music. It is possible however that video modeling alone would not have been an effective intervention in the absence of this prior experience in learning to use the iPod Touch® to watch entertainment videos.

While the video modeling intervention was associated with an increase in the percentage of steps performed correctly, participants did not consistently perform all of the steps of the task analysis throughout the intervention phase. This is a limitation of the intervention. However, even though the participants did not always complete the task analysis with 100% independence, their increased proficiency level was still meaningful in that it enabled the participants to participant more independently in an age-appropriate leisure skill. Still, future research should focus on enhancing the present intervention to produce 100% independence. Future research should also aim to replicate the effects of this type of video modeling intervention with more complex tasks, such as using an iPod Touch® for multiple-player games.

Despite the aforementioned limitations, this study contributes to the literature by demonstrating that the three students with severe developmental disabilities became more independent in listening to music using an iPod Touch®. The provision of a video modeling intervention delivered via the iPod Touch® is a unique aspect of the study that may offer several advantages over teacher-delivered instruction and other types of video-based instruction. The solicitation of the participants' perspectives is also a unique aspect of the study that suggests a possible way for participants to self-determine aspects of the interventions they receive.

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APPENDIX F

iPlay: Teaching leisure skills to children with developmental disabilities

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This poster presents the findings of two studies that employed video modeling, delivered on an iPod Touch®, to teach leisure skills to three students with developmental disabilities. Leisure activities are important for children's overall development and quality of life (Iwasaki, 2007). However, students with developmental disabilities may not have the necessary skills or the same opportunities to access leisure activities (Thompson, Whitmarsh, Southern, Brewster & Emira, 2009).

Video modeling involves learners watching a video of a model performing a task or behavior that they can then imitate (Sigafoos, O'Reilly, & Cruz, 2007). Video modeling has been successfully used to teach a range of skills to children with ASD (Bellini & Akullian, 2007).

iPods and similar portable devices provide an alternative to the traditionally employed televisions and desktop computers. These devices offer a range of applications and allow for flexible intervention delivery. In addition they appear to be highly motivating to children.

Method

Participants. Three participants, aged 15 to 19, took part in both studies. All participants had a diagnosis of severe developmental disability.

Procedure. A delayed multiple-probe design across participants was implemented with baseline, intervention, fading, and follow-up phases. Intervention consisted of a video demonstrating how to watch video clips (Study 1) or listen to music (Study 2) on the iPod. The first study employed video modeling and least-to-most prompting while the second examined the effects of video modeling alone.

Results

Discussion

The results from both studies are in line with previous research suggesting video modeling is an effective instructional strategy (Kagohara, 2010).

The studies also add to the literature by demonstrating how portable devices can be successfully used to teach age-appropriate leisure skills to individuals with developmental disabilities and to provide them with opportunities to independently engage in recreational activities.

Presented at the
ABAI's 6th International Conference 2011, Granada, Spain

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APPENDIX G

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Teaching children with autism spectrum disorders to check the spelling of words

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A R T I C L E I N F O

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A B S T R A C T

This study aimed to teach two students with autism spectrum disorders (ASD) to check the spelling of words using the spell-check function on common word processor programs. A multiple-baseline across participants design with baseline, video modeling, and follow-up phases was implemented. During baseline, the participants performed less than 40% of the task-analyzed steps correctly. When the video modeling intervention was introduced via an iPad®, both participants reached the 76–100% correct level on the task analysis and became more successful in using the word processor programs to check the spelling of words. Follow-up data showed 100% correct performance by both participants. The results suggest that the video modeling intervention, delivered via an iPad®, was effective in teaching two adolescents with ASD to check the spelling of words using common word processing programs.

1. Introduction

Children with autism spectrum disorders (ASD) often present with social and learning impairments that can interfere with their ability to cope with the demands of academic work (American Psychiatric Association, 2000; Matson & Wilkins, 2008). Nonetheless, many are mainstreamed into regular classrooms (Attwood, 2007; Goodman & Williams, 2007). With the increasing prevalence of ASD in recent years (Matson & Kozlowski, 2011), the number of children with special educational needs in regular schools is likely to increase. While many students with ASD have average to above average cognitive abilities, they may still struggle with the demands of the regular classroom and therefore require additional assistance or different arrangements to enable them to successfully complete schoolwork (Attwood, 2006; Carrington & Graham, 2001).

The need to provide extra support and accommodation to students with ASD may increase demands on teaching staff, disrupt the classroom routine, and negatively impact on students' academic progress. It would therefore be advantageous to teach children with ASD to independently perform the academic tasks required of them. Learning such skills would not only give teaching staff more time to complete other duties, but would also promote the students' independence and free them from the need to seek adult assistance. This in turn might allow them to work more cooperatively with peers, thereby possibly increasing opportunities for age-appropriate social interactions, increase academic achievement, and improve their self-esteem (Attwood, 2007; Davies, Stock, & Wehmeyer, 2002).

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One promising way of enabling children with ASD to independently perform the academic tasks required of them involves teaching them to use common resources, such as computer-based word processing applications. Along these lines, computers, laptops, and other portable devices have been employed in interventions aimed at teaching a range of academic skills to children with ASD (Mirenda, Wilk, & Carson, 2000). For instance, Ferguson, Myles, and Hagiwara (2005) taught an adolescent with ASD to use a personal digital assistant (PDA) for greater independence. The participant used the PDA to help him with school-based tasks, such as remembering what materials he should take out for class and when it was time to transition to another task. Another study (Myles, Ferguson, & Hagiwara, 2007), taught an adolescent with ASD how to use a PDA to improve his recording of homework. The student was able to independently record more complete information about his assignments with the help of the PDA. These findings suggest that computer-based technologies might be useful educational aides for students with ASD.

In terms of emerging technology, devices such as the iPod® and iPad® can now be fitted with a wide range of educationally relevant applications. For instance, iPods® have been used as a prompting device for a man with developmental disabilities in an employment setting (van Laarhoven, Johnson, van Laarhoven-Myles, Grider, & Grider, 2009) and as speech-generating devices for children with developmental disabilities (Kagohara et al., 2010; van der Meer et al., in press).

A particularly useful feature of iPods®/iPads® is that these devices can show video, which offers the possibility of using video modeling as part of the instructional strategy. Video modeling has been shown to be an effective strategy for teaching children with ASD (Bellini & Akullian, 2007; Delano, 2007b; Kagohara, 2010; Kagohara et al., 2011). It entails the presentation of a video segment showing the participant how to perform a specific task. The participant is then given an opportunity to imitate the video and in this way often learns to perform the task independently. Video modeling has some potential advantages over other instructional strategies, including the lower cost and time commitment, the increased control over procedural integrity due to the pre-recorded instruction, and the constant accessibility to instruction because the video can be permanently available (Bellini & Akullian, 2007; Sigafoos, O'Reilly, & de la Cruz, 2007). Video modeling may also facilitate quicker learning and generalization of skills (Charlop-Christy, Lee, & Freeman, 2000). When video modeling is presented on an iPod®, the instruction can be easily transported and thus easily delivered in different settings (van Laarhoven et al., 2009). Individuals can keep the necessary guidance close to them so that the instructional video can be easily reviewed. Along these lines, video modeling delivered on an iPod Touch® has been successfully used to teach leisure skills to students with developmental disabilities (Kagohara, 2011; Kagohara et al., 2011) and improve transitional behavior for students with ASD (Cihak, Fahrenkrog, Ayres, & Smith, 2010).

While video modeling has been used to teach a range of skills, relatively less research has focused on its use for teaching academic skills (Bellini & Akullian, 2007; Kagohara, 2010). In one relevant study, Kinney, Vedora, and Stromer (2003) used video modeling to teach a girl with ASD to spell words. Delano (2007a) also used video modeling to improve the written language performance of adolescents with ASD. These two studies suggest that video modeling is useful for teaching academic skills to students with ASD.

To successfully participate in academic activities, school-aged children need to gain competence in written language. Students have to be able to read and write to complete homework and assignments. Being able to correctly spell words is an important skill. The learning process will likely involve the use of a dictionary or similar resources, but students with ASD may have difficulties using these materials without assistance. If they learn how to independently check the spelling of words and correct their own work, their academic competence may increase while the demands on the teacher or teacher aid might decrease.

To extend previous research in this area, the present study aimed to teach two students with ASD to use the spell-check function on a word processor. The teaching intervention involved the use of video modeling. A unique aspect of the intervention was that the instructional video was presented on an iPad®. The appropriate university ethics committee approved the study prior to obtaining parent and teacher consent.

2. Method

2.1. Participants

Two students with ASD took part in the study. Both attended mainstream classrooms with an average of 25 other students and were supported by a part-time teaching assistant. Dan was a boy with diagnoses of Asperger syndrome (AS) and Attention Deficit Hyperactivity Disorder (ADHD). He was 12 years and 1 month old at the beginning of the study. He was taking medication for the ADHD and could sit for extended periods of time during the sessions, but had some attention issues. Results of an assessment using the second edition of the Vineland Adaptive Behavior Scales (Vineland II; Sparrow, Cicchetti, & Balla, 2005) indicate a low adaptive level. For the Communication Domain, Dan obtained age equivalencies of 4:7, 5:7, and 8:6 (years:months) on the *Receptive*, *Expressive*, and *Written* subdomains, respectively. For the Socialization Domain, he obtained age equivalencies of 2:2, 5:11, and 7:1 (years:months) on the *Interpersonal Relationships*, *Play and Leisure Time*, and *Coping Skills* subdomains, respectively. Dan had a good vocabulary and could have conversations about topics that interested him (namely technology and speakers). One of the educational goals set for Dan was for him to be able to correct the spelling of words on his homework. He used a computer and had some experience writing with a word processor, but his teacher indicated that he did not use the spell check function on the word processor to check the spelling of words.

Jane was a girl with diagnoses of AS and ADHD. She was 10 years and 7 months old at the beginning of the study. She received medication for the ADHD and could work and attend to tasks. Her scores on the Vineland II (Sparrow et al., 2005) indicate a moderately low adaptive level. Her *Receptive*, *Expressive*, and *Written* subdomains age equivalencies were 2:11, 5:6, and 8:0 (years:months), respectively. Age equivalencies for *Interpersonal Relationships*, *Play and Leisure Time*, and *Coping Skills* were 5:11, 6:7, and 7:6 (years:months), respectively. She could engage in simple conversations about daily activities and things she liked. She reportedly enjoyed reading and had a good vocabulary. She was not proficient in using a word processor according to her teacher.

2.2. Setting

Baseline, intervention, and follow-up sessions were conducted in the participants' respective schools. Dan's sessions were conducted in his classroom. Dan had a separate space in the classroom's corner where he worked with the teaching assistant. Sessions were conducted in this corner while the other students were having regular lessons. Jane's sessions were run either in her classroom during lesson breaks or in a separate room when the other students were having lessons. Jane was the only student present during her sessions. During all sessions, the participant sat at a table with the trainer (first author). When reliability data were collected, a second observer was present.

2.3. Materials

2.3.1. Stakeholder questionnaire

The participants, as stakeholders, had an opportunity to provide input into the study design via a stakeholder questionnaire. The questionnaire involved asking the students if (a) they would like to work with the computer, (b) what things they liked watching or playing (e.g., cartoons, video games), and (c) if they would like to learn by watching a video on the iPad®. The students answered these questions by listing things they liked to watch and play and by affirming their interest in learning to work on the computer by watching a video.

2.3.2. Word processing applications

During the sessions, Dan used *Apple's Pages* on his iMac and Jane used *Microsoft's Word* on a Windows®-based desktop. These programs and the equipment were selected due to their availability in the student's classroom.

2.3.3. Task analysis

A task analysis (see Table 1) was constructed with the steps necessary to successfully use the spell-check function on the word processor program (i.e., either *Microsoft's Word* or *Apple's Pages*). The word processor task had five different steps (see Table 1), but five words were given to the participants in each session, therefore Steps 2–4 were repeated five times for a total of 17 steps per session. The task analysis was validated by three nondisabled adults. Each checked if they could successfully complete the task by following the steps of the task analysis, which they could.

2.3.4. Instructional video

The task analysis was used to create an instructional video to be shown in the intervention (i.e., video modeling) phase of the study. The instructional video was recorded from a subjective viewpoint (as if from the observer's perspective) with an iPhone®, edited on iMovies® and loaded on a 16GB iPad®. The video was 2 min and 4 s in duration and showed the steps of the task analysis being followed in sequence for checking the spelling of three words. A pair of hands operated a computer and a keyboard to open the word processor, type words, and check for correct spelling using the spell-check function.

2.3.5. Target words

The words used in the sessions were selected from the *Ayres List of Most Common Words Used in English* (Ayres, 1915). The list is widely used to teach spelling to school aged children and the words in it were likely to be regularly present in the students' classroom and schoolwork. The words were selected randomly from the list and given to the participants in the order they appear in Table 2. The words were not necessarily novel because the aim of the study was not to teach new words. Rather, the study was intended to teach the participants how to check the spelling of words.

Table 1
Task analysis for using the spell-check function on the word processor.

Step	Description
1.	Click the word processor icon on the computer to launch the application
2.*	Type the word as you think it is spelled
3.*	If there is a red line under the word, right click with the mouse to find suggestions and select appropriate spelling. If the line is green the word is spelled correctly
4.*	Show the word to the trainer when you think it is spelled correctly
5.	Close the application by clicking the "close" button on the page

* Steps 2, 3, and 4 are repeated five times (one for each word in the session set) before the final step (5).

Table 2
Target words For Dan and Jane.

Dan Session. Words	Jane Session. Words
1. Please, night, good, think, house	
2. Other, year, before, next, today	
3. Before, morning, three, people, church	
4. Work, number, doctor, book, life	
5. Time, make, after, today, many	
6. Truly, take, great, home, mother	
7. Week, want, girl, fire, paper	
8. Nothing, return, Friday, cold, picture	
9. Very, hope, first, Sunday, children	
10. Eight, nine, long, day, afternoon	
11. About, never, money, under, because	
12. Like, street, look, friend, hand	12. House, eight, nine, after, under
13. Tomorrow, away, office, most, give	13. Other, year, before, next, today
14. Sometimes, yesterday, child, ground, best	14. Work, number, doctor, book, life
15. Late, little, Tuesday, head, business	15. Time, make, after, today, many
16. Thursday, party, believe, back, talk	16. Nothing, return, Friday, cold, picture
	17. Eight, nine, long, day, afternoon
	18. Sometimes, yesterday, child, ground, best
	19. Week, want, girl, fire, paper
	20. About, never, money, under, because
	21. Tomorrow, away, office, most, give
	22. Before, morning, three, people, church
	23. Please, night, good, think, house
	24. Truly, take, greet, home, mother

2.4. Experimental design

A delayed multiple-baseline across participants design was employed in this study with baseline, video modeling intervention, and follow-up phases (Kennedy, 2005). The study had a delayed baseline because Jane was unavailable when the baseline procedures began with Dan. Due to scheduling constraints, Dan had one session a week, whereas Jane had two sessions per week. For both Dan and Jane, only one session was conducted on any given day.

2.5. Response definition and measurement

The dependent variable was the number of steps in the task analysis that were performed correctly during each session. For each session, the trainer recorded which steps in the task analysis had been performed correctly within the allocated period of time (see Section 2.6). Data were recorded on a prepared data sheet and for each of the five words presented in the session.

2.6. Procedures

2.6.1. Baseline

At the start of each baseline session, Dan and Jane were first asked to start the word processor software. If they did not open the word application within 30 s, the trainer performed the step out of the participants' sight. The trainer then read a word out loud to the participant and asked him or her to type the word, check the spelling of the word, and show the trainer the correct spelling on the computer. For instance, on Jane's first session, the trainer asked her to type the word *house* and then check if it was spelled correctly. A correct response was recorded if the step was independently completed within 5 s, so as to ensure development of proficient and fluent use of the spell-check function. If Dan or Jane did not perform the step correctly within 5 s, he/she was praised for his/her effort and given an instruction to attempt to spell and spell-check the next word on the list (e.g., "Can you type the word *eight* and check if the spelling is correct?"). If 30 s elapsed without an attempt to type or check the spelling of a word, the session was terminated. This process was repeated until all five words in the set for that session (see Table 2) had been presented. Once all five words had been presented, the trainer asked the participants to close the application. At the end of the session, the participant was given the opportunity to play with the iPad® (e.g., play games, watch video clips) for 5 min, which was unrelated to their performance on the task analysis.

2.6.2. Intervention

During the intervention phase, the video modeling instruction was presented on an iPad® before the session began. This involved the trainer starting the video clip on the iPad® and asking the participant to watch the video. If the participant did not attend to the video, the trainer repeated the request to watch the video and it was shown a second time. After viewing the video, participants were then asked to perform the task as in baseline. As in baseline, a correct response was recorded if the step was correctly performed within 5 s. If the participants completed the step, they were praised for the effort and given the next word in the list. If the participants made incorrect attempts, the trainer asked them to think of the video they watched and try to do the same. No other instructions were given. If no attempts were made in 30 s, the session was terminated.

2.6.3. Follow-up

Follow-up sessions for Dan were conducted 4, 5, and 10 weeks after the final instruction session and after 3 and 5 weeks for Jane. The follow-up procedures were the same as in baseline. The participants had no video instruction in the period between the last session of intervention and first follow-up session.

2.7. Inter-observer agreement

A second observer independently gathered data on participants' performance during 34% of all sessions to ascertain the reliability of recorded data. Inter-observer agreement (IOA) was determined by comparing the data collected during each session by the trainer and independent observer on a step-by-step basis. IOA ranged from 41 to 100% with an overall mean of 93%.

2.8. Procedural integrity

Procedural integrity was measured on 34% of sessions. The second observer used a checklist to record if procedures were followed as specified. The results were that the procedures were recorded as having been implemented correctly on 98% of these checks.

3. Results

Fig. 1 shows the percentage of correctly performed steps by Dan and Jane. During baseline, Dan's performance was consistently below 30% correct, on one occasion (Session 5) he correctly checked the spelling of one word. When video modeling was introduced, Dan's performance increased and remained above 75%. At the 4, 5, and 10-week follow-up sessions, Dan performed the task with 100% accuracy.

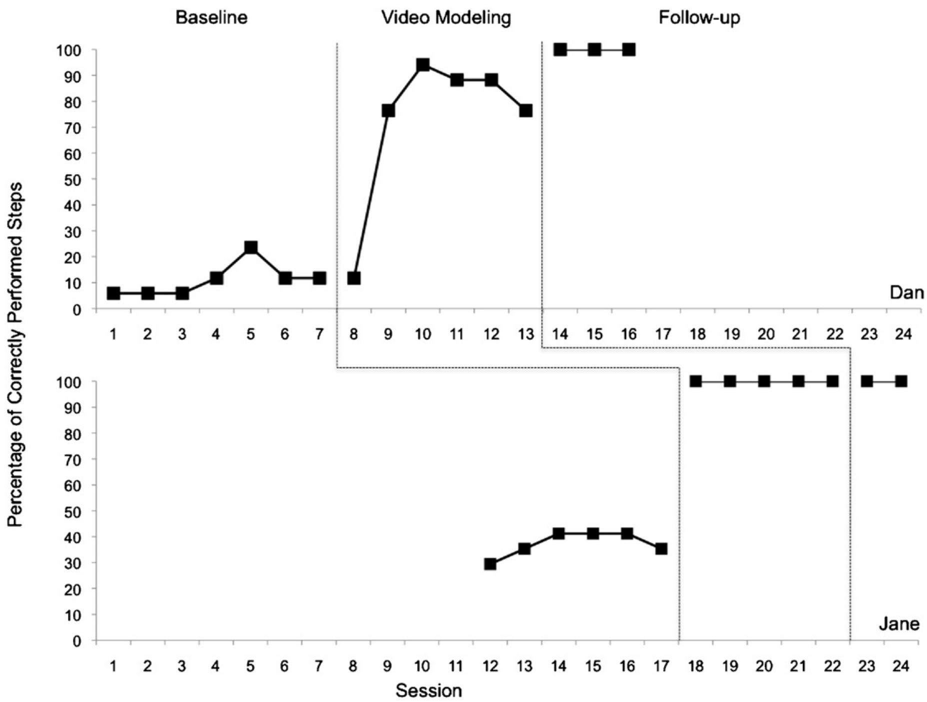

Fig. 1. Percentage of task analyzed steps performed correctly for Dan and Jane during baseline, video modeling intervention, and follow-up.

During baseline, Jane's performance was consistently below 40% correct. Although she did consistently perform several steps in the task analysis (i.e., starting the word processor program, typing the words as she thought they were spelled), she never successfully checked the spelling of a word during baseline. When the intervention started, Jane correctly performed 100% of the steps across her five intervention sessions. During her follow-up sessions at 3 and 5 weeks, Jane performed 100% of steps correctly.

4. Discussion

Both students successfully learned how to find the spelling of words using the spell-check function on a word processor. The percentage of correct steps performed by the participants increased when the intervention was introduced and remained at 100% correct at follow-up. This is an important outcome as it suggests the students could now be more independent in this aspect of an important academic task. However, the findings should be viewed with caution because only two participants were involved in the study. Other limitations include lack of generalization assessment to other words and a relatively short follow-up period.

In addition to demonstrating successful learning of an important academic skill, this study also supports the use of video modeling as an instructional strategy (Bellini & Akullian, 2007; Kagohara, 2010). The use of video modeling in this study allowed the intervention to be easily conducted in different schools and still retain procedural integrity, as the pre-recorded video instruction was always the same. Video modeling can also be seen as relatively inexpensive and perhaps easier to implement than other teaching strategies, involving procedures such as response prompting and prompt fading. While video modeling appeared to be an effective intervention, the participants also received praise for the effort, which may have functioned as a reinforcement. In addition, when participants made incorrect attempts during intervention, the trainer asked them to think of the video they watched and try to do the same. Thus it is possible that this use of praise and additional verbal instruction may have been effective and perhaps even necessary components to the intervention. Still, the large and rapid improvement for both Dan and Jane once intervention began suggests that the video modeling procedure was largely responsible for the positive intervention effect.

The video modeling procedure seemed to be well accepted by the participants and the teachers. Dan's teacher indicated that he was always enthusiastic when informed it was a session day. Indeed, on such days, he was quick to take his place in his working area and sat quietly waiting for the session to begin. Jane also appeared to be happy to participate in the study. She would run to the computer and become talkative, something she seemed to do when she was pleased, whenever it was time for the sessions.

The positive effects of the intervention may have been due to the novelty effect of delivering the video-based instruction on an iPad® as the participants seemed interested in this device. Dan and Jane seemed to look forward to watching the video model on the iPad® prior to the sessions and having access to the iPad® after each session.

The inclusion of the stakeholder questionnaire may also have had some positive impact on the results of this study. That is, motivation to cooperate and learn may have been increased by soliciting the participants' assent to participate and giving them choices regarding which games and videos they would like to play or watch on the iPad® after each session. By using information from the stakeholder questionnaire in this way, the participants could also be seen to have some degree of self-determination with respect to the intervention they received, which might also have increased their motivation to participate.

Future research could replicate the study with other students and examine the intervention effectiveness with children of other ages. Future research is also needed to extend the use of iPads® and video modeling to other academic tasks, such as note taking and calculating math problems.

In closing, the results of the present study support the use of video modeling and new portable technology (e.g., iPad®) to teach an academic skill to two students with ASD. These findings are important because while some students with ASD may have adequate cognitive skills, they may still require additional support when mainstreamed into regular classrooms. The strategies used in this study could be useful in giving these students more independence in completing academic tasks.

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