Improving social and behavioural functioning in children with autism spectrum disorder: A videogame skills based feasibility trial

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Abstract

Autism spectrum disorder (ASD) is a neurodevelopmental disorder identified in early childhood that is characterised by social, communication and behavioural impairments. Affecting approximately 1-2% of the population, ASD is a prevalent disorder and there is increasing demand for effective and accessible intervention services. The aim of this thesis was to obtain preliminary data on the feasibility of using specifically designed videogames as an intervention for improving social and behavioural functioning in children with ASD.

A systematic review of the literature was conducted to explore the current evidence-base for videogame interventions targeted at improving core deficits in children and adolescents with ASD. This review identified 19 studies that met inclusion criteria and found that evidence of efficacy was generally apparent despite varying methodologies. The most common methodology used a treatment package approach combining videogame based learning with another intervention (typically human administered) such as social skills training (n = 11). Although these interventions demonstrated promise, none accounted for the effects of the individual treatment components (e.g., videogames vs human instruction). The other common methodology utilised videogames as an intervention on their own (n = 8). These sole videogame based interventions demonstrated similar promise to the interventions using a mix of computer and human mediated approaches, but were generally based on weaker research designs. Combined, the findings from this review highlight the promise of videogame interventions for improving core deficits in children and adolescents with ASD, but recommend further research on specific videogame interventions with more rigorous methodological designs.

The studies presented in this thesis researched a specific videogame intervention using a rigorous methodological design. The studies focused on one videogame: Whiz Kid Games, which is a freely accessible, online videogame based intervention for children with
ASD aimed at improving independent living skills and social skills in children with ASD. It was designed by a team drawn from Swinburne University’s National eTherapy Centre, Multimedia Design Program, and an ASD-specialist school (Bulleen Heights School). Development of the program was undertaken by 80 multimedia design students, eight multimedia and design lecturers as well as ten autism experts. Whiz Kid Games consists of five games targeting core deficits in ASD such as coping with change, matching emotions, following a route (way finding/directions) and making eye contact. The basic structure of the games are based on operant conditioning learning strategies using reinforcement principles. For example, if the participant selects a correct response, he or she is positively reinforced (e.g., verbal praise or a spinning star). If the child makes an incorrect response, he or she is negatively reinforced (e.g., removal of the incorrect stimuli to increase the likelihood of a correct answer). Although this intervention is currently in wide use internationally and, as a freely accessible resource, represents a highly accessible intervention, there has been no research on the feasibility of its use.

Study 1 was designed to obtain preliminary data regarding the feasibility and efficacy of using Whiz Kid Games as a social and behavioural intervention for children with ASD. Difficulties in social and behavioural functioning in children with ASD often lead to increased familial stress. Study 1 further obtained preliminary data regarding the potential for improvements from Whiz Kid Games in family functioning or parenting stress. The participants were 18 Australian children (14 male, 4 female) who had received a diagnosis of ASD using either Diagnostic and Statistical Manual of Mental Disorders 4th Edition Text Revised (DSM-IV-TR) or 5th Edition (DSM-5) criteria by a qualified health care professional. Participants were between 6-12 years of age. Ten participants were randomly allocated to the active intervention group and eight to a waitlist control. Participants in the intervention group comprised 11 males and two females aged between 6-11 years with a total Social
Responsiveness Scale, Second Edition (SRS-2). Primary caregivers of children in the intervention group completed measures of social skills, behavioural functioning, parenting stress and family functioning at baseline, post-intervention and at a five-week follow-up. Findings suggest that repetitive use of Whiz Kid Games over a five week intervention period led to measurable improvements in social skills and behavioural functioning. Concerning social skills, participants demonstrated significant improvements on the subscales of social communication and restricted interest. Improvements in social communication on the social skills outcome measure were consistent with findings from the behavioural measure that suggested participants improved significantly on the subscale for communication. Although improvements in the primary outcomes of social skills and behavioural functioning were found, no improvement was observed in either of the secondary outcomes (i.e., parenting stress or family functioning).

Study 2 was developed to explore the feasibility and user acceptance of Whiz Kid Games as an intervention for children with ASD from a primary caregiver perspective. Semi-structured interviews using open-ended questions were conducted with 12 primary caregivers (all mothers) whose children had participated in Study 1. The interview questions were developed to explore parent-reported behaviour change following the Whiz Kid Games intervention as well as to identify factors that promoted or inhibited participants’ engagement. Using thematic analysis, findings indicated that from a parental perspective, videogames were able to facilitate social relationships (videogames in general) and improve behavioural functioning (specifically videogame interventions) in their children (e.g., child saying “change is good” and laughing instead of having a meltdown at a change in routine). Parents further identified a number of factors essential to facilitate their child’s engagement in videogames. Other than enjoyment, parents felt the safety of having control over the amount of engagement with peers and the ability to be successful at something after having
persistent difficulties during the day were the primary motivations for which their children engaged in videogames. Parents identified that the level of their child’s engagement was mediated by the platform of games used, their child’s technological capabilities, game predictability, appropriate difficulty to challenge the child whilst maintaining success, using appropriate stimuli / characters and that it was essential game instructions were presented in audio, visual and text formats.

The results of these two studies suggest that videogame interventions continue to be promoted as a promising avenue for improving core deficits such as social skills, communication, behavioural difficulties, emotional functioning in children with ASD. According to the pilot study, *Whiz Kid Games* is an effective videogame intervention improving social skills and behavioural function for children with ASD. Parents of the children who participated in the pilot trial reported *Whiz Kid Games* was an enjoyable and perceived it to be a useful therapeutic intervention capable of engaging children diagnosed with ASD who are generally notoriously difficult to engage. Given this evidence, the low-cost service delivery, ease of accessibility and high levels of engagement from participants, *Whiz Kid Games* warrants a full-scale efficacy trial.
Chapter 1 Introduction and overview of thesis

Autism spectrum disorder (ASD) is a neurodevelopmental disorder identified in early childhood that has a significant impact on the life of the individual and their family. A diagnosis of ASD is hallmarked by deficits in social and communicative functioning, as well as stereotyped and repetitive behaviours (American Psychiatric Association [APA], 2013). There has been a significant rise in the prevalence of ASD since its inclusion in the Diagnostic and Statistical Manual of Mental Disorders (DSM), third edition (Yeargin-Allsopp et al., 2003; Centre for Disease Control [CDC], 2016). Researchers are uncertain whether the rising prevalence reflects a genuine increase in incidence, changing diagnostic criteria (e.g., from DSM-IV to DSM-5), increasing awareness and observation of potential symptoms due to the increased awareness of ASD in society, or a combination of these and possibly other factors.

Currently, there are few efficacious interventions that have been developed to improve core deficits in ASD. Of the interventions that are frequently used by families of children with ASD (e.g., applied behaviour analysis [ABA], social skills training, social stories, video modelling) both ABA (Peters-Scheffer, Didden, Korzilius, & Sturmey, 2011) and video-modelling (Bellini, Peters, Benner, & Hopf, 2007) have withstood the scrutiny of academic research. Although ABA has been found to be an efficacious intervention for social interactions, social language and even IQ in children with ASD (Lovaas, Koegel, Simmons, & Long, 1973; Peters-Scheffer et al., 2011), it is time consuming, expensive and requires the use of highly trained therapists (Roberts & Prior, 2006). Although some families are able to afford the 20-40 hours of personalised therapy that is recommended, many families, of course, may not have the financial capacity to provide this intervention for their child.

In video-modelling, children watch videos of an actor (basic video modelling) or themselves (video self-modelling) modelling a desired behaviour, skill or routine in order to
make the skill salient and to facilitate learning (Ormrod, 2004). This is a potentially more cost efficient means of intervention and boasts good efficacy, however, it is also time consuming to develop videos and edit the footage for each individual skill that is targeted. Other interventions, such as social skills training programs and social stories interventions, are well accepted and feasible in the community and mainstream practice but have little scientific evidence to support their continued use (McGill, Baker, & Busse, 2015; Gates, Kang & Lerner, 2017). Families and health professionals engaging in the use of interventions with little evidence-base highlights the lengths parents are willing to go to support their child’s needs and development in the relative absence of affordable evidence-based options.

As ASD is a prevalent disorder affecting 1-2% of the population, the lack of efficacious and widely accessible interventions highlights the need for the development of new and innovative models of intervention for children with ASD. Computerised and assistive technology has been suggested as a potential means of addressing this current gap in service delivery (Mazurek, Shattuck, Wagner, & Cooper, 2012). A number of studies have been conducted reporting that children with ASD spend substantial amounts of time engaged with technology (Kuo, Orsmond, Coster, & Cohn, 2014; Mazurek et al., 2012; Mazurek & Wenstrup, 2013). More specifically, children with ASD spend the majority of their time using technology to play videogames or search the web for information about their games of interest (Kuo et al., 2014). The ability to harness the potential of this medium to engage children with ASD provides a promising new avenue to support children with ASD.

Making current therapeutic interventions into videogames has been accepted in the academic literature for a number of different health sectors (Fleming et al., 2016). Modifying therapeutic interventions to games has led to an emerging body of literature surrounding the possibility of harnessing children with ASD’s passion for videogames and not only providing them with therapeutic support, but doing so in a fun and entertaining way. For example,
Lieberman (2001) found interactive health games to effectively promote health behaviours and outcomes using the game “*Bronkie the Bronchiasaurus*”. “*Bronkie the Bronchiasaurus*” is a dinosaur that has asthma in a world filled with dust clouds from a meteor shower. The game requires participants to manage “Bronkie’s” asthma by taking daily medication, using an inhaler and spacer correctly, avoiding asthma triggers and using a sick day plan appropriately (Lieberman, 2001). Following a single use of “*Bronkie the Bronchiasaurus*” patients experienced significant improvements in their asthma-related knowledge, self-efficacy for managing their symptoms and self-efficacy for discussing their asthma with peers both immediately after game use, and at a one month follow-up (Lieberman, 1997; Lieberman, 2001). The novelty and interactive nature of learning through gaming technology has been found to deepen the participant’s level of engagement with the intervention due to their investment of control over the characters. Due to the recreational and relaxing nature of the games, participants were found to seek out and play the games in their leisure time, increasing their overall exposure to the learning experience (Lieberman, 2001).

The current thesis investigates the potential of gamification in relation to ASD. Chapter 2 provides a historical overview of ASD following its original conception by Kanner and Asperger in the 1940’s (Frith & Mira, 1992; Kanner, 1943). It describes Kanner’s “infantile autism” and Asperger’s “autistic psychopathy” and compares and contrasts the two. It also describes the diagnosis of ASD in earlier editions of the DSM (DSM-III to DSM-IV-TR) as well as the changes in the DSM-5. The chapter concludes with a summary of research showing the increased prevalence of children being diagnosed with ASD over the last two decades.

Chapter 3 outlines the current best practice guidelines for supporting children with ASD in Australia. Best practice guidelines highlight the need for early intervention for ASD, and recommends a minimum of 15-20 hours per week of one-on-one therapy with a trained
professional for interventions to elicit improvement (Roberts & Prior, 2006; Prior, Roberts, Rodgers & Williams, 2011). The current body of literature around the most commonly used interventions targeting social and communication functioning, as well as stereotyped and repetitive behaviours in children with ASD, is inconsistent with recommendations of health care professionals. There is an emerging body of literature that suggests that computer and assistive technology interventions may provide an equitable and enjoyable means of providing intervention for children with ASD (Ploog, Scharf, Nelson, & Brooks, 2013).

Specifically, children with ASD appear to demonstrate a strong affinity for videogames. As no high-quality reviews exploring videogame interventions have been published in the academic literature, a systematic review of videogame intervention targeted at improving core symptom deficits in children with ASD was conducted, and is presented in Chapter 4.

The systematic review identified 19 studies of sufficient quality to be included as part of the analysis. Two types of studies were identified and included for analysis in this review; interventions where the videogame was the sole intervention \((n = 6)\), and interventions where videogames were a component of a broader intervention consisting also of other forms of instruction (e.g., social skills training programs, computerised lesson-based instructions; \(n = 13\)). Although both types of studies indicated that videogame based interventions developed specifically for children with ASD were a promising medium for improving core deficits, the heterogeneous nature of the interventions, and measures used to assess change in variables made it difficult to claim efficacy for this form of intervention. The small number of sole videogame interventions was another limitation in claiming efficacy for this type of intervention, as none of the studies using a videogame as a component of a broader intervention controlled for the individual benefit of the videogames themselves.

In Chapter 5 a videogame intervention for improving social and communicative functioning as well as daily living skills in children with ASD “Whiz Kid Games” was piloted
as part of a feasibility trial. *Whiz Kid Games* is a freely accessible website that hosts a suite of five games for children with ASD that each target specific skills that have been identified as common deficits for children with ASD. This intervention has already been in wide use internationally as it has been made freely available at [www.whizkidgames.com](http://www.whizkidgames.com). It makes use of animated games and characters to teach children with ASD skills such as coping with change, following directions, matching emotions and making eye contact.

Chapter 6 reports the findings from Study 1, a pilot trial of *Whiz Kid Games*. Study 1 was designed to obtain preliminary data to determine whether use of the games over a five week intervention period could be used to elicit change in social and behavioural functioning in children with ASD aged 6-12. Family functioning and parenting stress were also measured as a part of the intervention to observe whether improvements in primary outcomes such as social and behavioural functioning could elicit improvements in family functioning within the home. A key finding from Study 1 revealed that the level of engagement with *Whiz Kid Games* varied significantly amongst children with ASD.

Study 2 (reported in Chapter 7) followed up this key finding with an examination of parents’ experiences of their child using the *Whiz Kid Games* during the intervention. Study 2 aimed to explore potential factors that led some children to find the intervention engaging, while others did not. Information about general gaming experience, what makes a successful game for children with ASD and what parents wanted to see in future games was also gathered in order to guide future videogame development.

Finally, Chapter 8 provides an overview and integrated discussion of the key findings and implications of this thesis. It addresses the current body of evidence supporting the use of videogame interventions with an emphasis on which game types have been found useful for improving social and communication skills and emotional functioning in children with ASD. In particular, this chapter explores the potential of videogame interventions to improve
behavioural functioning in children with ASD. Although behavioural functioning is a known
deficit for children with ASD it has not yet been addressed by the videogame literature. Children with ASD’s difficulties in behaviour as well as social and communicative skills and emotional functioning often contribute heavily to familial discordance and parenting stress. This chapter also discussed the implications on parenting stress and family functioning for families following the Whiz Kid Games intervention. This chapter concludes with an exploration of the limitations of the studies completed within this thesis and provides recommendations for future research.
Chapter 2 Autism Spectrum Disorders and DSM

History of autism

Infantile autism

The use of the word autism in clinical writing originated in 1912 by the renowned Swiss psychiatrist Eugene Bleuler who adapted the word “autos” to “autism”. Bleuler used the word “autism” to describe a fundamental disturbance of contact with others that often manifested in patients with extreme forms of schizophrenia (Bleuler, 1912). It wasn’t until later that this term was used by the psychiatrist Leo Kanner (1943) to describe a specific and unique set of symptoms in young children he called “infantile autism”. It was from Kanner’s work that we begin to understand how the word autism is understood today.

Kanner (1943) published a report on 11 cases of children who had presented for psychiatric support at Henry Phipps Psychiatric Clinic, the Harriet Lane Home for Invalid Children, the Johns Hopkins Hospital and the Child Study Centre of Maryland. Kanner described each of the 11 cases in detail with a particular focus on each of their unique symptoms. The fundamental symptom that was consistent for each of the children was an inability to relate to others from birth. This finding was an important factor that differentiated Kanner’s proposed syndrome from early onset schizophrenia, which was marked by typical development during early years of life followed by gradual social withdrawal. Kanner described the children he observed as aloof from other individuals, preferring “aloneness” (p. 242) to interaction. Kanner’s hypotheses around the children’s need for aloneness was consistent with his observations of the children’s play interactions with typically developing children. The children in his study would sit next to other children, but their play would be autonomous. They would not engage in competitive play, often removing themselves to the safety and comfort of their solitude. If the child’s aloneness was violated by external stimuli or physical contact, it was met with either blatant disregard or distress.
Along with their need for aloneness Kanner (1943) also identified that these children had an inherent desire for “sameness” (p. 245). Changes in routine (i.e., not following the same route on a walk) or things being broken or incomplete (e.g., a crack in the ceiling) were often met with distress. Kanner reported the restricted and repetitive interests in spontaneous activity and play were due to children’s fear of violating the need for sameness (p. 245). Objects and activities that were bound by strict rules and applications were more readily accepted by these children and often became a fixation. Restricted and repetitive behaviours were also observed in the children’s bodily movements (e.g., hand waving) where the children were observed to repetitiously move in certain ways with an excitatory demeanour.

Kanner (1943) described the children’s difficulty in forming expressive and receptive language skills. He found that in cases where children developed some form of language, it was mostly echolalic and the children were unable to convey meaning to others. In the remaining cases, the children were mute. While this was likely a contributing factor, Kanner also noted a marked deficit in communication in the children he observed. The inability to develop functional communication in these children was evident from birth and pervasive through their development.

**Autistic psychopathy**

Independent of Kanner’s work, but concurrent to it, a paediatrician named Hans Asperger made similar conclusions in 1944. Asperger coined the term “autistic psychopathy” for the children he observed (Asperger, 1944 as cited in Frith & Mira, 1992). Asperger’s original article was published in German in 1944 and was not translated to English until 1992 by Frith and Mira (1992). Much like infantile autism, autistic psychopathy was hallmarked by difficulties in social interactions that were pervasive and persistent over time. Social skills were difficult for these children due to concrete, rigid thinking patterns that made it difficult
to understand the subtle nuances of social interactions. They lacked personal boundaries and
were egocentric without consideration of the consequences of their actions on others.
Asperger felt the children were isolated from their family and peers due to an apparent lack of
interest in social behaviour.

Asperger, as another hallmark feature of his syndrome, identified disturbances in
communication in all children observed (Asperger, 1944 as cited in Frith & Mira, 1992).
These children presented with deficits in non-verbal communication (e.g., making eye
contact) and a lack of expressive language. Difficulties in each of these components of
communication may have also added further complexity to the children’s deficits in social
interactions. Asperger suggested that even if these children were interested in creating social
relationships, they did not have the fundamental building blocks to facilitate such
connections.

A third facet of Asperger’s syndrome related to restricted and repetitive interests and
behaviours (Asperger, 1944 as cited in Frith & Mira, 1992). Asperger observed that these
children typically presented with either little or no interests in objects, or had abnormal
fixations. They demonstrated a marked lack of interest in imaginary play and were often
distracted by external stimuli. These behaviours were often associated with collecting or rigid
ordering behaviours. This rigidity in thinking was not that the children lacked intelligence, in
fact, quite the opposite. Although these children presented with difficulties in mechanic
learning, Asperger found that in specific areas of interest such as individual facets of science,
nature or art, these children often excelled. Asperger found that the children were overly
analytical, had concrete assumptions of the world, and became distressed when their
assumptions were violated.

Perhaps the most evident differences between Asperger’s and Kanner’s syndromes
was that, unlike infantile autism, in children with Asperger’s autistic psychopathy, there was
no evidence of delayed onset, or failure to develop language (Asperger, 1944 as cited in Frith & Mira, 1992). Although a subtle difference in presentation, many researchers promoted this as the keynote feature in differentiating the two disorders. A body of research exists suggesting that the difference in presentation extends beyond language. Rinehart, Bradshaw, Brereton, and Tonge (2002) conducted a review, which identified significant clinical overlap between the two presentations, but also evidence distinguishing the disorders from one another. Their review showed that there were subtle differences in executive functioning, lateralization, visual-perceptual processing and motor functioning. Whether Kanner’s infantile autism and Asperger’s autistic psychopathy are one or separate syndromes has been an issue of great interest and debate among the scholarly literature. In the following section, this issue is explored through the evolution of the Diagnostic and Statistical Manual of Mental Disorders (DSM) (American Psychiatric Association [APA], 2013).

**Autism Spectrum Disorders and the history of DSM**

*Diagnostic and Statistical Manual of Mental Disorders 3rd and 4th Editions*

*Autistic Disorder*

Since its inclusion in DSM-III, Autistic Disorder (originally termed “Infantile Autism”) is marked by impairment in three key areas of functioning (APA, 1980). First, it is marked by impaired social interactions manifesting as problems with physical interactions, such as eye contact and facial expressions, an inability to develop relationships with peers, not seeking shared enjoyment with others and a lack of emotional or social reciprocity. Second, there must be impairment in communication manifesting as a delayed onset or complete inability to develop functional language, impaired ability to initiate or sustain conversation, stereotyped or idiosyncratic use of language and a lack of social and/or imaginary play. Finally, the individual must demonstrate repetitive, stereotyped patterns of
behaviours, interests and activities manifesting as an abnormally intense preoccupation with one or more stereotyped and restricted patterns of interests, inflexibility to complete non-functional routines and rituals, repetitive and stereotyped mannerisms (e.g., hand flapping, toe walking, etc.) and a preoccupation with parts of objects. Earlier editions of the DSM (DSM-III to DSM-IV-TR; APA, 1980, 1987, 1994, 2000) made further distinctions, including the onset of deficits in social interaction and communication or a lack of interest in social or imaginative play to be evident before three years of age. To obtain a diagnosis of Autistic Disorder, the symptoms must not be better explained by Rhett’s Disorder or Childhood Disintegrative Disorder. Although each version of the DSM contained minor differences in diagnostic criteria, each edition’s requirement that there were symptoms of impairment in all three areas of functioning (i.e., deficits in social, communication and behavioural functioning) were consistent throughout.

*Asperger’s Disorder*

Included in DSM-IV, Asperger’s Disorder was introduced as an individual diagnosis separate from Autistic Disorder. Deficits in social interactions and repetitive, stereotyped patterns of behaviours, interests and activities remain identical from Autistic Disorder to Asperger’s Disorder, however, the key distinguishing feature was the removal of a criterion pertaining to an impairment in communication. A diagnosis of Asperger’s Disorder requires that there is not a clinically significant delay in language or cognitive development and age appropriate self-help skills. Similar to Autistic Disorder, Asperger’s Disorder is also marked by deficits in social interactions and their stereotyped and repetitive behaviours. To receive this diagnosis there must be significant impairment in their social, occupational or other important areas of functioning and cannot be better explained by another Pervasive Developmental Disorder (PDD) or Schizophrenia.
**Pervasive Developmental Disorder – Not otherwise Specified**

A diagnosis of PDD not otherwise specified is given if there is severe impairment in the development of social interactions associated with verbal or non-verbal communicative abilities with the presence of stereotyped behaviours, but does not meet the criteria for another PDD.

**Diagnostic and Statistical Manual of Mental Disorders 5th Edition**

**Autism Spectrum Disorder**

The release of the DSM-5 (APA, 2013) marked significant and controversial changes from the previous diagnostic criteria. Adopting both a categorical and dimensional approach to diagnosis, DSM-5 has collapsed each of the previously differentiated categories within PDD into a singular diagnostic entity, autism spectrum disorder (ASD). ASD is now defined by two main criteria; first, by persistent deficits in social communication and interaction across multiple settings and contexts. Manifestations of these deficits include, social and emotional reciprocity, abnormal or absent nonverbal communication (e.g., eye contact, facial expressions, etc.) and difficulties developing, maintaining and understanding their relationships. Second, it is characterised by restricted and repetitive patterns of behaviours, interests or activities. Manifestations of these deficits include, repetitive and stereotyped motor functioning, abnormal and inflexible insistence on sameness, adherence to routine and rituals, intense fixated interests, and hyper- or hyposensitivity to sensory input. The severity of these criteria is rated across three levels. These levels of severity range from level 1 “requiring support” (previously specified informally as high functioning ASD), level 2 “requiring substantial support” to level 3 “requiring very substantial support” (previously specified informally as low functioning ASD). DSM-5 requires that the symptoms be present
in early development, and that they cause significant impairment across social, occupational and other important areas of functioning. A diagnosis of ASD is only given if the symptomology cannot be better explained by intellectual disability or global developmental delay.

**Prevalence**

Over the last three decades since its original inclusion in the DSM-III, a large number of epidemiological studies have been published. Furthermore, estimates of the prevalence of ASD have risen dramatically. Whether the rise in prevalence is due societal change, the evolution of the diagnostic criteria through the DSM, an authentic increase or increased detection remains contentious (Matson & Kozlowski, 2011). Claims that changes in the diagnostic criteria or an authentic increase in prevalence are difficult sustain due to the differences in each study. Increased ASD awareness appears to have had a stronger impact on the field, with the widespread coverage of ASD in the media leading to greater resources for assessment and diagnosis being available. Nevertheless, the evidence for increasing prevalence over time is compelling.

Irrespective of the disparate current prevalence rates internationally, the trend of increasing prevalence of ASD in all populations studied over the last 30 years has increased demand for treatment provision and educational support. Increases were observed in the USA from the mid 1980’s to the mid 1990’s from 4 per 10,000 children (Kirby, Brewster, Canino, & Pavin, 1995) to 20-60 per 10,000 children (Yeargin-Allsopp et al., 2003). Most recent prevalence estimates of ASD in the USA has indicated that it affects as many as 148 in 10,000 children (CDC, 2016). These figures are much higher than current estimated prevalence rates of ASD in Australia, which have been estimated at 51 per 10,000 children (Bourke, de Klerk, Smith, & Leonard, 2016). However, the Australian statistics were drawn
from 1983-2005 using DSM-III to DSM-IV-TR criteria, and do not include findings based on children diagnosed according to DSM-5.
Chapter 3 Behavioural interventions for autism spectrum disorders

Treatment guidelines for ASD in Australia

Current best practice guidelines for the treatment of children with ASD in Australia suggest the optimal time to intervene is at two to four years of age, and that the intervention must be intensive, comprising at least 15-20 hours a week over a minimum of a two year period (Roberts & Prior, 2006; Prior, Roberts, Rodger & Williams, 2011). This model presumes that the intervention is in the form of a one-on-one personal interaction with a trained behavioural therapist. Understandably, such intervention program requires intensive time commitment, considerable financial investment and highly specialised and trained staff (Roberts & Prior, 2006). In their more recent review Prior, Roberts, Rodger and Williams (2011) added to the findings in their original review (Roberts & Prior, 2006) highlighting the necessity of a multidisciplinary approach to service provision and a commitment to employing staff with a minimum of two years’ experience. The culmination of these requirements are significant barriers to the application of the guidelines. The quantity and diversity of treatment programs developed for ASD has grown significantly since the development of these guidelines and in this section, an overview of the main body of literature concerning common ASD interventions and their efficacy is presented.

Behavioural Interventions

Applied Behaviour Analysis

Applied Behaviour Analysis (ABA) is a systematic and measurable method of improving behaviours in children with ASD developed using the principles of learning theory. The foundations of ABA were built on creating a socially significant change in the child. The focus is on increasing adaptive behaviours and skills, teaching new skills, maintaining learned behaviours, generalising skills learned and reducing behaviours that
interfere with learning (Roberts & Prior, 2006). A number of skills such as self-help, imitation, receptive language, expressive language, communication, sentence structure, grammar and syntax are often the subject of an ABA intervention. The earliest research evaluating the use of ABA for children with ASD was conducted by Ivar Lovaas and colleagues (Lovaas et al., 1973). Prior to the inclusion of ASD in the DSM-III, Lovaas’ understanding of ASD came from the early work of Kanner’s (1943) Autistic Psychopathy. Lovaas’ ABA (Lovaas et al., 1973) aimed to increase the likelihood of desirable behaviours occurring through the use of pre-established primary reinforcers (e.g., food). It also aimed to reduce the frequency of undesirable behaviours (e.g., self-stimulation and tantrum behaviours). To reduce the likelihood of undesirable behaviours occurring, children were exposed to negative reinforcement (e.g., therapist would remove a stimulus to increase the likelihood of a behaviour), positive reinforcement (e.g., praise) and punishment (e.g., therapist would look away whilst child engaged in undesirable behaviour or deliver a painful stimuli such as a slap or electric shock). Therapists aimed to teach children with ASD simple desirable behaviours through the use of a verbal command and physical prompt, for example, sitting. This was frequently done in combination with suppression of undesirable behaviours. Following the same example, the therapist would demand the child “sit” when engaging in an undesirable behaviour (e.g., self-stimulation). Depending on the child’s response the therapist would engage in one of the three methods of reinforcing the child’s behaviour. If the child continued to self-stimulate the therapist would provide either negative reinforcement or a punishment, whereas if the child sat as requested the therapist would provide positive reinforcement.

Although contemporary forms of ABA continue to be influenced by reinforcement theory and the earlier work of Lovaas, some minor changes have occurred. Contemporary forms of ABA do not use physical punishment as a means of reducing the likelihood of
undesirable behaviours occurring (Smith, 2001). Although physical punishment in itself can be an effective method of decreasing the likelihood of an undesirable behaviour, it can also induce the inverse response (Ormrod, 2004). In some cases the attention derived from physical punishment is reinforcing on its own, leading to increases in the undesirable behaviour (Ormrod, 2004). In other cases, it was found to result in undesirable emotional responses leading to consequences such as avoidance or aggression (Ormrod, 2004). Along with its inability to model desired behaviours (Ormrod, 2004) the inconsistency found in physical punishment’s ability to reduce the likelihood of undesirable behaviours resulted in its removal from ABA protocol. Contemporary forms of ABA continue to include the use of punishment, but have adapted to the removal of physical punishment by including positive punishment (e.g., the use of a reprimand to reduce the likelihood of a behaviour occurring) and negative punishment (e.g., adopting a blank / neutral face removing attention from the child to increase the likelihood of a behaviour) strategies (Smith, 2001).

Another change in contemporary ABA is the focus on discrete trial data collection. Discrete trial training refers to each presentation of a stimulus and its consequence as an individual trial (Smith, 2001). Data is collated and evaluated from each individual trial to monitor progress and assess the effectiveness of the intervention. Discrete trial training is comprised of five key components: 1) the child is presented with a cue (discriminative stimulus) or direction, 2) the child is prompted in how to complete the given instruction, 3) the child responds to the cue and prompt, 4) therapist presents consequence (child receives positive reinforcement for a correct response, and negative reinforcement for an incorrect response), and 5) the child receives a brief pause between the consequence and presentation of the next trial, which is termed the inter-trial interval period. Although discrete trial training allows strict monitoring and evaluations of the trials, there have been concerns raised about its ability to teach generalisation of skills, initiation of responses and independence (Smith,
2001). This calls into question the ecological validity of this intervention in its ability to support children with ASD outside of the clinical setting.

Although there have been some concerns raised regarding the efficacy of ABA in improving desirable behaviours and reducing undesirable behaviours in children with ASD, there is evidence supporting its continued use. In Lovaas’ original paper, it was reported that desirable behaviours increased in frequency whereas undesirable behaviours decreased (Lovaas et al., 1973). Following their intervention, some children had begun to engage in spontaneous social interactions as well as spontaneous language production. Perhaps the most interesting finding from this study was that ABA not only elicited improvements in social functioning, but that there were measurable improvements in participants’ IQ. However, a major limitation of this study is the indication of the dose of ABA that was given to each child. Lovaas reported that each child was administered ABA over a 12-14 month period but was not consistent in the amount of time per week spent in training. A common finding was that children whose parents were taught ABA principles and remained in their parents’ care post-intervention, retained the improvements made in therapy, whereas their counterparts who had been institutionalised regressed. Although the report suggested that training occurred for 2-4 hours per day several days per week, the amount of training per week was only noted for two participants. This lack of clarity around the dose of ABA required to elicit improvements in desirable and undesirable behaviours, particularly for young children with ASD, was highlighted in a later article by Smith (2001). Smith’s findings further suggested that there was inconsistency in the broad body of evidence for ABA around the issue of dose, with some studies suggesting 10 hours was sufficient to elicit change, whereas others claimed the need for up to 40 hours of intervention per week. Smith reported that one consistent finding in the literature was the necessity of early intervention, typically prior to 4-5 years of age. More recent research by Eldevik, Eikeseth, Jahr, and Smith (2006) found that 10-20
hours of intensive one-on-one treatment using ABA therapy was sufficient to observe change in children with ASD. Specifically, they found improvements in cognitive functioning, communication skills and behaviour pathology. Although the authors acknowledged the improvements in cognitive functioning in their study were not as large as in studies using a more intensive intervention dose (i.e., up to 40 hrs per week), they suggested that this may have been due to the lower baseline cognitive functioning of their sample.

A recent meta-analysis conducted by Peters-Scheffer et al. (2011) assessed the literature to ascertain the efficacy of ABA for children with ASD. Inclusion criteria for this meta-analysis required that studies were of high quality (i.e., included a control group, pre-post measures), addressed all three core deficits in an ASD diagnosis (using DSM-IV-TR criteria), participants were under the age of 10 when they began treatment, had a confirmed diagnosis of autistic disorder or PDD-NOS, and were published in English. Their review identified 11 studies meeting criteria for inclusion. The authors found that children who engaged in ABA therapy improved significantly more on measures of cognitive functioning and behaviour than those who continued treatment as usual. These findings were consistent with previous meta-analyses conducted by Eldevik et al. (2009) and Reichow and Wolery (2009). Additionally, Peters-Scheffer et al. (2011) found that there were clinically significant improvements in measures of expressive and receptive language following ABA intervention. On measures of adaptive behaviours, the ABA intervention groups did not improve more than treatment as usual groups. Although each of the articles reviewed demonstrated strong findings supporting the use of ABA, Peters-Scheffer et al. (2011) highlighted the threat of publication bias when reporting their results and concluded that their findings were either biased, or ABA was an efficacious intervention to treat core symptomatological deficits in children with ASD.
Although results from recent meta-analyses provide some support for the efficacy of the use of ABA in improving symptoms of ASD in children, the time constraints and financial demands of such an intervention make it difficult for many families to engage in this intervention. ABA requires between 15-40 hours of intensive therapy delivered by a trained therapist in order to meet the research guidelines of effectiveness (Eldevik et al., 2006; Smith, McEachin, & Lovaas, 1993), costing in excess of $30,000 annually (Sharpe & Baker, 2007). Clearly, this intervention has characteristics that make it unlikely to ever be administered routinely to children with ASD.

**Therapy Based Interventions**

**Social Skills Training**

Social skills training was originally proposed in 1984 by Mesibov as a means of addressing the social deficits inherent in a diagnosis of ASD. To improve social behaviours, Mesibov (1984) found that the most important variables to elicit a positive change were social interest and social skills. The social skills training program proposed by Mesibov met weekly for 10-12 weeks, with 30 minute individual sessions where the participant would first practice the major lesson of the day, followed by group sessions lasting for approximately 60 minutes. Group sessions were divided into four separate parts. First, participants engaged in a group discussion (including food in order to help facilitate interaction between participants). Second, participants engaged in listening and interaction skills (in dyads containing one staff member to one participant) focusing on practicing attending skills as well as the expression and identification of emotions. Third, participants then engaged in role plays in order to practically apply the skills that had been learned. Finally, participants were introduced to an “appreciation of humour” time. This included “joke” time in order to help develop the humour component of social skills that was observed to be lacking in these children.
Mesibov’s social skills training program was designed to effect change by providing positive peer-related experiences in a controlled and supportive environment, facilitate the development of a long term peer-group, develop/improve specific interpersonal skills, and to enhance participants self-esteem. Feedback from participants and their families suggested that the group was able to facilitate positive peer relationships and social experiences in a safe and controlled environment. Although the data was preliminary, Mesibov found that the children improved on the specific social skills that were targeted as part of the intervention (e.g., looking at people they were talking with, responding appropriately), and self-esteem.

Over time, minor changes have occurred to the design and implementation of social skills training programs, however, the basic structure and intervention length appear to have remained relatively stable. Although some studies have adopted much larger intervention periods (e.g., 30 weeks; Cotugno, 2009) most studies continue to adhere to the 10-12 week model (Tse, Strulovitch, Tagalakis, Meng, & Fombonne, 2007) originally set out by Mesibov. One consistent factor between each intervention is the recommended length of each session being 1 to 1½ hours. Experts appear to agree that this is the optimum maximum amount of time to engage children with ASD in each individual session (Cotugno, 2009; Mesibov, 1984; Tse et al., 2007). The structure of each session remains relatively stable between each of the studies consisting of an introductory period (usually facilitating discussing in group), a review of the previous week’s lessons, group discussions, role plays, snacks and farewells. While minor variations occur between studies (e.g., additional components such as game activities) the studies continue follow the basic structure set out in Mesibov’s original study (Cotugno, 2009; Tse et al., 2007).

Although many of the more common social skills such as greetings, making eye contact, listening to others and ending a conversation are taught in each intervention, some variations are evident between studies in regard to the specific social skills targeted by the
intervention. This may depend on the child’s physical or developmental age, but may also reflect minor differences in each study’s design. For example, a study teaching social skills specific to younger children may target skills such as taking turns (Kamps et al., 1992) or sharing (Maddox, 2010), whereas interventions for older children or adolescents may target more advanced skills such as dating or dining etiquette (Tse et al., 2007). Some studies have looked beyond the primary intervention goals (i.e., improvements in social skills) and have also assessed for secondary outcomes such as improvements in anxiety, affect regulation and stereotypic behaviours (Tse et al., 2007). Each of the studies identified claimed positive improvements across the social skills such as: joint attention, social flexibility, social awareness, social cognition, social communication and social motivation (Cotugno, 2009; Tse et al., 2007). Those that included secondary outcomes reported further improvements, particularly on measures of stress and anxiety (Tse et al., 2007).

A systematic review has been published on the efficacy of group social skills training adolescents and young adults with ASD (Miller, Vernon, Wu & Russo, 2014). Miller et al.’s (2014) study required that participants in the reviewed papers had a confirmed diagnosis of ASD, were between the ages of 13-18 years, were published in a peer reviewed journal and written in English, and that each study included information about a relevant outcome measure (e.g., social skills). Miller et al. (2014) found an emerging body of literature in supporting the efficacy of group social skills training programs for individuals between 13-18 years of age. Although the review highlighted a lack of the rigorous, randomized controlled trials necessary to claim efficacy they noted a trend in the literature to be moving from preliminary feasibility trials to full powered randomized controlled trials. The authors found that although most research was conducted in clinical settings, there was an also a small body of evidence that social skills training was effective in both school and community settings. Group size did not appear to be a significant indicator of the effectiveness of social skills
training groups with both small and large groups recording similar improvements in the outcome measures. Key components that appeared to lead to facilitate improvements from these training programs included a combination of some form of didactic teaching, and in vivio learning (e.g., through role-plays). One inconsistent factor between the studies reviewed was the total intervention time. Studies ranged from six to 180 hours of training time. Although there was a large discrepancy in the intervention length, a consistent finding appeared to be that several months of weekly sessions was required to elicit lasting change. The evidence highlighted in this review promoted the promise of this type of intervention for improving social skills in adolescents and young adults with ASD, but lacked the scientific rigour to claim efficacy.

More recently, a meta-analysis was conducted to review the effectiveness of group social skills interventions for children, adolescents and young adults with ASD (Gates, Kang & Lerner, 2017). For inclusion in this meta-analysis Gates et al. (2017) required that studies were empirical, peer reviewed or dissertations published in English, evaluated an intervention for social skills, included participants aged 5-21 years with a confirmed diagnosis of ASD and were not based on early intervention programs. Gates et al. (2017) found that that overall their meta-analysis found moderate improvements in in social competence across the studies reviewed. The authors noted that this moderate finding may have been inflated due to self-reported and parent-reported improvements in social knowledge and an expectancy bias of the efficacy of the intervention. Although the authors note a genuine increase in social knowledge, the studies which reviewed the impact of this knowledge in social situations found that this did not translate to social competence. This was confirmed by teacher-reports which found no difference in social interventions post-intervention between the intervention and control groups. These finding appear consistent throughout childhood, adolescence and young adulthood. The authors reported that the lack of translation from social knowledge to
social competence may have been a result of a lack of sufficient experiential learning in the studies. Although the meta-analysis reported moderate improvements in social competence, it does not support group social skills training programs as an efficacious intervention for improving social skills in children, adolescents and young adults with ASD.

**Social Stories**

Social story interventions were proposed by Gray and Garand (1993) as an alternative method of improving social and behavioural functioning in children with ASD. The rationale for the development of social stories was based on social cognition. Social cognition is commonly thought of as being severely reduced in children with ASD who are often described as “withdrawn” or “in a world of their own” (Gray & Garand, 1993). Gray and Garand (1993) suggested that this generalised assumption is not accurate for describing these children. They posited that children with ASD want to engage with others socially but that they lack the skills to facilitate reciprocal social interactions. Some behaviours which had previously been described as “inappropriate” (i.e., echolalia and stereotypic questioning) were found to be attempts at initiating and sustaining social interactions. The proposal of social stories was an attempt at teaching children with ASD appropriate ways of initiating, sustaining and concluding interactions with others.

In their original paper, Gray and Garand (1993) presented a number of guidelines for writing social stories for children with ASD. In order to be relatable to children with ASD, the authors highlighted the importance of the social story beginning from the children’s perspective and written to their comprehension level. The structure of the writing in the stories was focused around three separate types of short sentences; descriptive, directive and perspective. *Descriptive* sentences were used to illustrate what individuals do in situations and why (e.g., the children do not shout in the classroom). *Directive* sentences were used to
illustrate the desired response of the child in a situation (e.g., I will talk quietly in the classroom). They focus on responses that will help the child be successful in the desired situation. Finally, *perspective* sentences described others’ reactions to the target situation (e.g., my teacher will be happy when talk quietly in the classroom). It is essential when writing a social story to remain objective and ensure that it does not assume the reaction of the child. The number of each sentence type differed between social stories and was dependent on the individual child’s needs and target behaviour or situation. Further guidelines required that the story contain one concept per page, did not include illustrations, and were inherently flexible in how they were written. Although the original guidelines warned against the use of illustrations or photographs in the majority of cases (Gray & Garand, 1993), more recent studies have highlighted the benefits of their use (Scattone, Wilczynski, Edwards, & Rabian, 2002; Swaggart et al., 1995). Although some contention still exists surrounding the benefit of including illustrations, the remaining guidelines appear to have remained stable throughout the use of social stories among the academic literature to date.

Social stories are typically presented in a book format (Swaggart et al., 1995) and implemented in one of three ways depending on the individual child and his or her needs (Gray & Garand, 1993). The first type of implementation is for children who are able to read independently. In this condition the story is first read to the child by an adult. The child is then required to read the story back to the adult. Once children have become acquainted with the story, they read it on their own once a day. Second, for students who cannot read independently, the story is first recorded as an audio file (originally on a cassette tape) and the child follows along with the social story book, turning the pages as indicated by a tone on the audio file. The third, and final type of implementation of social stories is suitable for students who are, or are not, able to read independently. In this condition, children are
presented video clips of the social story. The clip consists of a voice over reading the story with the corresponding page presented on the screen. Irrespective of the method used to implement the social story, comprehension is generally tested through a check-list, role playing and answering questions about the learned skill.

Social stories have been suggested to be effective in improving social skills (Gray & Garand, 1993; Swaggart et al., 1995) as well as promoting positive behaviour, and decreasing disruptive behaviours (Scattone et al., 2002). Scattone et al. (2002) developed three specific social stories for three individual children and adolescents with ASD between the ages of 7-15 years in an attempt to reduce their disruptive behaviours. Scattone et al. (2002) developed each of the stories following the guidelines set out by Gray and Garand (1993) and employed a social story ratio of one directive sentence for every two to five descriptive sentences and/or perspective sentences (Scattone et al., 2002). Each story targeted a specific disruptive behaviour that was identified as an area in need of improvement for the child with ASD. The story consisted of an eight to nine-page written script of the target situations as well as the desired response from the child. Each child either read, or had the story read to them, once a day during school time for the duration of the intervention. Although the specific duration of the intervention was not mentioned in the study, it is inferred from their report on gathering data that it lasted a minimum of nine weeks. The authors reported that over this time period, they observed an overall reduction in each participant’s respective disruptive behaviour. Although it used a case study design, this study demonstrated some support for the use of social stories in children and adolescents with ASD.

Recently, meta-analyses have been conducted to explore the efficacy of social story interventions for children and adolescents with ASD (Kokina & Kern, 2010; McGill et al., 2015). The inclusion criteria for Kokina and Kern's (2010) original meta-analysis required that studies were single subject designs with an experimental control, included participants
with a confirmed diagnosis of ASD from an independent diagnostician and that social stories were the sole intervention. Studies were excluded from the analysis if they did not contain quantitative data, used non-experimental designs, the social stories intervention were used as a part of a “treatment package”, used populations other than ASD and studies with floor or ceiling effects. Eighteen studies were identified for inclusion in this analysis. Results from the analysis suggested that there was questionable effectiveness of social stories as interventions for children and adolescents with ASD. The authors highlighted that while there had been an increase in the quality of studies being conducted, they did not meet the threshold to claim efficacy as an intervention. Although improvements were observed in a number of studies, the effect sizes were noted to be small and specific to disruptive behaviours and social skills. Studies that utilised a combined picture and written story book, conducted in a school setting, with participants with higher levels of communication skills were the most effective.

More recently, McGill et al. (2015) conducted a follow-up meta-analysis on social stories to explore for potential improvement in the efficacy of this intervention over time. McGill et al.’s (2015) inclusion criteria required that studies used a population of school aged children with a primary diagnosis of ASD, that social stories were the primary intervention, each program monitored the targeted behaviour, used single case research designs with a minimum of pre-post data, reported single case effect size and had sufficient information to evaluate the research design. McGill et al. (2015) found that studies varied significantly, demonstrating small to large effects of the interventions. Results varied across intervention settings, intervention agents, target behaviours, length of treatment and publications type. Consistent with Kokina and Kern (2010), the largest effects were observed in school based settings, with the addition of interventions that were delivered by researchers and targeted specific verbal behaviours. Although this intervention type is currently utilised widely by
families, schools and health professionals, the heterogeneity of the research and inconsistency of effects make it difficult to claim efficacy for social stories as an intervention for children and adolescents with ASD.

**Computer and Assisted Technology Interventions**

*Video Modelling*

Video modelling is an intervention for children with ASD that has been used to teach a range of different social skills and adaptive behaviours. The child watches a video of an actor (basic video modelling) or themselves (video self-modelling) modelling a desired behaviour, skill or routine in order to make the skill salient and to facilitate learning (Murray & Noland, 2012). Originally, the term “self-modelling” was used to refer to a set of videos made of children with ASD modelling appropriate behaviours that were given to parents of children with ASD so the children could see themselves enacting desired behaviour (Creer & Miklich, 1970). Creer and Miklich (1970) used these videos to help facilitate the learning process in a series of case studies of children and adolescents with ASD. Parental reports suggested that the videos were able to teach skills to their children that they had otherwise struggled to comprehend and enact. Since its conception in the 1970’s, video-modelling has been found to be effective in improving daily living skills (Shipley-Benamou, Lutzker, & Taubman, 2002), perspective taking skills (LeBlanc et al., 2003), social initiations (Nikopoulos & Keenan, 2004) and pretend play (MacDonald, Clark, Garrigan, & Vangala, 2005). Already widely accepted and used by schools, health professionals as well as families of children with ASD, many individual studies have demonstrated support of the use of video-modelling as an intervention for this population.

However, there has been some controversy about its effectiveness compared to *in vivo* exposure (i.e., experiencing the situation in real life) for children with ASD. Charlop-Christy,
Le, and Freeman (2000) conducted a study to assess the effectiveness of in vivo interventions compared to basic video-modelling. In both conditions (i.e., in vivo and basic video-modelling), an adult familiar to the child was used. Prompting in the basic video-modelling condition was limited to on-task behaviours (i.e., directing the child back to watching the video if becoming distracted) and was conducted by an experimenter who sat beside them throughout the intervention. Children were not rewarded or prompted to elicit a correct response. Following the initial two viewings of the video, the experimenters began to assess children for the acquisition of targeted behaviours by stating “Let’s do the same”. Testing occurred over weeks or months depending on the child’s individual schedule. The authors reported that their study suggested that video-modelling was an effective and efficient means of teaching children with ASD a range of different behaviours. Four out of five children acquired the desired outcomes faster in the basic video-modelling condition than the in vivo condition. Basic video-modelling further resulted in generalisation of the target behaviours whereas the in vivo condition found no generalization occurred. These results suggested that children with ASD may have more of an affinity for learning through a technology-based medium than face to face learning.

An early review was conducted on video self-modelling by Dowrick (1999), which identified commonalities between the uses of video self-modelling among the literature. Individuals using video modelling enjoyed watching the films and in turn began to enact the behaviours modelled in the video. The videos were commonly captured footage of the child edited into a two to four-minute vignette demonstrating the desired behaviour. Children would then repeatedly watch themselves enacting the desired behaviour. Dowrick (1999) identified a number of factors included in the videos that contributed to the personal learning, efficacy of the intervention and well-being of the child. These included, “clarification of the goals and outcomes, demonstrating positive self-image, reminders of previous competence,
repeated observation of competent role play, observation of ones skills applied to a new setting, anxiety-free behaviour or successful outcomes despite anxiety, and demonstration of new skills composed of pre-existing subskills” Dowrick (1999, p.36). Although some variability is evident in the making and implementation of video-modelling between the reviewed studies, the key elements (i.e., recording of either self or actor modelling skill, routine or behaviour) and freedom to watch the video repetitively remained constant.

A meta-analysis was conducted by Bellini et al. (2007) to assess the efficacy of both basic video-modelling and video self-modelling. To be included in the analysis, it was required that studies used participants diagnosed with ASD, included outcome measures for behavioural functioning, social skills or functional skills, included basic video-modelling or video self-modelling as the main intervention, used a single subjects design, presented data with graphic displays depicting individual data points rather than aggregated data, were peer reviewed and published in English. Studies with dichotomous dependent variables with fewer than three probes or questions per data point were excluded from analysis. Bellini et al. (2007) identified 23 studies that met inclusion criteria for analysis. Results from the analysis suggested that both basic video-modelling and video self-modelling are effective interventions for improving social and communication skills, behavioural functioning and functional skills in children with ASD. Improvements made using these interventions were able to be generalised across settings and were found to be maintained over time. Both basic video-modelling and video self-modelling were found to be equally effective in supporting children with ASD with no major differences in the improvements made by either. Improvements were observed across settings in 16 separate geographical locations across the world. The median number of times a video needed to be viewed in order to elicit a lasting change was nine and a half sessions, with the median duration of the videos being approximately three minutes. The authors concluded that basic video-modelling and video
self-modelling were efficacious for improving social and communication skills, behavioural functioning and functional skills for children with ASD.

**Robot assisted therapy**

The original design of a robot to help children with ASD was developed as a challenge to electrical and computer engineering students at the Université de Sherbrooke in 1999 (Michaud, Clavet, Lachiver, & Lucas, 2000). Students who registered for the competition were given access to ROBUS, an autonomous mobile robotic platform on which to base their design, and the electrical components and sound generating device necessary to complete the robot. They were further given information about current therapeutic tools and models that were used to support children with ASD (e.g., the Treatment and Education of Autistic and Communication-Handicapped Children program), eight video profiles of children with ASD with unique presentations, and videotapes related to ASD (Michaud et al., 2000). Students were registered in teams of three to seven and created their own unique robot. Twelve robots were made using the ROBUS platform, and were evaluated by two individuals who worked in the ASD field and two people with technical knowledge of the design and programing. The robots were designed to complete a number of different tasks such as playing games, interactive sensory functions (e.g., could be tickled) and dancing. The four winning robots were then presented to a class of children with ASD. The ability of these robots to engage the children in different games and play was a foundation that paved the way for human-robot interaction as a potential medium of intervention for children with ASD.

Following the initial robot building contest, Dautenhahn, Werry, Salter, and Boekhorst (2003) reported results from a pioneering study into human-robot interaction for children with ASD, the Aurora Project. Dautenhahn et al. (2003) hypothesised that robots
would be an effective means of supporting children with ASD due to their ability to facilitate \textit{in vivo} learning in a rule-based non-threatening environment. This project aimed to develop a robot to teach social skills to children with ASD by facilitating play interactions between the robot and the child. They targeted specific communicative skills such as proactive behaviour, interacting with peers and family, taking turns, coping with change, independent play, eye gaze and imitation. Preliminary studies for this project found that children readily engaged with the robots on first encounter and were more attracted to the mobile robots than they were to static toys. Dautenhahn et al. (2003) found that robots were able to facilitate interactions with children with ASD. Although the level of interaction differed between children, they felt that the interactions that were created were able to be encouraged and mediated by the robot. Interacting with technology such as a robot removes the anxiety and stress of social situations in \textit{in vivo} learning for children and adolescents with ASD (Bellini et al., 2007). This suggested that it may be possible to harness the interactions developed between the robot and the children to teach them social skills in a safe, controlled and enjoyable way.

Whether the intervention utilises a humanoid (Nikolopoulos et al., 2011) or animal robot (Stanton, Kahn Jr, Severson, Ruckert, & Gill, 2008), their most basic function is to engage children with ASD and facilitate play. This was sometimes facilitated by a human researcher who would help prompt the child’s learning whilst engaged in play with the robot (e.g., asking the child about the robot’s affective state; François, Powell, & Dautenhahn, 2009). In other cases, the programming of the robot facilitated game play that inherently applies the skills targeted for improvement (e.g., imitation games; Boccanfuso & O’Kane, 2011). A number of different robots have been created over the years as a therapeutic intervention for children with ASD. Although the majority of the robots have been developed specifically for teaching social skills to children with ASD (Boccanfuso & O’Kane, 2011; Jordan, King, Hellersteth, Wirén, & Mulligan, 2013; Nikolopoulos et al., 2011; Pioggia et al.,
2007; Ranatunga, Rajruangrabin, Popa, & Makedon, 2011), robots have also been developed to teach motor skills (Ranatunga et al., 2012) and tactile interactions (Robins & Dautenhahn, 2010). Although majority of research on human-robot interaction is preliminary, there have been some promising findings suggesting that this type of therapy is effective for improving attention, communication, joint attention, group play and social skills in children and adolescents with ASD (Jordan et al., 2013; Begum, Serna & Yanco, 2016). Robots are able to make precise, repetitive movements and actions to help facilitate learning for children with ASD (Begum, Serna & Yanco, 2016). Although there is preliminary data suggesting the potential for robot assisted therapy concerns have been raised about the quality of the current body of evidence (Begum, Serna & Yanco, 2016).

A systematic review of the literature was conducted by (Pennisi et al., 2015) to assess the efficacy of socially assistive robotics as a therapeutic intervention for children with ASD. Studies were considered for inclusion as part of this review if they focused on ASD, assessed the efficacy of diagnosis or rehabilitation in ASD, and included experimental data. Studies were excluded if they focused on technical descriptions of the robots, tested the robot’s specific skills, contained case studies with a sample of less than three participants, or were non-replicable. Specifically, in relation to social behaviours, the review identified 16 studies for analysis. In some cases, robots were found to be a better stimulus than human agents at improving social skills in children with ASD. The children were able to engage in social behaviours with the robot in almost all of the studies reviewed. Universally, the nine studies that assessed the ability for social robots to improve social behaviours of children with ASD towards others people found that robots were able to effectively improve these behaviours. The seven other studies assessing social behaviours in children with ASD did not measure this variable. Although their findings suggested that socially assistive robots are promising as
therapeutic interventions for ASD they concluded that the data was insufficient to claim efficacy.

**Computer-assisted technology**

The evolution of information and communication technology has opened up new and expansive modes of delivery for novel and stimulating therapeutic resources. The explosion of computer-assisted technology that manifested in the widespread adoption of the personal computer and gaming consoles in family homes during the 1980’s opened the doorway to a new body of research for the assessment and support of health difficulties. Nevertheless, it was not until the 1990’s that the research community began to empirically validate these types of interventions in supporting individuals with mental health concerns (Wilkinson, Ang, & Goh, 2008).

Computer-assisted technology is a promising area of intervention for children with ASD that has begun to emerge in the literature. The difficulty in assessing the efficacy of computer-assisted technology interventions is that the current body of literature is heterogeneous. Computer-assisted technology is a blanket term that has been used to refer to a number of interventions that utilise different aspects of technology as a part of their intervention. To date, there have been a number of systematic reviews published on the use of computer-assisted technology as an intervention for core symptoms of ASD in children and adolescents. There appears to be a consistency in the literature showing promising evidence for computer-assisted technology based interventions for social and emotional functioning (Ramdoss, Machalicek, et al., 2012), social communication (Ploog et al., 2013; Wainer & Ingersoll, 2011), communication (Ramdoss et al., 2011) and language development (Ploog et al., 2013). A search of the literature did not yield any reviews of the effectiveness of computer-assisted technology for stereotyped and repetitive behaviours for this population.
The major limitation highlighted by all review authors was a lack of high quality studies with sufficient sample size, randomisation and blinding to support computer-assisted technology as an evidence-based treatment for ASD. Ploog et al. (2013) highlighted a lack of programs specifically developed for child and adolescent ASD populations. This was largely due to attempts to adapt existing programs that did not cater to, and control for, this population’s unique needs. The few programs specifically designed for children and adolescents with ASD had inherent flaws in their usability and generalisation such as potential for increasing problematic behaviours, the teaching of a limited range of responses to computers, and a lack of generalisation.

More recently, Grynszpan, Weiss, Perez-Diaz, and Gal (2014) conducted a meta-analysis on the use of computer-assisted technology for ASD across two categories; pre-post test designs (n = 14) and a subsample of randomised-controlled trials (n = 10). The authors note that the average effect size for each analysis was in the medium range (0.47 and 0.45 respectively). Grynszpan et al. (2014) concluded that their meta-analysis indicated support for the efficacy of computer-assisted technology interventions, but found that the diversity of location, assessment tools, participant characteristics and methodological approaches in their sample were a concern when interpreting their findings. The authors recommended that future research be more rigorous with randomisation and blinding, and urged consistency with the type and quality of measures used.

Although each of the reviews detailed above found that computer-assisted technology interventions in general were a promising approach to improving core deficits in ASD, the heterogeneous nature of interventions reviewed (e.g., games, video modelling, role-play) mean that average or aggregate results cannot capture the differential effects of the various interventions on the various outcomes of interest.
**Videogame Interventions**

Videogames are regarded as an innovative and promising resource that may be utilised for the treatment of psychiatric conditions across the lifespan (Wilkinson et al., 2008). Virtual reality role-player games have been designed for a number of psychiatric conditions including substance use, PTSD (Wilkinson et al., 2008), anxiety disorders and ASD (Hadley, 2011). Role player games were proposed for these conditions due to the ability to expose individuals to arousal provoking stimuli (e.g., substance related paraphernalia and novel social situations) in a safe and supported environment without real-life consequences (Hadley, 2011). Although the possible benefits of videogame interventions were recognised in the 1980s, it was not until the late 1990’s that there was a large increase in research publications on videogames which lead to an increase in interest in videogames as a promising intervention modality for psychiatric and behavioural conditions (Ploog et al., 2013).

Children with ASD have been found to be heavy users of computer technology (Kuo et al., 2014; Mazurek et al., 2012; Mazurek & Wenstrup, 2013) and their natural affiliation for the technology suggests its potential as a therapeutic tool for this population (Mazurek et al., 2012). Mazurek and Wenstrup (2013) found that compared to their typically developing siblings, children with ASD engaged significantly more with computer-based technology during their spare time than other activities. The children who participated in this study spent, on average, four and a half hours per day engaged with screen-based technology. Kuo et al.’s (2014) research reinforced the findings from Mazurek and colleagues with the additional finding that, when using technology, children with ASD were spending the majority of their time playing videogames and, when not playing videogames, children with ASD were found to be most likely searching the internet for videogame-related content (Kuo et al., 2014). The heavy use of screen-based technology with an affinity for playing videogames suggests that
gaming models of intervention may provide a safe and engaging mode via which individuals with ASD may be able to both learn about, and interact with, their peers. The following chapter will assess the current body of literature regarding computer-assisted technology interventions through a refined lens, assessing the efficacy of videogame-based interventions only.
Chapter 4 Videogame based interventions in autism spectrum disorders – A Systematic Review

Aims and Hypotheses

The current review aimed to provide a more succinct summary of the literature relating to the use of videogaming interventions. As such, this review analysed the efficacy of pre-post test design studies and randomised controlled trials that employed videogames as an intervention for core deficits in children and adolescents with ASD.

Method

Eligibility Criteria

Studies focusing on videogames (a rule based, engaging or amusing activity that is conducted on a monitor or screen) that were developed with the express purpose of improving deficits in social and emotional functioning, communication and stereotyped and repetitive behaviours in children with ASD were identified for analysis following PRISMA guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). Figure 1 highlights the search strategy used to identify potential articles for review. As videogame interventions are a relatively new field, no limit was set on the year of publication. Inclusion criteria were as follows: a) peer reviewed studies published in English, b) participants had a confirmed diagnosis of ASD, c) participants were children and/or adolescents (i.e., 0-18 years of age), d) a clinical trial of a videogame intervention and e) improvement in core symptomatological deficits in ASD was explored by at least a Type 3 study (Nathan & Gorman, 2007). Studies that included a dual diagnosis (i.e., comorbid ASD and attention deficit hyperactivity...
Figure I. Identification and selection of studies for the systematic review.

- **Literature search**
  - Databases: Academic Search Complete, CINAHL, ERIC, MEDLINE, Psychology and the Behavioural Sciences, PsycINFO, and SCOPUS

- **Search results combined** ($n=7597$)

- **Papers screened on basis of title and abstract**
  - Excluded ($n=7437$)
    - Exact duplicate papers filtered ($n=2766$)
    - Papers not meeting the inclusion/exclusion criteria for this review ($n=4671$)

- **Included ($n=142$)**

- **Papers screened on basis of full manuscripts**
  - Excluded ($n=125$)
    - Game design papers ($n=64$)
    - Other papers not meeting the inclusion/exclusion criteria for this review ($n=61$)

- **Included ($n=17$)**

- **Papers identified from reference lists of included papers** ($n=71$)

- **Papers screened on basis of full manuscripts**
  - Papers not meeting the inclusion/exclusion criteria for this review ($n=69$)

- **Included ($n=2$)**

- **Included ($n=19$)**
disorder, intellectual disabilities and learning disabilities) were also considered for this review. Articles were identified in June 2016 through an extensive search of Abstracts from the electronic databases: Academic Search Complete, CINAHL, Eric, MEDLINE, Psychology and Behavioural Sciences Collection, PsychINFO and Scopus. Abstracts were identified through individual database searches using terms related to: *autism*, *gaming*, *technology*, *interventions*, and *symptoms*. Reference lists from the identified articles were searched independently in order to ensure all of the relevant articles had been considered for this review.

**Analysis**

Titles and abstracts of the identified articles potentially relevant to the review were screened by two independent reviewers. Eligible articles were then screened for meeting inclusion and/or exclusion criteria by each reviewer. Each of the identified studies are summarised in Table 1 based on the following components: a) participant characteristics, b) methodology/design, c) risk of bias in individual studies, d) type of game intervention, and e) details regarding the findings from the study.

The type of study was assessed based on Nathan and Gorman's (2007) framework in “A Guide To Treatments That Work” whereby studies may be categorised as belonging to 1 of 6 groups. Type 1 studies are the most rigorous and involve a randomised controlled clinical trial that meets full criteria. Type 2 studies are clinical trials but are missing some components of a Type 1 study. Type 3 studies are trials that are clearly methodologically limited such as pilot or open trials and are typically used to suggest whether a more rigorous design is warranted. Type 4 studies are reviews of published data that have secondary data analysis such as a meta-analysis. Type 5 studies are reviews without secondary data analysis
but are helpful to give an impression of the literature. Finally, Type 6 studies are reports of marginal value such as case studies, opinions and essays.

The overall quality of the methodological design and risk of bias for each of the identified studies was assessed using the PEDro scale (Maher, Sherrington, Herbert, Moseley, & Elkins, 2003), which has commonly been used in physiotherapy research to judge the quality of clinical trials. The PEDro scale consists of 11 items, each contributing one point to the total PEDro score (except the first item regarding eligibility for review). The PEDro scale assesses for randomisation and allocation procedures, homogeneity of groups at baseline, blinding procedures, control conditions, between group comparisons, and treatment effect. The authors rated each of the identified studies independently using this scale and the framework by Nathan and Gorman (2007) before coming together and discussing the scores. Where discrepancies occurred, the raters discussed the criteria until consensus was achieved. PEDro scores will be taken into account when analysing the strength of reported results due to the potential risk of bias (see Appendix B).

**Results**

Tables 1 and 2 summarise the studies identified for inclusion in this review. Table 1 summarises the studies alphabetically and includes the participant characteristics, methodology and design of each study, risk of individual study bias analysis, game interventions used and details regarding the findings from the study. Table 2 summarises the platform used to host the games identified in this review as well as the games’ design and features.
<table>
<thead>
<tr>
<th>Author</th>
<th>Participants</th>
<th>Design</th>
<th>Risk of bias</th>
<th>Game intervention</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson-Hanley, Tureck, &amp; Schneiderman, 2011</td>
<td>Pilot 1 n=12; 10-18 years diagnosed with ASD confirmed with the GARS-2</td>
<td>Type 3 study; pre- post-test within subjects design</td>
<td>PEDro score = 4/10</td>
<td>Intervention: Dance Dance Revolution; Exergame</td>
<td>Repetitive behaviours decreased significantly in the experimental phase compared to the control condition (p&lt;0.001).</td>
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<tr>
<td>Bauminger-Zviely, Eden, Zancanaro, Weiss &amp; Gal, 2013</td>
<td>n=22; average age 9.83 years (18 male, 4 female) diagnosed with ASD using DSM-IV-TR and confirmed with the ADOS and SCQ; PIQ &gt; 70 on WISC-IV and VIQ &gt; 70 from PPVT.</td>
<td>Type 3 study; pre- post-test design.</td>
<td>PEDro score = 5/10</td>
<td>Intervention: (1) Join-in (2) No-problem</td>
<td>Results showed a significant difference in collaboration concept clarification (p&lt;0.05), social conversation concept clarification (p&lt;0.01), problem solving (p&lt;0.001-0.05), and social engagement (p&lt;0.001). Group 1 with the &quot;Join-in&quot; program first improved significantly better on collaborative skills than Group 2 who had &quot;No-problem&quot; first.</td>
</tr>
<tr>
<td>Beaumont &amp; Sofronoff, 2008</td>
<td>n=49 (Exp n=26, Wait-list control n=23); 7-11 years 11 (44 male, 5 female) with diagnosis of Asperger’s Syndrome using DSM-IV-TR confirmed with the CAST; IQ &gt; 85 on WISC-III</td>
<td>Type 2 study; randomised controlled trial.</td>
<td>PEDro score = 6/10</td>
<td>Intervention: Junior Detective Program</td>
<td>The experimental group has significant improvement in emotion regulation and social skills and emotion management strategies p&lt;0.001. At both the 6-week and 5-month follow ups the improvements on the SSQ-P and ERSSQ were maintained</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Study Design</td>
<td>PEDro Score</td>
<td>Intervention</td>
<td>Outcome Measures</td>
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<tr>
<td>Bernadini, Porayska-Pomsta &amp; Smith, 2014</td>
<td>n=29; 4-14 years (28 male, 1 female) with a diagnosis of ASD confirmed with the SCQ.</td>
<td>Type 3 study; pre-post-test design.</td>
<td>PEDro score = 2/10</td>
<td>Intervention: ECHOES</td>
<td>Outcome Measures: SCRETS assessment protocol</td>
</tr>
<tr>
<td>Chung, Han, Shin &amp; Renshaw, 2016</td>
<td>n=25 (Exp n=13, Control n=12); 13-18 years diagnosed with ASD confirmed with the ADOS; IQ &gt; 70 on the Korean WAIS; without a comorbid diagnosis</td>
<td>Type 3 study; randomised controlled trial.</td>
<td>PEDro score = 5/10</td>
<td>Intervention: Poki Poki prosocial game and CBT.</td>
<td>Outcome Measures: Social Communication Questionnaire - Korean (SCQ-K) and assessment of brain activity regarding 60 emotional words and 60 facial emoticons.</td>
</tr>
<tr>
<td>Didehbani, Allen, Kandalaft, Krawczyk &amp; Champan, 2016</td>
<td>n=30; 7-16 years with a diagnosis of ASD and confirmed with the ADOS; without a comorbid diagnosis other than managed ADHD; IQ range 90-119 on the WASI</td>
<td>Type 3 study; pre-post-test design.</td>
<td>PEDro score = 5/10</td>
<td>Intervention: Virtual Reality Social Cognition Training</td>
<td>Outcome Measures: Developmental and Neuropsychological Assessment Second Edition (NEPSY-II) affect recognition and auditory attention response set as well as the Social Attribution Task</td>
</tr>
<tr>
<td>Gal et al., 2009</td>
<td>n=6; 8-11 years, all male diagnosed with HFASD using DSM-IV-TR confirmed with the CARS or ADI-R</td>
<td>Type 3 study; pre-post-test design.</td>
<td>PEDro score = 3/10</td>
<td>Intervention: StoryTable</td>
<td>Outcome measures: Social interactive observation scale and the Friendship observation scale</td>
</tr>
<tr>
<td>Gal et al., 2016</td>
<td>n=14; 8-12 years, all male diagnosed with HFASD using DSM-IV and confirmed with the ADOS; VIQ &gt; 80 on the WISC-R</td>
<td>Type 3 study; pre-post-test design.</td>
<td>PEDro score = 4/10</td>
<td>Intervention: StoryTable</td>
<td>Outcome measures: Friendship observation scale</td>
</tr>
<tr>
<td>Study Reference</td>
<td>Sample Size and Diagnostic Criteria</td>
<td>Study Type</td>
<td>PEDro Score</td>
<td>Intervention</td>
<td>Outcome Measures</td>
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<tr>
<td>Golan et al., 2010</td>
<td>n=57 (ASD Exp n=20, ASD control n=19, typically developing control n=18); 4-8 years (42 male, 15 female) with a diagnosis of ASD confirmed with the ADI-R (Exp) and CAST (ASD control).</td>
<td>Type 2 study; randomised controlled trial.</td>
<td>6/10</td>
<td>Intervention: Transporters DVD series</td>
<td>Outcome measures: Emotional vocabulary and situational-facial expression matching.</td>
</tr>
<tr>
<td>Gordon, Pierce, Barlett &amp; Tanaka, 2014</td>
<td>n=34 (Exp n=17, typically developing control n=17); 6-18 years diagnosed with ASD using either the BCAAN or ADOS and ADI.</td>
<td>Type 3 study; pre- post-test design.</td>
<td>4/10</td>
<td>Intervention: FaceMaze.</td>
<td>Outcome measures: 46 naive undergraduate students rated the quality of the facial expressions of each of the participants at each time point.</td>
</tr>
<tr>
<td>Hopkins et al., 2011</td>
<td>Total n=49; 6-15 years (44 male, 5 female) with a diagnosis of ASD using DSM-IV and confirmed with the CARS; HFASD group n=24 with a KBIT &gt; 70. LFASD group n=25 with a KBIT &lt; 70. Control group n=25 (HFASD n=11, LFASD n=14), Exp n=24 (HFASD n=13, LFASD n=11).</td>
<td>Type 1 study; randomised controlled trial</td>
<td>9/10</td>
<td>Intervention: FaceSay</td>
<td>Outcome measures: Photographs from Ekman and Friesen, (1975) &quot;Unmasking the face&quot; and schematic drawings of emotional expressions, Benton Facial Recognition Test - Short form, The Social Skills Rating System, Naturalistic Social Skills Observations</td>
</tr>
<tr>
<td>Lacava, Golan, Baron-Cohen &amp; Myles, 2007</td>
<td>n=8; 8-11 years (6 males, 2 females) diagnosed with ASD using either DSM-IV or DSM-IV-TR confirmed using the ASDS.</td>
<td>Type 3 study; pre- post-test design.</td>
<td>2/10</td>
<td>Intervention: Mind Reading software</td>
<td>Outcome measures: Cambridge Mindreading Face-Voice Battery for Children (CAM-C), Child Feature-Based Auditory Task (C-FAT), Reading the Mind in Films Test - Children's Version.</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Intervention</td>
<td>Outcome measures</td>
<td>Results</td>
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</table>
| Lopata et al., 2016                       | n=36 (Exp n=18, Control n=18); 7-12 years (34 male, 2 female) diagnosed with ASD of PDD-NOS, confirmed using the ADI-R; IQ > 70 as measured by the WISC-IV. | Type 2 study; randomised controlled trial | PEDro score = 6/10 | Intervention: Mind Reading software  
Outcome measures: CAM+, Emotion Recognition and Display Survey (ERDS), Social emotional evaluation (SEE), Adapted skill streaming checklist (ASC), Social Responsiveness Scale (SRS), Behaviour Assessment System for Children 2 (BASC-2) - Parent Rating Scale. | Participants improved significantly in the experimental condition on the CAM-C faces subtest (p < 0.01). Participants all improved on the CAM-C voices (p < 0.01), ERDS parent and clinician rating (p < 0.001), SEE (p < 0.001), parent ratings on the ASC (p < 0.001), parent and clinician ratings on the BASC-2 social skills (p < 0.05 and p < 0.001 respectively) and parent and clinician ratings on the SRS (p < 0.001) irrespective of condition. |
| Rice, Wall, Fogel & Shie, 2015             | n=31 (Exp n=16, Control n=15); 5-11 years (28 male, 3 female) eligible for special education services for autism; no specific mention of diagnosis | Type 2 study; randomised controlled trial | PEDro score = 7/10 | Intervention: FaceSayTM.  
Outcome measures: NEPSY-II affect recognition subtest, NEPSY-II Theory of Mind subtest, and the SRS-2 | The intervention group had a significant difference in: post-test affect recognition p<0.001, post-test theory of mind p<0.001 and SRS-2 score p<0.05.                                                                 |
| Tanaka et al., 2010                       | n=79 (Exp n=42, Wait-List Control n=37); mean age 10.9 years (62 males, 17 female) with a diagnosis of a ASD confirmed with the ADI-R or ADOS; mean IQ = 94.7 measure by the WASI, WISC-III or DAS. | Type 3 study; randomised controlled trial | PEDro score = 6/10 | Intervention: Let's Face It  
Outcome measures: Let's Face It - Skills Battery | There was a significant difference from pre- post-intervention on the Parts/Whole identity task (p<0.01).                                                                                                                                 |
| Thomeer et al., 2011                      | n=11; 7-12 years (8 male, 3 female) with a diagnosis of ASD or PDD-NOS confirmed with the ADI-R; IQ > 70 as measured by the WISC-IV.            | Type 3 study; pre-post-test design | PEDro score = 4/10 | Intervention: Mind Reading software  
Outcome measures: ERDS, SRS, and Parent and child satisfaction survey. | Participants significantly improved on the overall SRS (p < 0.001), ERDS encoding (p < 0.001) and ERDS decoding (p < 0.01).                                                                 |
<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Study Type</th>
<th>PEDro Score</th>
<th>Intervention</th>
<th>Outcome Measures</th>
<th>Results</th>
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<tbody>
<tr>
<td>Thomeer et al., 2015</td>
<td>n = 43</td>
<td>Type 2 Study; randomised controlled trial</td>
<td>6/10</td>
<td>Mind Reading software</td>
<td>CAM-C, ERDS, SRS, BASC-2 - Parent Rating Scale and a Satisfaction Survey. Participants in the experimental group improved significantly from pre-post-testing and at follow up on the CAM-C faces and voices subtests (p &lt; 0.001), ERDS Expressive subtest (p &lt; 0.05 and p &lt; 0.01 respectively) and the SRS (p &lt; 0.05). Participants in the experimental group improved significantly at follow-up on the ERDS Receptive subtest (p &lt; 0.01). There was no significant difference found on the BASC-2.</td>
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<tr>
<td>Young &amp; Posselt, 2012</td>
<td>n=25</td>
<td>Type 2 Study; randomised controlled trial</td>
<td>6/10</td>
<td>Transporters DVD</td>
<td>Affect recognition subtest of the NEPSY-II, the Faces Task (Baron-Cohen et al., 1997) Participants in the experimental condition improved significantly on emotion recognition and the Faces Task (p&lt;0.001).</td>
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<td>Study</td>
<td>Design</td>
<td>Sample Details</td>
<td>Intervention</td>
<td>Outcome Measures</td>
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<td>Williams, Gray &amp; Tonge, 2012</td>
<td>Type 1 study; randomised controlled trial</td>
<td>n = 55 (Exp n=28, Control n=27); 4-7 years (48 males, 7 female) with a diagnosis of ASD using DSM-IV and confirmed with ADOS; mean IQ 76.28 measured by the WPPSI.</td>
<td>Transporters DVD</td>
<td>Affect recognition subtest and Theory of Mind tasks of the NEPSY-II, Socialization component of the Vineland, Pictures of Facial affect (Ekerman &amp; Friesen, 1976), Situational and desire-based mindreading tasks,</td>
<td>Participants improved in overall matching emotion expression (p = 0.00), specifically anger (p &gt; 0.05) from pre- to post-testing. There were no significant improvements in affect recognition, theory of mind or socialization. Recognising anger was not maintained at follow-up. From post-testing to follow-up participants in the intervention group improved on recognizing expressions of happiness (p &gt; 0.05) and performance on mindreading situational tasks (p &gt; 0.05).</td>
<td></td>
</tr>
</tbody>
</table>
**Table 2.** Game design and features of identified studies

<table>
<thead>
<tr>
<th>Author</th>
<th>Game / Type / Platform</th>
<th>Game design and features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson-Hanley, Tureck, &amp;</td>
<td><em>Dance Dance Revolution</em></td>
<td>“Dance Dance Revolution” is a popular arcade game requiring users to follow a dance pattern dictated by a set of arrows (i.e., up, down, left and right) appearing in a random order and projected onto a monitor set at eye level. At the top of the monitor there are four deluminated arrows. As the game progresses the set of arrows dictating the dance pattern scroll up from the bottom of the monitor. Arrows become highlighted when they reach the corresponding deluminated arrow. As the arrow becomes highlighted the user is required to touch the corresponding arrow on a footpad. The game steadily becomes more difficult as the user moves through levels by increasing speed and complexity of the arrow combinations.</td>
</tr>
<tr>
<td>Schneiderman, 2011</td>
<td>Exergame</td>
<td></td>
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<td></td>
<td>Console</td>
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<tr>
<td>Bauminger-Zviely, Eden,</td>
<td>Join-In and No Problem</td>
<td>“Join-in” and “No-problem” based on principles from cognitive behavioural therapy, each game comprised a learning and experiential component. The learning (cognitive) component of “Join-in” included social problem solving and collaboration through a number of social vignettes and discussing alternate social solutions. The experiential (behavioural) component required users to use DiamondTouch technology to play three cooperative games with another user. These games were &quot;Raindrops&quot; focusing on joint-performance, &quot;Bridge&quot; requiring participants to share resources with their peer, and &quot;Save the Alien&quot; requiring mutual planning. Similar to &quot;Join-In&quot; in the “No-problem” condition participants were required to watch social vignettes and concept clarification. The learning component included a definition of social conversation, description of how it differs from other conversation and why it’s important. They were also exposed to social vignettes demonstrating these skills in three different social situations. The experiential component required users to practice these skills using a role-playing technique, feedback and reinforcement through creating a video-tape through the computer program social conversations.</td>
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<tr>
<td>Zancanaro, Weiss &amp; Gal, 2013</td>
<td>Collaborative interface</td>
<td></td>
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<td></td>
<td>game</td>
<td></td>
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<td></td>
<td>DiamondTouch and PC</td>
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<tr>
<td>Beaumont &amp; Sofronoff, 2008</td>
<td>Junior Detective Program</td>
<td>The “Junior Detective Program” is a role player game set in a futuristic environment in which genetic screening is used to determined employment suitability. The user’s avatar is chosen to become a secret agent specialising in decoding suspect’s thoughts and feelings through a variety of cues. The first level requires the user to decode how suspects are feeling from facial expressions, body posture and prosody of speech. The user is also required to calibrate physiological scales to identify emotions in themselves. Users are taught how to identify complex emotions with human and computer-animated caricatures. The second level requires the user to decipher how cartoon characters are feeling from non-verbal and environmental cues across a variety of situations. This knowledge is applied in level 3 where users are required to attempt virtual missions regarding situations such as bullying, playing with others and trying new things. This may include things such as identifying how characters might be feelings, and choosing an appropriate option for how they could cope in the situation. On completion of level 3 the junior detective graduates from the academy and is awarded promotions and detective gadgets throughout the game for successful completion of future missions.</td>
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<tr>
<td></td>
<td>Role Player Game</td>
<td></td>
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<td></td>
<td>PC</td>
<td></td>
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<tr>
<td>Bernadini, Porayska-Pomsta &amp; Smith, 2014</td>
<td>ECHOES</td>
<td>Point and click game</td>
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<td><strong>“ECHOES”</strong> is a virtual reality program facilitated by a 42 inch multitouch LCD monitor with eye gaze tracking. Activities are chosen through a graphical interface. It aims to improve the social skills of joint attention and symptom which have been identified as key deficits in the social interactions of children with ASD. It focuses on teaching through repetition of specific stimuli, It provides the user with a virtual peer “Andy” for them to engage in positive interactions with in a safe and predictable environment. Andy is a responsive intelligent agent that is capable of experiencing certain emotions based on the environment and provides positive feedback to the user. All &quot;ECHOES&quot; activities are set in a sensory garden consisting of Andy and a number of 'magic' objects that react in unusual ways (e.g., flower becoming a floating bubble) in order to teach principles of cause and effect. For specific learning the programmers designed two sets of activities; 1) goal oriented - consisting of clear sequences with an end goal, and 2) co-operative turn-taking - with no clean end-goal whose main objective is reciprocity, turn taking and mutual enjoyment. Users engage with the character Andy through a number of different skills such as responding to bids for interaction, initiating bids for interaction and engaging in turn taking behaviours in order to support social communication and joint attention. It does this using simple verbal (using simple phrases e.g., 'my turn' or 'your turn') and non-verbal (i.e., gazes and gestures) communication. Examples of tasks that the Andy guides the user to complete are; facilitating turn taking or touching clouds on the screen. Andy is a 'responsive' agent. His responsiveness ranges from simple physical interaction (e.g., laughing if the child tickles him) to responding to the child’s needs (e.g., repeats bid for interaction if child is delayed).</td>
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<tr>
<th>Chung, Han, Shin &amp; Renshaw, 2016</th>
<th>Poki Poki</th>
<th>Role Player Game</th>
<th>PC</th>
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<td><strong>“Poki Poki”</strong> is an online prosocial game in which users are able to create their own social environment. User are able to create, modify and maintain their own avatar as well as personalize it to become a digital representation of themselves. They are also able to build their own home, and website for their avatar. Users are then able to invite other people using the &quot;Poki Poki&quot; website to be a part of their social network and can interact with them in the virtual environment. Peers that have been invited to interact with the user are able to make comments about the user’s avatar and their home as well as interact with them socially. The game has been developed in a cartoon style which makes it more appealing and less threatening to younger audiences.</td>
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<th>Didehbani, Allen, Kandalaft, Krawczyk &amp; Champan, 2016</th>
<th>Virtual Reality Social Cognition Training</th>
<th>Role Player Game</th>
<th>PC</th>
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<td>Children engaged in a virtual environment in the company of a lead clinician (coach), confederate clinician and a peer. The child would manipulate an avatar within this virtual environment as directed by the coach in the VR via their avatar to a social situation at a specific location within the environment in which they would interact with a specific person (the confederate clinician). These situations included things such as; ‘dealing with a bully, bonding with friends, confronting conflict, consoling a friend or handling social dilemmas’ (e.g., catching someone cheating). The confederate clinician changed avatars to a suitable character for each situation and would modify their voice to match the avatar. Clinicians followed manualised training regarding the situation, and responses to the user. They would engage the user in a loosely scripted conversation to which the confederate clinician and user could independently respond based on pre-established social prompts. The coach would provide feedback to the user as they responded.</td>
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Gal et al., 2009; Gal et al., 2016  | **StoryTable**  
| Collaborative interface game  
| DiamondTouch  
| “**StoryTable**” application to produce and record joint narratives from children with ASD. It provides a virtual environment where users can manipulate objects and characters within the set narrative. A number of scenarios are available for use, each having their own characters that users manipulate to make stories. The interface was created with the concept of lady bugs wandering around the screen. By clicking on one lady bug the user gains access to the different backgrounds or settings for their stories. Background selection is crucial to the narrative and therefore it requires a double touch (both users) in order to select the background from the lady bug. If the users click on a second lady bug this allow the selection of characters appropriate to the background chosen. A number of other smaller lady bugs are also present which contain audio snippets used to create the story. The user must drag the lady bug to a recorder and presses the button whilst speaking to record the audio file. The audio lady bug is then dragged over the interface to the bottom of the table and aligned with other audio snippets. This platform allows the children to manipulate objects and characters cohesively within a set story background.

Golan et al., 2010; Young & Posselt, 2012; Williams, Gray & Tonge, 2012  | **The Transporters**  
| Point and click game  
| TV / DVD  
| “**The Transporters**” is an animated series based around eight characters shaped as vehicles to help engage children in the intervention. The vehicles were chosen for having determined motion (e.g., can only go back on forth over linear tracks). Each vehicle had a real human face of an actor in order to demonstrate human emotion in a non-threatening, engaging and predictable way. Faces were from a variety of ages, sexes and ethnicities in order to help generalize learning. All characters were depicted as toys in a child’s bedroom. The premise was that through hours of systematically and repetitively watching the DVD series children might tune into faces rather than ignoring them without even realizing they were doing so. The series consists of fifteen 5 minute episodes, each focusing on a key emotion; happy, sad, angry, afraid, disgusted, surprised, excited, tired, unfriendly, kind, sorry, proud, jealous, joking and ashamed. The DVD also includes a section of quizzes of varying difficulty relating to each episode. Quizzes consist of matching faces to faces, matching faces to emotions and matching situations to faces. If a child answers a question right they are congratulated by the narrator and a reward appears. If they question is answered incorrectly it is asked again until a correct answer is given.

Gordon, Pierce, Barlett & Tanaka, 2014  | **FaceMaze**  
| Acade style game  
| PC  
| “**FaceMaze**” is a program in which individuals are required to navigate a ‘Pac-man’ like maze and overcome a number of obstacles. The obstacles are emoticon “face” obstacles denoting a “happy” or “angry” facial expression. Participants are required to make facial expression on the emoticon and hold it while a camera records and analyses the quality of the expression. If the participants is able to reproduce the emotion accurately for a sufficient amount of time the obstacle is removed from their path. The program utilizes the Computer Emotion Recognition Toolbox system developed by Bartlett et al. (2005) to analyse the quality of facial expression of the individual via webcam and gives real time feedback. If the user adopts the appropriate facial expression, the “expression meter” (a bar indicating the time of expression held) fills and the obstacle is removed. In order to complete each stage of the game successfully, participants are required to produce 24 facial expressions to remove all obstacles and complete the maze. This game utilizes two distinct mazes; “HappyMaze” and an “AngryMaze” (requiring participants to produce “happy” and “angry” expressions respectively).
### FaceSay

*FaceSay* contains three games with humanistic avatars designed specifically to teach specific social skills. The avatars were animated from photographs of real people and would interact with the child in order to direct the child into completing each of the games. The games attempt to teach social skills related to joint attention, eye gaze, recognizing facial expressions and recognizing faces. The three games developed as a part of the *FaceSay* program are as follows: 1) “Amazing Game” teaching eye gaze and responding to joint attention where the participant is required to follow and click on the focal point of an avatar’s gaze, 2) “Band Aid Clinic” teaches facial processing and recognition requiring the participant to pick a puzzle piece to complete a picture where two thirds have been completed for them, and 3) “Follow the Leader” teaches attention to movement in the area around a person’s eyes to understand their emotion based on facial expression requiring the participant to make a judgement on whether two faces presented together are exhibiting the same, or different, expressions of emotion. In the first level children are required to judge "yes" or "no" if the facial expressions are the same. In the advanced level they are required to change the expression of the second avatar to match the original by moving the eyes up or down using the touch screen technology. If the child is correct, they receive praise from the avatar using the child’s name.

### Mind Reading

*Mind Reading* is a program using interactive software to teach facial expression and prosody decoding to children with ASD. The program contains 6 levels of difficulty and various forms of help to facilitate independent use by children. The intervention is comprised of four separate areas; an "Emotions Library", a "Learning Centre", a "Games Zone" and a "Rewards Area". The “Emotions Library” has 412 emotions organised into 24 groups. The child selects one of these groups they can click on an emotion in that group and are presented with a video of 6 actors of different ages, sexes and ethnicities in which a narrator describes the emotion and what to watch for. They are also exposed to sample storylines of the emotion and sample voice expressions of the emotion. In the "Learning Centre" the emotions are grouped similar to the library but the structure focuses more on learning and exploration with videos, stories and vocal expressions separately. Lessons contain quizzes with a variety of questions based around; finding faces with specific emotions, matching emotional statements and faces and matching statements with people in a picture. The rewards area is accessed through building up correct answers and contains stimuli typically of interest to children with ASD (e.g., trains). In the "Game Zone" children are able to partake in games that involve matching, hand-eye coordination and real world faces (e.g., the opportunity to control Daniel Radcliffe) in a variety of emotions. The program allows for tracking of progress, and limiting time spend in game areas and on specific emotions.

### Let's Face It

*Let’s Face It* was designed to facilitate learning of facial recognition, facial emotional recognition and the meaning of facial cues in social settings. There were three suites of games which increased in difficulty based on the “Hierarchical Model for Face Processing”. The first suite of games required the participant to selectively distinguish faces from other objects (e.g., “Find a Face” requires selecting a face hidden amongst a group of non-face objects such as bikes). The second suite of games aimed to support participants in learning facial recognition (e.g., “Zap It” requires participants to remove face icons from a large set by identifying and grouping identical icons into groups of three) and facial emotions (e.g., “EmotionMaker” requires participants to copy a facial expression by identifying the correct components from a distractor set). The final suite of games required participants to interpret the meaning of various facial cues in the context of social situations (e.g., “The Eyes Have It” requires the participant to identify the direction in which a face is gazing).
Participant Characteristics

A total of 19 studies have been published that met criteria for inclusion in this review. A combined total of 615 subjects participated in these studies, with sample sizes ranging from 6-79. Participants’ ages ranged from 4-18 years for the 17 studies that reported an age range. Of the remaining two studies, one reported using school-aged children with a mean age of 9.83 years, and the other reported using children, adolescents and young adults with a mean age of 10.5 years. A majority of the participants from the 14 studies that reported participant sex were male \((n = 400)\) and 69 were female. The remaining five studies \((n = 126)\) did not report sex. The majority \((n = 580)\) of participants met a diagnosis for ASD or PDD-NOS, with only two studies using a typically-developing control group \((n = 35)\). Eighteen studies administered measures such as the Gilliam Autism Rating Scale (GARS), Childhood Autism Rating Scale (CARS), Autism Diagnostic Interview (ADI), Autism Diagnostic Observation Schedule (ADOS), Social Communication Questionnaire (SCQ) or Autism Spectrum Rating Scale (ASDS) to confirm autism based symptoms. The remaining study did not report how the participants had been diagnosed. Symptom severity ranged across studies from low-functioning ASD to high-functioning ASD or Asperger’s disorder. This review included ten randomised controlled trials (RCT) and nine pre-post test designs. Thirteen studies included in this review explored the effectiveness of combined human instruction and videogame based learning, and six examined the efficacy of videogame-based learning alone (i.e., administered as a self-directed tool).

Combined videogame and instructional based learning

Although it is possible for videogames to include difference game types features (e.g., *role player games* may include *point and click* features), this section will separate and critique them in regard to the predominant game type utilised in the study. Studies that
evaluated a combined approach (both videogame and alternative instruction) encompassed a broad range of additional instructional learning. This varied from human interaction to additional computer-assisted technology components of learning that were not game based (e.g., instructional animations/videos, learning modules without a fun interactive component). Specifically, for social skills, researchers utilised a combination of role player game gaming technology and human coaching (Beaumont & Sofronoff, 2008; Chung, Han, Shin, & Renshaw, 2016; Didehbani, Allen, Kandalaft, Krawczyk, & Chapman, 2016) as well as collaborative interface games and human instruction (Bauminger-Zviely, Eden, Zancanaro, Weiss, & Gal, 2013; Gal et al., 2009). For emotion recognition and regulation, they utilised point and click games requiring matching and instructional video-based learning (Golan et al., 2010; Young & Posselt, 2012), as well as logic and understanding-based games paired with computerised instructional lessons (Lacava, Golan, Baron-Cohen, & Myles, 2007).

Three studies used role player games to improve social skills in children and adolescents with ASD. Role player games refer to videogames which require the user to control a fictional character to complete tasks in an imaginary world. The “Junior Detective Program” (Beaumont & Sofronoff, 2008), “Pokí Pokí” game (Chung et al., 2016) and virtual reality social cognition training (Didehbani et al., 2016) each provide an engaging medium for children with ASD to experience a diverse range of social situations and emotional expressions. Within these games, children with ASD learn appropriate responses to social situations in a safe and controlled environment. Players manipulate characters through simulated social situations and are provided with instruction and experience in the skills necessary to navigate an environment that is often confusing and stressful for them. Simulated environments allow children to experience stressful situations and experiment with different response types without the fear of real-life repercussions for mistakes. Results from studies reviewing each of these games suggest significant improvements on measures of
social skills. Beaumont and Sofronoff (2008) and Didehbani et al. (2016) each employed a randomised controlled trial study designs for their evaluations adding weight to the promise of role player games as a social intervention for children with ASD. Each intervention group demonstrated significant improvement compared to controls. Although each of these studies suggest that role player games are a promising avenue for intervention, their results are based on weak study designs, which failed to account for potential bias inherent in their design (reported in Table III). Additional caution is warranted in interpreting the efficacy of these interventions due to the human instruction component of each intervention. Without controlling for the human instruction variable, the efficacy of the videogame component alone cannot be determined.

**Collaborative interface games** accounted for three of the studies included in this review. Collaborative interface games require *in vivo* learning of social skills (e.g., collaboration and cooperation) facilitated by joint game play with multiple users. The collaborative interface game interventions included in this review consisted of two components; 1) instruction in the skills necessary to complete the collaborative multiuser game, and 2) exposure to a situation where they were required to use these skills collaboratively as part of a game (Bauminger-Zviely et al., 2013; Gal et al., 2009; Gal, Lamash, Bauminger-Zviely, Zancanaro, & Weiss, 2016). Each study reported improvements in social skills following intervention. Although promising, these findings were based on weak study designs without controls, blinding or accounting for variables such as multiple intervention components (i.e., human instruction and videogames).

**Point and click games** and additional computer-assisted technology based learning accounted for the majority (*n* = 7) of the studies identified by this review. **Point and click games** are games where the user is presented with options where they must click the correct answer, but little other manipulating is required. Both “*The Transporters*” (Golan et al.,
2010; Williams, Gray, & Tonge, 2012; Young & Posselt, 2012) and “Mind Reading” (Lacava et al., 2007; Lopata, Thomeer, Rodgers, Donnelly, & McDonald, 2016; Thomeer et al., 2015; Thomeer et al., 2011) programs utilised gaming components in their interventions, however, the main focus was on additional computer-assisted technology based learning. The point and click games reviewed required participants to attend to an emotional expression (either a real face, animated or drawn) and pick a correct corresponding emotion from a distractor set (i.e., including other emotions). This was often done with static faces where the user is required to match the specific face with its identical counterpart. Other point and click games required the participant to match a facial expression on one face with a dynamic corresponding face (i.e., a different person). Using a dynamic battery of faces in matching games attempts to teach the user to generalise a type of facial expression across a number of factors such as ethnicity, age, gender and the intensity of the expression. Although both interventions yielded positive outcomes based on (for the most part) high quality studies for emotion recognition and regulation (Beaumont & Sofronoff, 2008; Golan et al., 2010; Young & Posselt, 2012), neither accounted for the various components of the interventions. As a result, it remains unclear whether the videogame component was associated with additional improvement in social skills and emotional regulation than the human-instructe social skills training, video instruction or computer-based instruction.

**Self-directed videogames and learning**

Consistent with the joint videogame and other instructional-based interventions, self-directed videogame interventions each implemented a game type targeted to a specific symptomatological deficit. The majority of the self-directed videogame interventions identified by this review targeted emotion recognition and expression, with one game designed to target reductions in repetitive behaviours. *Point and click games* accounted for
the majority \((n = 4)\) of self-directed videogames identified by this review. “FaceSay”, “Let’s Face it” and “ECHOES” each utilised videogame based interventions comprised of various point and click games designed to teach specific skills such as communication, joint attention, identifying facial cues, facial processing, facial recognition, and facial identification (Bernardini, Porayska-Pomsta, & Smith, 2014; Rice, Wall, Fogel, & Shic, 2015; Tanaka, Lincoln, & Hegg, 2003). These games comprised a range of point and click tasks such as identifying faces amongst a set of random distractor objects, and attending to movements in the area around the eyes of two separate individuals and discerning whether they were making the same facial expression. As the game difficulty increased, the games typically switched from using static (or identical) pictures of facial expressions to dynamic pictures where the participant would have to generalise concepts across non-identical faces. “ECHOES” had an additional component of a virtual peer to collaborate with and guide the participant through the instructions as part of the game intervention (Bernardini et al., 2014).

Each of the interventions using the “FaceSay” program reported improvements in facial/emotion recognition skills (Hopkins et al., 2011; Rice et al., 2015). The high quality nature of the studies used to assess the effectiveness of this game supports its use as an intervention for facial/emotional recognition skills in children with ASD. Additionally, Rice et al. (2015) found improvements in theory of mind following the intervention, which negatively correlated with symptoms of autism. Although the “Let’s Face It” program also demonstrated improvements, the evaluation was completed using outcome measures developed by the authors that have not been validated by any other researchers (Tanaka et al., 2003). Unlike the other point and click games, “ECHOES” identified no significant impacts on skills related to social interaction and communication. Findings from these studies are promising and add support for the use of point and click games as an intervention for children...
with ASD. However, due to the heterogeneity of measures and the lack of impact of the “ECHOES” program, more high quality research is needed to confirm efficacy.

“FaceMaze” is an arcade style game requiring participants to make their way through a pac-man like maze collecting tokens, and removing obstacles that appear in the way (Gordon, Pierce, Bartlett, & Tanaka, 2014). Obstacles are removed from the maze once the participant physically makes the appropriate emotional facial expression (Gordon et al., 2014). The facial recognition system evaluates the accuracy of the expression prior to removing the obstacle and allowing the children to continue through the maze (Gordon et al., 2014). Incorporating an arcade style of game with this system allows users to practice emotional expression in a novel and entertaining way. Although Gordon et al. (2014) found this to be an effective method of teaching both “happy” and “angry” emotional expressions, it did not account for more complex emotions. The initial piloting of this program was deemed successful; however, a more rigorous study design is needed to properly valuate this intervention.

Exergaming (gaming coupled with an exercise component) has also been shown to have positive outcomes in treating core symptomatological deficits in children with ASD. Anderson-Hanley, Tureck, and Schneiderman (2011) hypothesised that there would be a reduction in repetitive behaviours in children with ASD who used exergames. Exergaming, like each of the other forms of videogames described above, creates an engaging environment to stimulate learning in children with ASD. Unlike the other videogames described, it contains an added component of physical exercise. Anderson-Hanley et al. (2011) noted that immediately following their exergaming intervention, they observed a significant decrease in the repetitive behaviours of their participants by coding independent play with “Play-Doh” and Lego using the repetitive behaviour scale of the GARS-2. The authors conducted a single exergaming session and assessed the participants immediately following the session for
repetitive behaviours. Although the authors observed reduced repetitive behaviours following the intervention, they did not control for confounding factors such as fatigue. The lack of follow-up data and comparison to a control suggest that, although this may be a promising intervention, further research is needed to establish efficacy.

**Discussion**

This review aimed to explore the available literature on the effectiveness of videogame based interventions for core deficits in children and adolescents with ASD. The search yielded 19 studies that met the inclusion criteria. Of the included studies, six assessed the effectiveness of a videogame intervention alone (i.e. without additional assistance), and 13 examined a combination of videogame based interventions with an additional component of learning (e.g., human instruction, computer animated lessons etc.). As the majority of the studies included in this review included an additional intervention component as a treatment package with the videogame, it is difficult to assess the effectiveness of videogames as stand-alone interventions for children and adolescents with ASD. Without a comparison between the intervention components it cannot be concluded with certainty that the videogame component of these interventions had an effect on the measured variables. Of the six studies that reviewed independent videogames, only the studies reviewing the program “FaceSay” were of sufficient quality to assess the efficacy of videogames at improving deficits in social and emotional functioning in children and adolescents with ASD (Hopkins et al., 2011; Rice et al., 2015). The remaining studies suggested that videogames are a promising avenue for intervention in this population (with the exception of “ECHOES”) but lack the scientific rigour to elucidate the effects.

Difficulties with forming and maintaining relationships are core deficits in children and adolescents with an ASD. Findings from this review suggest that there is a positive
foundation for the use of videogames as an intervention for improving social skills necessary in forming reciprocal peer relationships. General improvements in social skills were found following use of the point and click games “Mind Reading” (Lopata et al., 2016; Thomeer et al., 2015; Thomeer et al., 2011), “FaceSay” (Rice et al., 2015) as well as the role player game “Poki Poki” (Chung et al., 2016). Collaborative interface games were found to improve specific skills related to social conversation, social problem solving, social engagement (Bauminger-Zviely et al., 2013) and social interactions (Gal et al., 2009; Gal et al., 2016).

Problems with interpreting social situations is largely due to an inability to understand cues that are inherent in social interaction such as emotional state. This often presents as children with ASD having difficulty understanding their own emotions as well as identifying and understanding the emotional state of others. Point and click games and role player games have been used effectively to improve these skills in children and adolescents with ASD. Understanding emotions in general was taught through systematic digital learning environments using “The Transporters” (Golan et al., 2010; Williams et al., 2012; Young & Posselt, 2012) and “Mind Reading” (Lacava et al., 2007; Lopata et al., 2016; Thomeer et al., 2015) programs. Both “The Transporters” and “Mind Reading” programs utilised a point and click gaming as a secondary component to their intervention. Similarly, Hopkins et al. (2011) and Rice et al. (2015) found that users improved dramatically after using the “FaceSay” games at recognising emotions in others. Whilst the efficacy of these interventions cannot be determined due to the heterogeneity of the studies and the differing methods of videogame instruction, the improvements in social and emotional functioning warrant further attention to this mode of service delivery.

The majority of the studies identified in this review (including eight of the ten identified randomised controlled trials) utilised point and click video games. As such, it is unsurprising that this game mode also showed the strongest efficacy for improving social and
emotional functioning in children and adolescents with ASD. It is likely that these programs are utilised more frequently than other games due to the basic programming and development requirements and minimal technological capabilities of the user. These games typically require minimal technological manipulation consisting of touching a screen, or manoeuvring a mouse to click on an appropriate response. Tasks are usually set on the same screen as the answer (i.e., user identifying if two faces are making the same facial expression and clicking “yes” or “no”). Role player games that allow for controlled exposure to social skills and emotional understanding require more sophisticated programing and financial investment. In these games, users are able to manipulate an avatar through a virtual world that experiences situations similar to real life interactions (i.e., being exposed to a bully). This adds an additional complexity to both the development, usability and engagement with the game. Point and click mechanics are frequently included in these games when users are presented with a situation (i.e., exposure to a bully) and required to click on an option displayed on the screen of how they would respond the situation. Although this review only identified three studies utilising role player games, their promise for generalising social skills to real life situations through controlled exposure, coupled with promising findings from the other reviewed studies suggests further investigation is warranted.

Conclusions and Implications for Future Research

Videogame based intervention in ASD is a promising area of research, albeit in its infancy. A lack of high quality research limits the ability to make conclusions about the efficacy of videogame interventions in improving core symptomatological deficits in children with ASD. Of the studies reviewed, eight utilised a RCT design and were of sufficient quality to be ranked as a Type 1 or 2 study (Nathan & Gorman, 2007). The remaining 11 studies utilised a pre- post-test study design or did not meet standards to be ranked as a Type 1 or 2
study. Although these designs are appropriate for obtaining pilot data, they do not provide sufficient evidence to indicate videogaming as an evidence-based treatment for children with ASD. The heterogeneity of the studies included in this review (i.e., types of games used, symptoms targeted, intervention lengths, intervention location and outcome measures used) adds additional complexity to interpreting the efficacy of videogame interventions. These findings are consistent with the previous reviews on computer-assisted technology interventions for children and adolescents with ASD in that technology-based approaches appear to be a promising avenue for improving core deficits in ASD, however, the current evidence-base is limited.

A range of different game designs were used to target symptomatological deficits in children with ASD. Due to the variability of games and the variability in outcomes targeted it is impossible to support the use of one form of videogame intervention over another. As children with ASD are notoriously difficult to engage in human-delivered intervention, this remains a highly attractive property of the videogame modality for this population. This is especially important given the findings of Kuo et al. (2014) who showed that children with ASD spend the majority of their spare time voluntarily playing videogames. To attempt to engage this natural behaviour in the service of alleviating ASD symptoms and/or improving functioning and quality of life is clearly justified based on this review, and further research and development is warranted.
Chapter 5 Whiz Kid Games Intervention

Currently, the available science cautions against claims that videogames are an efficacious method of improving social, communicative and behavioural functioning for children with ASD. Although promising, the current body of literature assessing the efficacy of videogames for ASD have a number of major limitations. First, as evidenced in Chapter 4, there is a lack of quality studies assessing the efficacy of sole videogame interventions, with many of the studies reviewed including videogames in combination with other interventions. Each of the 19 studies reviewed suggested that videogames were effective irrespective of whether it was a sole intervention or in combination; however, the lack of control for the separate interventions and their individual contributions dilutes the strength of the findings. Second, studies assessed a variety of deficits that are inherent in children with a diagnosis of ASD. Finally, the outcome measures varied significantly across interventions from bespoke measures developed by the research team of the study to assess the target deficits, to measures with established reliability and validity. The heterogeneity of the skills targeted and the quality of the measures used in the current literature base further dilute the ability to claim efficacy for these interventions. In order to begin to address some of these issues, a promising new videogame intervention called “Whiz Kid Games” [www.whizkidgames.com] was selected for a pilot study.

Whiz Kid Games – An Overview

“Whiz Kid Games” is an integration of two internet-based sister sites developed as an interactive, videogame-based intervention for children with moderate to severe ASD. There is a game site, as well as a companion site that provides information for parents and educators. The first site, [www.autismgames.com.au] (see Figure 1a) is an instructional site for parents and teachers of children with ASD that explains the purpose and use of each of the games
located on the sister site. It includes instructions on the target skills of each of the games, as well as instructions for real life reinforcement of the lessons learned in each game. The second site, “WhizKid Games” [www.whizkidgames.com](http://www.whizkidgames.com) see Figure 1b) is the portal in which the children are able to access the “games.” “WhizKid Games” was designed through a collaboration of Swinburne University’s Multimedia Design Program, Bulleen Heights Specialist Autism School, Swinburne University’s School of Psychology and the National eTherapy Centre. The program was developed as a suite of games to target known deficits in ASD, such as social functioning and independent living skills. Development of the program was undertaken by 80 multimedia design students, eight multimedia and design lecturers as well as 10 autism experts. The development of program represents over 16,000 hours of research and development to provide games each targeted at a specific deficit of essential living skills in children with ASD. Each game has keywords such as “special activity”, which are reinforced throughout the game in an attempt to generalise in-game learning to real life situations.

**Figure 2. Whiz Kid Games and Autism Games Homepages**

a)  

b)
The excellent of “WhizKid Games” has been recognised by the web-design industry as it won the “2010 Melbourne Advertising and Design Club, Best Online Game”, “2010 Web Marketing Association (WMA) Award, Education Standard of Excellence”, “2010 WMA Aware, Health Care Standard of Excellence”, and the “Swinburne University Vice-Chancellor’s award for community engagement.” Furthermore, anecdotal evidence from specialist school staff, parents and children with ASD who have engaged in the current version of the freely distributed online games, has been overwhelmingly positive.

Target Behaviours

Coping with Change

Repetitive and stereotyped actions often involving ritualistic and compulsive behaviours are common in children with ASD (DSM-5, 2013). Behaviours often include lining up objects or toys and rigid routines or rituals in daily activities. Deviations from these behaviours, routines and rituals can be anxiety-provoking for these children and even minor changes may trigger increased ritualistic or compulsive behaviours, aggressive or verbal outbursts and/or withdrawal.

The aim of “Ron Gets Dressed” (see Figure 3a) is to improve children with ASD’s ability to cope with changes in clothing. The game requires the child to attend to the weather outside of the window (see Figure 3a) and select the appropriate item of clothing as prompted. Children are prompted verbally by a voiceover in the game, and visually by a rectangle lighting up around the correct item in the wardrobe (see Figure 3a). The child is then required to select an item of clothing from the wardrobe and drag it to the appropriate body part of “Ron.” Children are reinforced verbally and visually on completing an outfit appropriate to the weather. Incorrectly chosen items immediately slide back to their position in the wardrobe after the child attempts to place it on “Ron” and they are given immediate
Figure 3. Coping with Change - Ron Gets Dressed and Rufus Goes to School

a) verbal and written feedback explaining why it is inappropriate for that item of clothing (e.g., “It’s too hot to wear pants”). Keywords such as “hot” and “cold” are reinforced in this game in order to encourage generalisation to real-life situations.

“Rufus Goes to School” (see Figure 3b) aims to improve children with ASD’s ability to cope with changes in their typical school day. The game introduces changes such as being driven by different people, interactions with classmates and changes in routine such as the car
breaking down and Rufus and his dad needing to catch the bus to get to school. Children are required to follow visual and verbal prompts to select who is going to take them to school, followed by prompts for the child to move the car to school by clicking on an arrow using the mouse. Only one selection is highlighted for the child to select and the child is immediately reinforced verbally and visually upon selecting a “different” person to take them to school each time (see Figure 3b). Change is reinforced as being ok through visual and verbal feedback, such as “change is good.” This process is repeated in the classroom and then with out-of-school activities with more highlighted options for the child to choose from. On completion of the first task, the child must then choose another objective and is unable to choose their previous option. One activity involves “Rufus” going to the playground and choosing an activity then picking a different activity to allow another child a turn, or waiting his turn for an activity because another child is currently using his choice. Correct choices are immediately reinforced verbally and visually. “Rufus Goes to School” emphasises key words such as “change” and “different” suggesting the notion that change can be necessary but also fun. This game also attempts to get parents to use these terms with their children to help them cope with changes in routine. This game was designed with further generalisation in mind to enhance coping ability to real life situations where some form or routine may be broken.

**Finding a Route**

Children with ASD often experience difficulty in social interactions (DSM-5, 2013) such as understanding and following instructions and may require many prompts to complete tasks set before them. Common difficulties may include problems “finding a route” where the child is required to follow instructions such as “stop”, “wait”, “fast” and “slow.” “Florence the Frog” (see Figure 4) aims to improve children’s ability to “find a route” as well as listen and comply with directions. In order to engage the children, this is done through the use of an
avatar called “Florence” (see Figure 4) who is a hungry frog attempting to make her way across a pond to eat a fly. Children must click on the appropriate lily pad (which lights up as the child hovers the mouse over it) for “Florence” to jump to in order to make her way across the pond. Levels with increased difficulty include “bad lily pads”, which cannot be jumped on. If the child does not follow the instructions and selects the “bad” lily pad, it will vanish forcing the child to make the correct choice, which is then reinforced by “Florence” jumping. “Florence the Frog” attempts to reinforce instructional words such as “go up”, “go down”, “go left” and “go right” in an attempt to generalise these terms to real life situations.

**Making Eye Contact**

Core deficits in ASD include problems with social interactions, such as poor eye contact (DSM-5, 2013). Anecdotal evidence suggests that this may be because individuals with ASD find it difficult to engage in eye contact whilst communicating with others due to the sensory overload of processing speech whilst simultaneously watching facial expressions. “Ted’s Ice-Cream Adventure” (see Figure 6) attempts to improve children with ASD’s eye contact by teaching them that looking at someone indicates they wish to communicate with
them, and if someone is looking at them, they should respond correctly by returning eye contact.

This game attempts to be non-confrontational for the child by utilising a large eyed teddy bear character. “Ted’s Ice-Cream Adventure” requires children to identify who is “trying to talk” to them by clicking on the teddy that is looking at them. This is reinforced by “that’s right, you should look into their eyes.” The child must then follow the teddy bear’s gaze to the click on the correct ice-cream (see Figure 6). The gaze then shifts to the teddy bear’s favourite flavour and the child is required to follow the gaze and click on the corresponding choice. On completing the ice-cream for the teddy bear, the child is reinforced both visually with a shooting star and verbally with “well done”. “Ted’s Ice-Cream Adventures” reinforces keywords such as “look”, “looking”, and “eyes” for parents and teachers to attempt to generalise into real life situations.

**Matching Emotions**

Understanding and displaying empathy and appropriate emotions towards others and themselves is difficult for individuals with ASD. Facial expressions, body language and other physical and verbal social interaction cues are often misunderstood or not understood at all in
this population (DSM-5, 2013). In these situations, inappropriate responses may occur such as laughing or giggling when someone is hurt or upset. These traits often impact significantly on the individual’s social interactions and relationships. “Robbie the Robot” (see Figure 7) was designed to aid children with ASD in recognising emotions through the integrations of 3D animations and a real person’s face, to communicate the emotion that the character is feeling. “Robbie” is a mechanical character aimed at targeting children with ASD who find mechanical objects engaging and combining this with a real human face to help the child practice recognising emotions in a non-confrontational environment that is both engaging and enjoyable. This game requires children to match the emotion that “Robbie” is demonstrating; first, by clicking on the same emotion that is displayed on “Robbie the Robot,” (see Figure 7), second, by dragging the face onto “Robbie,” and finally, by engaging in a game of match to identify the two matching faces that have been verbally requested and displayed on “Robbie’s” face. As the difficulty increases, children must identify different emotions, with an increasing number of screens (each with their own emotions to discriminate from). After each correct match of the emotions, the child is immediately reinforced by verbal cheering and visually with fireworks. This game reinforces the keywords “happy”, “sad”, “angry”

**Figure 7. Robbie the Robot**
and “surprised” in an attempt to help parents and teachers generalise these words to real life situations.
Chapter 6 Can videogames improve social and behavioural functioning in children with ASD? – A pilot trial

Aims and Hypotheses

This study was designed to gather preliminary data to evaluate whether using Whiz Kid Games over a five week period would result in improvements in primary outcomes related to social and behavioural functioning in children with ASD, and secondary outcomes related to parenting stress and family functioning. Following use of Whiz Kid Games over a five week period, it was hypothesised that participants in the active intervention group would show improvements in 1) measures of social skills and 2) measures of behavioural functioning compared to the wait-list control group. It was also expected that these improvements would be maintained at the five week follow-up. It was further hypothesised that caregivers of children in the intervention group would report improvements in 3) measures of parenting stress and 4) measures of family functioning compared to the wait list control group. It was also expected that these improvements would be maintained at the five week follow-up.

Method

Participants

Ethical approval for this study was granted by the Deakin University Human Research and Ethics committee. Participants were recruited via the newsletters of two specialist ASD schools in Melbourne, Australia and through recruitment notices posted on several online ASD forums (e.g., ASD-specific Facebook groups). Individuals who expressed interest in the study were sent a plain language statement and parental consent form. Participants were eligible for inclusion in this study if they had received a previous diagnosis of ASD using either DSM-IV-TR or DSM-5 by a qualified health care professional (APA, 2000; APA,
were between 6-12 years of age, able to manipulate a computer mouse and keyboard, and owned a home computer capable of running the most current Flash Player software. The presence of ASD symptoms was confirmed via total scores greater than the T-score cut off of 70 on the Social Responsiveness Scale, 2nd Edition (SRS-2) (Constantino & Gruber, 2012). Participants were excluded from the study if they had used the website "www.whizkidgames.com" in the previous 12 months, were unable to operate a computer mouse and keyboard, or did not have a SRS-2 T-score total >70.

Following the return of the consent forms, participants were randomly assigned to either the wait-list control group or the active intervention group using a computerised random numbers generator. Participants allocated to the wait-list control group (n = 8) were asked to continue with treatment as usual (TAU) over a five week wait period. Participants in the wait-list control group consisted of five males and three females aged 6-11 years (M = 8.25, SD = 2.19). Although no change was expected over the five-week TAU period, participants were administered a battery of measures at the beginning and end of the TAU period to assess for change. Data from the eight participants in the wait-list control group were analysed independently from the intervention group. Ten participants were randomly allocated to the active intervention group. In order to improve sample size and statistical power, participants completing the post-waitlist phase of the trial (n = 8) were invited to enter the intervention phase, and data from those who agreed (n = 3) were added to the total ‘intervention group’ data (n = 10). Therefore, participants in the intervention group comprised 11 males and two females aged between 6-11 years (M = 8.85, SD = 1.77) with a total SRS-2 T-score >70.
Materials

**Intervention:** [www.whizkidgames.com](http://www.whizkidgames.com) Whiz Kid Games is a free, online independent living and social skills intervention for children with ASD. It was designed by a team drawn from Swinburne University’s National eTherapy Centre, Multimedia Design Program, and an ASD-specialist school (Bulleen Heights School). Development of the program was undertaken by 80 multimedia design students, eight multimedia and design lecturers as well as ten autism experts. Each game uses key words or phrases (e.g., “change is good”) which is reinforced throughout the game in an attempt to generalize in-game learning to real life situations. The intervention originally consisted of a suite of 15 games designed to target specific behaviours including: coping with change, way-finding (directions), turn-taking, making eye contact, and recognising emotions. Due to updates in Flash player over time, only five of the original 15 games were still operational at the time of testing. Each of the games increased in difficulty as children complete each level in order to challenge them and maintain their interest in the program. Two of the games evaluated focus on coping with change; “Ron Gets Dressed” in which the child must change the clothes on the avatar appropriate to the weather and cleanliness of the items, and “Rufus Goes to School” in which the child is presented with a number of different changes to a typical daily routine, such as someone playing on the playground equipment they wanted to play on and having to choose and alternative activity in the playground. Another game focused on helping the child learn how to make eye contact: “Ted’s Ice-Cream Adventures” is a game in which the child must click on the appropriate item that the teddy is looking at when choosing their ice-cream. Another game focused on matching emotions: “Robbie the Robot” is a game where the child is presented with an emotional expression and must match it to its pair from a distractor list. Finally, a game that focused on children listening to instructions and finding their way geospatially called “Florence the Frog”, required children to listen to instructions and find a
route for Florence to jump along to get through a maze of lily pads. For more information about each game, please see chapter 5. While *Whiz Kid Games* remains a free, online intervention for children with ASD, in order to maintain the integrity of this study, it was made unavailable for public use, with addition password protected security to access the site, for the duration of the trial.

**Measures**

*Social Responsiveness Scale, 2nd Edition (SRS-2).* The SRS-2 is a 65-item questionnaire developed to objectively measure the presence and severity of symptoms of ASD such as social impairments and repetitive behaviours. SRS-2 T-scores <60 indicate that the parents’ responses are typically not associated with clinically significant ASD. T-scores ranging from 60-65 indicate a “mild” level of impairment in social interactions that is not determined to be clinically significant. T-scores ranging from 65-75 are indicative of “moderate” levels of social impairment that identify clinically significant difficulties in reciprocal social behaviours and T-scores >75 are typically associated with a “severe” level of clinical impairment in social interactions and are strongly associated with a clinical diagnosis of ASD. The SRS-2 has been used to accurately screen for ASD using a T-score cut-off value >70. This measure has been found to have high internal reliability (α = 0.95) in clinical subjects aged 4-18 years. It has been demonstrated to have strong test-retest reliability (coefficients ranging from 0.88-0.95 over a 3-6 month period) and interrater reliability (coefficients ranging from 0.72-0.82) across a number of studies (Constantino & Gruber, 2012). The SRS-2 was utilised in this study to confirm children’s eligibility for participation, as well as a measure of change in participant’s social interactivity over time.
**Developmental Behaviour Checklist – Parent Report (DBC-P).** The DBC-P is a 96-item questionnaire that was developed for the assessment of behavioural and emotional functioning in children and adolescents with developmental and intellectual disabilities aged 4-18 years. Parents or caregivers rate each item on a scale from 0-2; 0 = “not true”, 1 = “somewhat true” and 2 = “very true or often true”. The DBC-P provides data at three levels: 1) a measure of overall emotional and behavioural disturbance, (2) subscales scores for five dimensions (social relations, antisocial, communication, anxiety and self-absorption), and (3) scores at the individual item level. The DBC has good content validity and strong internal consistency, with Cronbach’s alphas ranging from 0.67-0.91 across subscales. Some variance was reported in regard to the inter-rater reliability between teachers and parents (Einfeld & Tonge, 1995). Teacher agreement was found to have weak to strong intraclass correlations (0.30-0.74) across subscales, whereas parent agreement was found to be more consistent across subscales with strong intraclass correlations (0.75-0.80). It has been found to have good test-retest reliability with moderate to strong intraclass correlations ranging from 0.51-0.87 (Einfeld & Tonge, 1995).

**Parenting Stress Index, 4th Edition (PSI-4).** The PSI-4 is a 101-item questionnaire with an additional “Life Stress Scale” developed to assess the level of stress in parent-child relationships. This index is comprised of two separate domains. The first domain is related to characteristics of the child in the parent-child dynamic, and the second is related to parent characteristics in the parent-child dynamic. The PSI-4 provides an indication of the magnitude of stress within each of these domains, as well as the family as a whole. Total stress score percentiles between the 16th to 84th percentiles are considered to be within the normal range. Score falling between the 85th and 89th percentiles are considered to be high, and scores above the 90th percentile are considered to be indicative of clinically significant
levels requiring assistance. The PSI-4 has strong internal consistency with the individual domains and total stress score reaching $\alpha > 0.96$. It has been shown to have good test-retest reliability with coefficients ranging from 0.65-0.96 across studies (Abidin, 2012).

*Family Assessment Device (FAD)*. The FAD is a 60-item self-report measure that assesses healthy and unhealthy family functioning. It is composed of six different areas of family functioning including problem solving, communication, roles, affective responsivity, affective involvement, behaviour control, with an additional scale related to general family functioning. The most recent updated of the FAD (60 items) was found to significantly improve on the subscale reliability of the measure from the original 53-item version. This measure is reported to have good validity (Epstein, Baldwin, & Bishop, 1983) and demonstrated significant improvements in the internal reliability scores ranged from 0.56 – 0.84 across the subscales (Kabacoff, Miller, Bishop, Epstein, & Keitner, 1990).

*Procedure*

Participants in this pilot trial were randomly assigned to one of two groups (wait-list control or intervention) following the return of signed parental consent forms. In the wait-list control group, parents were sent an initial intake assessment pack of questionnaires via post consisting of an initial ASD screening tool (SRS-2), as well as additional baseline measures of children’s social skills and behaviour, and measures of family functioning and parent stress (SRS-2, DBC-P, PSI-4 and FAD). A single group pre- to post-test, repeated measures design over a five-week TAU wait period was implemented to confirm stability of variables over the same time period as the intervention phase (5 weeks). Following the wait-list period, participants were then given access to the active intervention.
Upon returning signed consent forms, participants in the active intervention group were required to complete the same battery of questionnaires as the wait-list control group as baseline data for the intervention. Following completion of the baseline measures, participants were provided with a unique username and password that enabled access to Whiz Kid Games throughout the 5-week intervention period. Usernames and passwords were only required to be entered upon first accessing the games on each individual device used by the participant, and were automatically stored in the internet history to facilitate ease of access. Upon logging into Whiz Kid Games, participants were given access to five individual games, each of which targeted a specific deficit common to ASD. Participants were asked to play the games for at least 15 minutes per weekday in a naturalistic home environment and were encouraged to attempt to use each individual game across the intervention phase. Although participants were requested to complete at least 15 minutes of gameplay per weekday, they were not restricted in their use of the intervention and were able to access the program as frequently as desired over the five-week intervention phase. Participants were sent questionnaires five weeks following their completion of the pre-intervention questionnaires and again 5 weeks after their post-intervention questionnaires as a brief follow-up in order to evaluate the maintenance of any changes detected.

**Results**

Due to the small sample recruited for this pilot trial, a series of t-tests were identified as the most meaningful way of assessing for change from pre- to post-intervention. Although the use of a correction method such as the Bonferonni correction is usually desirable to reduce the likelihood of type I errors, this is considered overly conservative for a pilot trial with a sample size this small and would likely inflate the chance of type II errors (Armstrong, 2014). This study will instead use statistical significance at $p < .05$ to identify potential
change and Cohen’s $d$ to assess the strength of the effect. Homogeneity of variance was measured using Levene’s test and this confirmed that there were no violations of this assumption observed in the data.

To determine whether there was any difference between the wait-list control and intervention groups at baseline, a series of independent samples $t$-tests were run. No differences were observed between groups on any of the measures at baseline. Means and standard deviations for each of the measures are identified in Table III.

**Table 3.** Means, standard deviations and ranges of scores on the dependent measures at pre- and post-treatment for the intervention and wait period.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Intervention Group</th>
<th>Treatment as usual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>Social Skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRS-2 Pre</td>
<td>122.50 (20.08)</td>
<td>96-160</td>
</tr>
<tr>
<td>SRS-2 Post</td>
<td>111.43 (19.43)*</td>
<td>88-157</td>
</tr>
<tr>
<td>Behaviour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBC-P Pre</td>
<td>80.25 (20.98)</td>
<td>42-108</td>
</tr>
<tr>
<td>DBC-P Post</td>
<td>69.90 (24.57)*</td>
<td>36-110</td>
</tr>
<tr>
<td>Parent Stress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSI-4 Pre</td>
<td>333.10 (50.81)</td>
<td>177-230</td>
</tr>
<tr>
<td>PSI-4 Post</td>
<td>343.00 (58.60)</td>
<td>202-237</td>
</tr>
<tr>
<td>Family Functioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAD Pre</td>
<td>134.18 (18.52)</td>
<td>105-158</td>
</tr>
<tr>
<td>FAD Post</td>
<td>137.08 (24.97)</td>
<td>99-172</td>
</tr>
</tbody>
</table>

* Significant difference from pre- to post-intervention

$n = 13$

Data from the three participants who completed the wait-list control condition and the intervention phase were included for each respective statistical analysis.
**Wait-list control**

A series of paired samples t-tests were conducted to assess for change in social skills, behaviour, parenting stress and family functioning over the five-week period. No statistically significant differences were observed from pre- to post- wait-list period on any of the outcome measures.

**Intervention group**

A series of paired samples t-tests were conducted to assess for change in the means from pre- to post-intervention. Improvements were found on measures of social functioning and behavioural functioning at post-intervention. There were no significant differences identified from pre- to post-intervention on the measures of parenting stress or family functioning. On average, participants’ social skills improved from pre- to post-intervention as measured by the SRS-2 total score, \( t(12) = 2.28, p = .04 \), with a moderate effect size \( (d = 0.56) \). Specific improvements were found on the SRS-2 restricted interests subscale pre- \( (M = 24.62, SD = 5.41) \) to post-intervention \( (M = 21.92, SD = 5.68) \), \( t(12) = 2.18, p = .05 \), with a moderate sized effect \( (d = 0.49) \) and the social communication subscale pre- \( (M = 42.28, SD = 6.53) \) to post-intervention \( (M = 36.97, SD = 7.02) \), \( t(12) = 2.32, p = .04 \), with strong effect size \( (d = 0.78) \).

Participants also demonstrated behavioural improvements from pre- to post-intervention on the DBC-P total score, \( t(12) = 2.48, p = .03 \), with a moderate sized effect \( d = 0.45 \). Specific improvements on this measure were observed on the communication difficulties subscale, \( t(12) = 3.51, p = .004 \), with a large effect size of \( d = 0.96 \). Improvements on the social relation subscale of the DBC-P from pre- \( (M = 7.62, SD = 2.53) \) to post-intervention \( (M = 6.08, SD = 2.84) \) approached significance, \( t(12) = 1.82, p = .09 \), with a moderate to strong sized effect \( d = 0.57 \). Improvements on the self-absorbed subscale of the
DBC-P from pre- ($M = 25.69$, $SD = 8.76$) to post-intervention ($M = 22.54$, $SD = 10.43$) also approached significance, $t(12) = 1.91$, $p = .08$, with a small to moderate sized effect $d = 0.33$.

**Maintenance phase**

Due to the small amount of data returned by parents after the five-week follow-up period ($n = 6$), descriptive statistics of the means and standard deviations of scales that showed improvements in the active phase of the trial are presented in Table IV.

**Table IV.** Means and standard deviations pre- to post-intervention and at a five-week follow-up on measure with a significance difference pre- to post-intervention ($n = 6$).

<table>
<thead>
<tr>
<th>Measures</th>
<th>Pre-Treatment Mean (SD)</th>
<th>Post Treatment Mean (SD)</th>
<th>Follow-up Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SRS-2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restricted Interests</td>
<td>26.33 (5.61)</td>
<td>23.83 (7.03)</td>
<td>23.50 (6.66)</td>
</tr>
<tr>
<td>Social Communication</td>
<td>44.00 (7.38)</td>
<td>41.93 (6.28)</td>
<td>42.17 (8.01)</td>
</tr>
<tr>
<td>Total Score</td>
<td>125.25 (22.08)</td>
<td>121.26 (23.44)</td>
<td>121.43 (24.56)</td>
</tr>
<tr>
<td><strong>DBC-P</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication Difficulties</td>
<td>13.33 (4.76)</td>
<td>10.50 (2.81)</td>
<td>11.60 (1.36)</td>
</tr>
<tr>
<td>Social Relating</td>
<td>8.33 (2.25)</td>
<td>7.50 (3.56)</td>
<td>8.00 (3.85)</td>
</tr>
<tr>
<td>Self-Absorbed</td>
<td>28.33 (8.41)</td>
<td>26.17 (12.12)</td>
<td>25.50 (11.57)</td>
</tr>
<tr>
<td>Total Score</td>
<td>88.98 (15.70)</td>
<td>79.72 (23.81)</td>
<td>80.77 (20.08)</td>
</tr>
</tbody>
</table>

**Discussion**

As expected, the wait-list control group showed no significant changes over a five-week period of TAU on parent-report measures related to both primary and secondary outcome variables. Although the three participants who completed both the waitlist and
intervention conditions is not the optimal model for the purposes of exploring potential change in variables, the additional power statistical power gained does provide some preliminary evidence to support the conclusion that the effects observed in the intervention group did not appear as a function of time or at random.

**Primary outcomes**

As predicted, participants in the intervention group improved on parent-report measures of social skills and behavioural functioning. Specifically, on the measures of social functioning, participants improved overall on the measure, as well as on subscales related to social communication and restricted interests and repetitive behaviours. No change was observed on subscales related to social motivation, social awareness or social cognition. On the measures of behavioural functioning, participants improved on both the total score as well as on subscales related to communication difficulties. Although improvements on the “social relating” and “self-absorbed” subscales of the behavioural measure following the intervention were only approaching significance, the moderate to strong effect size observed in these variables suggest that the non-significance was potentially an artefact of the small sample size and resultant low statistical power. No change was observed on the subscales related to antisocial behaviours and anxiety. Although this was not a fully powered efficacy trial, these pilot findings suggest that *Whiz Kid Games* shows promise as a means to promote positive behaviour change across social skills and behavioural functioning in children with ASD.

The most prominent improvements observed from baseline to post-intervention were on scales measuring communicative and social skills. Parental reports of improvements in communication following the intervention were consistent across the measures of social and behavioural functioning. In both cases improvements in communication were supported by strong effect sizes ($d = 0.78$-$0.96$). Interestingly, only one game was specifically designed to
target communicative skills. With a specific focus on non-verbal communication, *Ted’s Ice-Cream Adventure* teaches children the importance of eye contact in communicating the focus of their attention, as well as making eye contact with others. Overall improvements on the social skills subscales are perhaps unsurprising due to the content of the games utilised in the intervention. “Coping with change” was taught as part of two games and “matching emotions” taught in a third. In one game related to coping with change, children learned skills such as taking turns, choosing different play options, and accepting changes to their daily routine. Improvements were consistent across both primary outcome measures for social skills. Although this study cannot confirm that *Whiz Kid Games* causes improvements in communication and social skills, congruent improvements for these factors across both measures paired with moderate to strong effects suggest that further investigation via a fully powered clinical trial may be warranted.

Interestingly, total time spent playing *Whiz Kid Games* did not correlate with improvements in either social skills or behavioural functioning. It is unclear whether the lack of a significant correlation between time spent playing *Whiz Kid Games* and improvements on measures of social skills and behavioural functioning represents an actual lack of correlation, if the sample size was not sufficient to detect a significant correlation between the variables, or if a single session of *Whiz Kid Games* is sufficient (for some children) to drive measurable change. Although the lack of a significant correlation between time spent playing *Whiz Kid Games* and the primary outcomes obscures the validity of the findings, this study was a pilot trial and, hence further research is required to explore whether the observations from this study are replicable in a large, well-powered controlled trial.

Although few studies have been published on the efficacy of sole videogame interventions, with the majority of the literature focusing on videogame interventions that include a secondary learning component (e.g., digital lessons and human instruction), a body
of evidence is accumulating highlighting the promise of videogame interventions at improving a wide variety of skills. The findings of this study add weight to the current literature suggesting that social skills, communication and behaviour may be improved using videogame based interventions (see Chapter 4).

In addition to Whiz Kid games, the “Junior Detective Program” (Beaumont & Sofronoff, 2008), “FaceSay” (Hopkins et al., 2011; Rice et al., 2015), and “Mind Reading Software” (Lacava et al., 2007; Lopata et al., 2016; Thomeer et al., 2015; Thomeer et al., 2011) have each demonstrated promise in training social skills using outcome measures such as the SRS-2 or a measure of similar quality (i.e., the Social Skills Questionnaire and the Social Skills subscale of the Behaviour Assessment System for Rating Children, 2nd Edition). Although each of these programs (including Whiz Kid Games) utilise different types of games and methods for teaching social skills, the common finding is that they each demonstrate the ability to engage children with ASD in the intervention and facilitate a learning process. The growing body of evidence suggesting that videogames have the ability to engage children with ASD and teach them valuable skills in a safe, controlled and comfortable environment highlights the importance of further research in this area.

**Secondary Outcomes**

Contrary to the hypotheses related to the secondary outcomes, no improvements were observed over the five-week intervention period on parent-report measures of family functioning and parenting stress. The lack of improvement on both of the secondary outcome measures may be due to there being little to no effect of videogames on family functioning and parenting stress, however, it may also be a function of the intervention length being too short to observe a change in these variables, or due to low power from a small number of participants. Although significant improvements were found on the primary outcome
measures related to social skills and behavioural functioning, it is unlikely these changes would have been immediate or dramatic. It is likely that these changes would have occurred over time during the five-week period. This in turn may suggest that there had not been sufficient time for these improvements to impact the family dynamic.
Chapter 7 Feasibility and user acceptance of WKG: A parent perspective

Aims and Hypotheses

The current study was developed to explore the feasibility and user acceptance of Whiz Kid Games as an intervention for children with ASD from a primary caregiver perspective. Questions were developed by the thesis author and a secondary researcher to explore anecdotal behaviour change following the Whiz Kid Games intervention, as well as to identify factors that promoted or inhibited engagement in participants. A thorough search of the peer-reviewed literature reporting on the design and development of videogame interventions for children with ASD, as well as gaps identified in the quantitative analysis in the previous chapter, were also taken into account for question development. Specifically, the interview protocol aimed to explore parental understanding of their child’s engagement in the Whiz Kid Games intervention, the feasibility of Whiz Kid Games to elicit behaviour change in children with ASD, and to identify additional areas of need from a primary caregiver perspective in order to guide future videogame development.

Method

Design

As observing their children playing videogames is already a salient experience for parents of children with ASD, thematic analysis was selected as the most appropriate method of elucidating parents’ responses and understanding of their children’s videogame use. Thematic analysis is frequently used in exploratory research in order to establish an empirically-based and ecologically valid data set based on the knowledge, understanding and experience of people who are part of the population under-represented in the current body of research (Braun & Clarke, 2006). Twelve in-depth interviews were conducted with primary caregivers of children and adolescents with ASD who participated in the Whiz Kid Games
trial using a semi-structured interview process. The interview questions were focused around three main research questions: 1) What do parents think about their child’s participation in Whiz Kid Games?, 2) What are parents’ perspectives of their child’s experience of video-game use? and 3) What outcomes are parents anticipating and/or hoping for from their child’s use of videogames? Probes regarding further clarification, examples and expansion on answers were used to explore topics directly related to the focal questions such as technology use, videogame use, previous intervention experience, and socialisation.

**Recruitment**

Approval for this study was granted by the Deakin University Human Research Ethics Committee. Participants were all primary caregivers of children with ASD who had participated in the pilot trial of the videogame intervention, Whiz Kid Games (refer Chapter 6). As the current study focused heavily on parents’ responses and understanding of their children’s videogame use, a purposive sample who had given permission to be contacted for an interview following the intervention phase of the trial of Whiz Kid Games was recruited. Of the 19 primary caregivers whose children completed the intervention, 12 agreed to be interviewed for this study. The remaining seven primary caregivers declined participation, with the most common reason provided being lack of time. The 12 primary caregivers who agreed to participate in this study were all mothers with children ranging in age between 5-12 years and with a confirmed diagnosis of ASD from a qualified health care professional. Due to one parent discussing three of her children (each with a diagnosis of ASD), 14 children were identified in the interview process (13 male, 1 female). Although this gender imbalance is not representative of the distribution of ASD across sexes (which is more typically around 4:1 male:female), it is perhaps unsurprising that males with ASD have been identified to engage more in videogames than their female counterparts (Macmullin, Lunsky, & Weiss,
One primary caregiver recruited for participation was the parent of two children who had participated in the Whiz Kid Games intervention, and discussed secondary outcomes from a third child also with ASD. Although the third child did not formally participate in the trial, his parents report that he sat with his brothers each time they engaged with the program. Data from the mother’s discussion of all three children has been included in the analyses below.

**Data Collection**

Interviews were conducted via telephone. Interviews followed a semi-structured format. Examples of the questions include; “What was your experience as a parent of your child’s participation in Whiz Kid Games?”, “What do you think led your child to remain engaged in Whiz Kid Games?”, “What technologies does your child use on a regular basis?”, “What is the best medium to explain videogame rules to your child?”, and “What do you think makes a successful game for children with ASD?”.

Participants provided verbal consent to the interviews being audio recorded and were informed that their information would remain confidential. Audio files from the recordings were stored on Deakin University servers in accordance with ethical requirements with only the research team having access. Each interview was transcribed verbatim from the audio recordings and checked for accuracy by the thesis author. Transcripts were de-identified and all mentions of child and primary caregiver names within the transcripts were changed to male gender identifiers for the children and an assigned letter identifier for parents. The average interview duration was 45 minutes (range 30 – 65 minutes).

Data were analysed by the thesis author and a secondary researcher, using thematic analysis. Due to the nature of the data focusing on primary caregivers and their child’s behaviour whilst undertaking a videogame intervention, it was decided to address the data at a surface level using a semantic approach. Data were analysed in six separate phases.
following the thematic analytical procedure outlined by Braun and Clarke (2006). Phases 1-3 were completed by each of the researchers independently. In Phase 1, each researcher familiarised themselves with the data through repeatedly reading through the transcripts searching for potential meaning. In Phase 2, each researcher generated initial codes to identify interesting features of the raw data. Phase 3 consisted of each researcher independently searching for themes by sorting through coded data and collating codes into potential themes. Upon completing Phases 1-3, the researchers came together to complete Phases 4-6. During Phase 4, the two researchers reviewed the themes they had each identified during Phases 1-3. This included comparing and contrasting identified themes, re-reading the coded data to confirm their fit with the proposed theme, and reviewing whether the theme fit with the overall dataset and its meaning. Following researchers discussing and coming to a consensus on the identified themes, Phase 5 consisted of the researchers naming and defining the themes identified in order to further refine them for analysis and to ascertain how the themes fit with the dataset overall. Phase 6 of thematic analysis consisted of the researchers reporting the results in the current thesis.

**Results**

Six themes regarding parents’ responses to videogames for children with ASD were identified. These included parents’ perceptions of their children’s motivations for playing videogames, parental motivations for their children playing videogames, social and communicative responses in children from using videogames, behavioural responses in children from using videogames, key components of game design and features for children with ASD, and future directions for videogame interventions for children with ASD. Each of these themes is described in more detail below.
Parents’ perceptions of their children’s motivations for playing videogames

Parents reported the predominant reason their children were motivated to engage in *Whiz Kid Games* was because it involved the use of videogames. When discussing previous game interventions one mother noted, “Well at the very start they love the idea of gaming, and the concept of gaming. That is something they’re good at, and that they really enjoy. And they love spending time on the computer as a reward, so that was a win-win situation from the very beginning.” Parents reported often wishing their children would go outside and play “like other children” but that, for the most part, their children did not find those activities enjoyable. According to the mothers interviewed, their children’s lives revolved heavily around playing and talking about videogames. One mother recalled her son explaining his passion for playing videogames stating, “he just calls it entertainment, and he basically says he lives for it”. Videogames in themselves were found to be an enjoyable and engaging activity for the children of the interviewed parents.

While enjoyment appears to be a primary motivating factor for children to engage in videogame interventions such as *Whiz Kid Games*, the inherent safety of playing videogames helped to facilitate the child’s enjoyment and engagement. Parents felt that their children were able to understand videogames due to them being a rule-based activity and, at least to an extent, predictable in nature. One mother noted that, for her child, videogames were “something he could be relatively independent with. Often he needs, or he seeks a lot of guidance and it is quite dependent on me to do things and so it’s having something he could do himself and he wanted to do himself, I would say is a big positive.” Predominantly, parents suspected their children felt safe playing videogames and believed this was because they had a sense of control, and were able to achieve a sense of mastery. They felt that if tasks were too difficult for the children, they would not engage and it would result in negative behaviours. In videogames, children were able to decide the level of difficulty and could
remove themselves if they became overstimulated. This created an inherently safe environment for them to learn and play. One mother noted, “it’s just his comfort zone. He knows what he’s doing there, he’s got a certain level of control there, it’s safe, he’s safe, it’s not scary, he knows what he’s doing and where he’s going and when he does take risks he’s got control over how big the risk is, when he can step back, and so if he is having a good day, he’ll take a huge risk and if he’s not having a good day he might take a couple of little ones or none at all. So it’s a lot about control for him I think, which is why we let him have it so often.” This ability to maintain control as well as remain independent and successful begins to elucidate why videogames are a motivating medium for children with ASD to learn and play.

**Parental motivations for their children playing videogames**

Parents allowed and, in many cases, encouraged their children to participate in videogame use. This was largely justified on the basis of the enjoyment that parents believed their children experienced when playing videogames, with one mother stating, “it’s fun for him, you want all your kids to enjoy what they are doing.” While parents largely felt that videogames had both positive and negative impacts on their children, their main drive was to ensure their children were happy. Videogames provided a medium where their children were able to engage and enjoy themselves in an age appropriate manner.

Parents identified that videogames also created an environment for their children to relax. One mother noted, “When he comes home from school I allow him to go into the room and play his Playstation for at least 15 to 20 minutes. Then he comes out and then he’ll engage with me. If I don’t do that he gets agitated.” The majority of parents felt it was important their children were allowed frequent opportunity to play videogames because they were able to use this medium to self-soothe when they were in a heightened state of arousal.
Providing this avenue for self-soothing allowed parents and children a reprieve from the pressures faced on a daily basis living an ASD.

Parents frequently stated that they acquired videogames for their children as an opportunity for learning, investing in educational as well as enjoyable videogames. One mother went as far as to suggest, “At the moment I am trying to teach him his maths, like multiplication, but I’ve found an app that’s a game. It’s got to be game oriented for him to learn.” Schools have also adopted videogames as an educative tool with programs such as “Reading Eggs” for literacy and “Mathletics” for numeracy as a part of their regular academic curriculum. While this has proven useful for all children, parents of children with ASD felt that due to their children already spending inordinate amounts of time on videogames compared to typically developing children, educational videogames had the capacity to facilitate learning in an enjoyable and engaging way that a standard curriculum could not.

Five mothers expressed concerns over their children’s futures and fear that their children would not be able to find or maintain employment. These parents often expressed interest in extending upon their child’s interest in videogaming to learning basic programming in order to create their own games. While their children spent varying amounts of time playing videogames, almost universally this was due to parental restriction. In each case where parents allowed their children to play videogames, they spent as much time as possible engaged with the screen. Parents hoped this would channel their child’s passion and enthusiasm for videogaming into potential future employment opportunities. The mother of an 8-year-old boy felt, “if he can follow his passion, and computers are his passion, then he’s going to be able to conquer whatever he wants. So if programming is his thing, then that’s his thing.” Children with ASD frequently become obsessive, researching their current fixation with an unsatisfied need to understand everything they can about it. Parents clearly felt that there
was a strong potential of videogames to provide a positive and enjoyable avenue for their children to learn skills such as the developmental mechanics and programming of videogames that would support their development and future employability.

**Social and communicative responses in children from using videogames**

Each of the mothers involved in this study noted that videogames were facilitative of socialisation and communication for their children. Six of the mothers reported that during and following videogame intervention, their children demonstrated increased socialisation and communication with family members. For the most part, mothers noted that videogames facilitated interactions between their child with ASD and their siblings in positive ways such as engaging in joint play, mimicking characters from the game, communicating with each other about what was happening in the game and laughing at different game features. There appeared to be a split in the data between games reinforcing the relationship of siblings who already interacted with each other, and facilitating a relationship that had not previously existed for others. One mother reported, “his five-year-old sister would sit on the computer desk and they would incorporate imaginary play into some of the games as well. They would start playing with it just doing the characters themselves.” Another mother noted that *Whiz Kid Games* created an environment for interaction amongst her boys, “which was unusual for him at the time, especially with the dramas at school. He was really willing to let his brother… sit next to him and engage, and that was unusual for him.” Mothers further reported that the videogames created a medium for both themselves and their partners to interact with their child. Exploring *Whiz Kid Games* with their child provided a dialogue from which they were able to find common ground and communicate. One mother noted, “it was interesting to have something, because my husband is also on the spectrum and it was something he could participate in with the boys, so because he had the expertise to set it up and get it going and
all the rest and it was just nice that it was something that he could do with the boys himself.” Parents felt that through videogames their children were able to build and consolidate positive social interactions with siblings and parents, where previously it would have been a point of contention.

Unsurprisingly, parents noted their children often had difficulties in interacting with their peers in social situations. Of the relationships the children did have, mothers noted their children used videogames as a means of initiating social interactions and communicating with their peers. One mother reported that videogames helped her son facilitate social relationships and communicate with his peers in person, “at school there’s a group of boys and they all talk about the same thing, and that’s videogames”. Parents reported their children made friendships through their passion for videogames, but their friendships were often through online communication. This allowed the children to maintain a sense of control over how and when they engaged in communication with their peers, but also gave them the ability to remove themselves without immediate consequence. In one case a mother reported, “Online, I find that because they’ve got similar interest, of different things, they chat about the interest and then they go on a wider variety, they start talking about school. I’ve noticed he talks with other ASD kids and they start talking about school and what they’re playing and then you hear laughter. When you hear real laughter, not the made-up laugh, then you know you’re hitting the right note.” These parents are aware that their children have difficulty connecting with others, but genuine laughter is easy for them to decipher and highlights when their children have actually made a genuine social connection. Although some interactions online are with peers, parents note that there is also a large amount of interaction that occurs between their children and miscellaneous others, particularly when playing large multiplayer games online such as ‘Minecraft’ and ‘Clash of Clans’. Parents’ level of monitoring and understanding of the socialising aspect of these videogames varied from ensuring their child
was on a safe or ASD-specific server, to explaining online safety to their child (e.g., “don’t give out our details”) with no additional follow-up. However, almost universally, parents whose children played multiplayer videogames allowed them to play online because they felt it created an environment for learning to socialise in an enjoyable way.

**Behavioural responses in children from using videogames**

Parents reported that their children were spending inordinate amounts of time engaged with computer technology. Although the length of time varied between families on their use of videogames from a low of approximately twice a month up to three hours a day, this was not representative of the amount of time their children *wanted* to engage in technology. Universally parents who reported their children played ‘less than everyday’ reported that reducing technology time was something they were actively working on with their child. One mother stated in regard to the frequency of her child’s game use, “not that much, not in the last six months or so and that’s kind of on purpose.” In fact, parents noted that their children’s desire to engage with technology (particularly videogames) bordered on obsession. Parents found that their children’s desire to play videogames was often excessive with a potential for resulting in negative behavioural responses. One mother noted, “I always fear that if I just let him play games, he’s just going to keep on wanting to do that all the time. Because it happens with his iPad, the more I allow him to use, the more difficult it is to take it away from him and he just depends on it and he’ll just ask for it all of the time.” Difficulties in children adjusting from playing videogames to engaging in other activities was reportedly due to inconsistent or unclear boundaries about finishing with technology time. If there was not a clear amount of time the child was given to use technology or play games with sufficient warning about finishing, it would end in adverse reactions. One mother said, “if I say, ‘You can have your games for 30 minutes exactly, you finish at 3 o’clock.’ He has no
problems, if I said, ‘It’s 3 o’clock its time to finish’, he’ll just put away straight away. If I forget to warn him about that, when he gets to 3 o’clock and I say ‘It’s 3 o’clock you need to finish’, oh god, it’s got the chance of turning into a meltdown at that point.” Parents consistently report their children have a strong desire to play videogames and that they need to have specific rules in place surrounding their children’s use.

All but two of the mothers interviewed as part of this study reported that their children were able to generalise skills learned in *Whiz Kid Games* to real life situations. The *Whiz Kid Games* intervention was targeted at independent living skills and common deficits in children with ASD such as making eye contact and coping with change. This was largely accompanied by reinforcement of learning from the videogames in real life situations by parents. One mother stated, “we applied the ‘Change is good’ out in the community quite a lot and you reminded me to get back to it because it was very effective with him. Because he would say it, he initiated it, which was the best outcome from your games that you could possibly expect, to initiate.” Parents of children with ASD spend large portions of time attempting to support and teach their children to attain skills related to socialization, communication and independent living. Although it is uncertain if the games on their own were directly responsible for change, they may have served as a platform that parents could build upon when the children were exposed to the gaming situations *in vivo*. One mother stated, “It was more me, reinforcing things that he was doing on there in real life. And so for me to sort of see those things and then reinforce it in an outside setting to sort of remind him of that. I would say, ‘That was a really good job mate, just remember like in *Whiz Kid Games* where the little boy would let someone else have a go, or would choose something else to do’”. Through a combination of repeated exposure to the videogames and *in vivo* reinforcement, parents anecdotally reported real-life transfer of skills learned through the videogames.
Key components of game design and features for children with ASD

A predominant theme identified in the data revolved around parents highlighting design components and game features that are important to include in order to maintain the engagement of their children. Parents reported varying capabilities when it came to utilising technology. Although the majority reported that their children were able to use most forms of gaming technology (e.g., computers with keyboard and mouse, consoles, tablets, touch screens), the only platform that all children were able to operate efficiently was an iPad. While not uncommon for children to engage daily with some form of technology, all except one parent identified that their children specifically used iPads on a daily basis. Parents identified a number of different reasons their children would engage with an iPad daily including learning, communication, browsing the internet and gaming. The remaining parent reported that although her child did not use an iPad, he did use an equivalent tablet on an Android platform. When discussing the best platform for engaging their child, parents universally said “iPad”.

Specific components that parents identified as important when trying to engage their children revolved around difficulty, predictability, responses to answers, instruction delivery, engaging stimuli, characters in games and miscellaneous features. Parents reported that game difficulty must be at a level where it is consistently challenging their child whilst enabling their child to remain successful. Parents felt that if games were too easy their children would become bored and want to move on to something that would provide more of a challenge. In contrast, parents felt that if the games were too difficult, their children would feel a sense of failure and refuse to engage. One mother reported that if games were too difficult, “Frustration, big time! Yelling, screaming, throwing, gives up, ‘I’m useless’, ‘I’m terrible’ not that we’ve ever referred to him like that but this is inherent.” This highlighted the
importance of creating games with adaptive difficulty in order to ensure that the children were consistently challenged, but able to remain successful. So in that respect, designing games for children with ASD is similar to designing regular games, where it is important to find just the right level of difficulty in order to fully engage the player.

Although difficulty was identified as a key component, parents felt that games must also be predictable in order to facilitate engagement. Parents found that their children would often have negative behavioural responses to unpredictable or surprising events in games. One parent suggested that her child, “doesn’t like not to know what’s expected. So the fact that he could answer a question, get it right, he finds that quite reassuring.” By following predictable pathways, children were able to maintain a sense of control over their environment and feel safe in participating in videogames.

In order to facilitate predictability, parents felt that it was important to have clear instructions. Although parents unanimously agreed that having clear, simple and concise instructions was important to engage their children, the medium to best present these instructions differed. Findings highlighted the importance of providing the instructions in multiple formats such as video, audio and text. One mother suggested that instructions should be, “probably visual, in as far as the written word, as well as it being verbalised to him. So a combination of both visual and auditory, in a text base. So he can read the words as well as hear the word being said”. Parents felt that without incorporating all three mediums of instruction games instructions would not be able to engage all children and their broad spectrum of capabilities.

When answering questions or completing tasks, parents reported that their children would frequently choose all potential incorrect answers in order to receive the audio visual stimuli that accompanied a negative response, regardless of whether they knew the correct answer. They felt the potential for their children to self-stimulate by choosing these responses
removed the potential for learning. Parents felt that no, or minimal, response should be given for incorrect answers with one mother stating, “if there’s nine options, he will touch eight before he hits the correct one because he wants to hear the ‘got it wrong’ sound effect before the right and then finishes it off.” Although rewards when selecting a correct answer are an inherent feature of most games, children with ASD often view the audio-visual stimuli when selecting an incorrect answer just as engaging as getting the answer correct. Parents felt the best way to combat this was to provide the child with an immediate reward (e.g., a star appearing on the screen or a high five animation), only following answering a question correctly.

*Audiovisual stimuli* were also suggested to be important in maintaining the child’s attention whilst completing a game. Although parents felt that it was essential to include engaging audiovisual stimuli, they also emphasised that it should be repetitive and basic regardless of their child’s age. Simple and repetitive language and music were highlighted as important audio features for engaging children with ASD. Parents felt that if the audio was too complex, their children would become overstimulated and have difficulty following the game. For visual stimuli, parents identified animation, particularly in relation to the characters in the game, as important to maintain the engagement of their children. One mother said, “even at his age, he’s turning 12 next month, and he still likes kiddie things, like cartoons and well, then again you know I haven’t outgrown some of them. A lot of the kids they do like watching things, watching cartoons” They felt that irrespective of their children’s age (i.e., 5-12 years) that basic animated visual components were more engaging than real life characters. Unlike their typically developing peer, older children with ASD engaged more readily with basic animations that were targeted at a younger audience.

*Animated clips* were also a means of motivating some children to complete levels; however, they reported having a ‘skip’ button was also important as some children preferred
to engage with the game itself. Parents felt that the *characters* in the animations should not be hybrid characters (e.g., human faces superimposed on a robot) because their children were concrete in their thought processes and found it disconcerting when the two were mixed. Parents reported that all types of characters were engaging (e.g., human, animal, dinosaur, super hero), but that it was important to stick to one type rather than combine them, with one mother noting, “it was interesting to see just how much those preconceived ideas are there. So if you go changing anything terribly much well you’ve lost that attraction in the first place”.

Other *miscellaneous features* that parents highlighted as important features of games were the inclusion of a timer so the child was able to clearly identify how long they had remaining on the game, randomising the presentation of each level at a difficulty setting and including prompts and cues when children were having difficulties identifying an answer. Parents felt that it was important to include each of the features detailed above as components of a game in order to best engage their child and create the opportune environment for learning.

*Future directions for videogame interventions for children with ASD*

When parents were asked what they would like to see in the future in terms of videogame interventions for ASD, they almost unanimously identified that the greatest area of need for their children was in the development of social skills, particularly in developing and maintaining relationships with peers. Ideas ranged from static games where the child could learn social skills related to social interactions in a safe and controlled environment, to creating a multiplayer game where children could develop social skills through facilitated multiuser engagement. One mother reported that a game that was, “multiplayer within a really structured game would be good, and he wants to engage, he wants to socialise but he
really doesn’t have the skills. So if it was a game play that he was confident in with and competent with, he’d be fine.” The social skills identified by parents varied, typically in relation to age appropriate skills (i.e., for a six-year-old, it was most important to learn to wait and take turns, whereas for a 12-year-old, parents were more concerned with social conversation and engaging with others).

Parents identified a number of other independent living skills that they would like to see gamified in order to support their child’s development. These included skills such as crossing the road safely, trying new foods, adjusting daily routines and toileting. One mother noted that her son, “just reminded me of this time when he was really little and we were struggling to get him to understand how the toilet thing worked and this video showed up and he was so engaged with this video that he actually went and did it. The video was an animation actually.” Parents were positive about the outcomes they felt had occurred through previous videogame intervention, and were hopeful that through gamification they would be able to find further support in developing skills to assist their children into becoming independent.

Discussion

Although still in its infancy, there is research that suggests the promise of videogames as a mode for delivering intervention that facilitates improvements in symptoms for children with ASD (Hopkins et al., 2011; Thomeer et al., 2015). Despite this, there is no evidence to the author’s knowledge that game developers have utilised input from parents of children with ASD in the design process. This chapter specifically addresses the gap in the current literature by elucidating parental knowledge, experience and perceptions that may effectively guide the design of videogames for ASD. Parental input is likely essential in the design of
effective videogames for children with ASD as they are the experts in the enablers of engagement for their children.

The large amount of time that children with ASD spend interacting with technology indicated the initial promise of harnessing this avenue for intervention. Children spend significant amounts of their spare time using technology, and a vast majority of that time is spent playing videogames (Kuo et al., 2014; Mazurek & Wenstrup, 2013). Parents are motivated to allow their children to use videogames in their current form because it is an age-appropriate activity that allows their children the opportunity to relax and enjoy themselves. The potential for learning from videogames has already been established from an academic standpoint as parents recognise the improvements their children make engaging in educational games for literacy and numeracy (Rosas et al., 2003). Videogames offer children a means by which they can learn various skills in a safe environment where they are able to maintain control and be successful. For children who often experience difficulty understanding subtle nuances of social interactions (APA, 2013), it is unsurprising they engage so well in a medium that is bound by rules and structure. Parents from this study reported wanting their children to succeed, and to be able to live independently but understand the complexity of developing the skills to achieve these goals.

Children with ASD in this study were found to become so fixated on using technology that its removal has often been found to result in severe negative behaviours. Many parents felt the need to counteract the potential of these behaviours by limiting the time their children spend engaging with computing devices. In many cases, this resulted in parents removing technology and videogames from their children’s everyday life, only allowing them to play as an infrequent reward. Although in the short term this may reduce the likelihood of negative behaviours, the secondary implications must also be considered. Engagement with videogames were reported by the parents in this study to facilitate socialisation with their
family, peers and even in developing miscellaneous friendships. If these children are not allowed to play these games, then they are missing learning opportunities that would have otherwise taken place. For children with ASD, it is even more important that this learning takes place, as they might not pick up these skills in other ways where their typically developing counterparts would (e.g., at home or school). Difficulties in developing skills in social interactions and communication are inherent in the diagnosis of ASD (APA, 2013). Reducing the amount of time with technology (i.e., the intervention), may limit the capacity for children to learn through a medium that in itself facilitates engagement. Although parents in this study reported technology use is often engaging to the point of obsession for children with ASD, clear timeframes were reported to significantly reduce the likelihood of these negative behavioural outcomes when removing technology. Time spent playing videogames remains a contentious point in the literature for all children (Shields & Behram, 2010), but its capacity to engage a population that is notoriously difficult to engage reinforces its potential for use as a social and behavioural intervention for ASD.

In order to be effective, all interventions must be able to maintain the engagement of individuals participating in them (Orlinsky, 1994). As videogames were found in this study to engage children with ASD to the point of obsession, it creates a unique and promising opportunity for supporting this disadvantaged population. Parents identified a number of game mechanics that were important in order to facilitate maintained engagement from their children and others that inhibit it. Many of these mechanics did not differ from what might be expected from current evidence base surrounding ASD (e.g., importance of predictability, using prompts and cues and that basic audio visual stimulation is important) but others were perhaps less obvious. The necessity for games to be adaptive in their difficulty may appear to be an obvious recommendation, but is one that does not appear to be accounted for in the current games that have been developed and tested. That it is essential to use multiple media
(e.g., audio, visual and text) for presenting instructions to children with ASD due to the extent of the differences in their presentation. Finally, that only a minimal and non-stimulating response should be given if the child gets an incorrect answer. These findings reinforce the importance of including parents in the game design process. Although their children’s input is also highly beneficial, these minor mechanical differences that may lead to a child engaging or disengaging from a program are perhaps best represented by the relative experts of this population, their family members.

In summary, the current study highlights the benefit and importance of including not just children, but also their parents, in the design process of videogame interventions for children with ASD. It is important that videogame design utilises the extensive knowledge base regarding current best practice interventions for children with ASD as well as including input from the children themselves, and their parents. This should not be a post hoc consideration assessing the likeability of the games but, rather, an a priori procedure that is an inherent feature of game design and development. Although this study focused on the lived experience of parents of children who had undergone a videogame intervention for ASD, further research is warranted to explore the experience of other caregivers that are regularly in contact with children with ASD such as teachers, siblings and other carers. This would help expand our understanding of the game features and mechanics that maintain engagement from children with ASD.
Chapter 8 General Discussion

The overall aim of this thesis was to assess the feasibility of using videogames as a social and behavioural intervention for children with a diagnosis of ASD. During the last three decades, there has been a significant rise in the number of children being diagnosed with ASD. Although the direct cause of this increase in prevalence is unknown, the increasing numbers of children diagnosed highlights the need for accessible and efficacious intervention services. Of the five most common forms of social and behavioural interventions for ASD, only ABA and video-modelling interventions have sufficient evidence to claim efficacy (Bellini & Akullian, 2007; Peters-Scheffer et al., 2011). Although ABA has been found to be an efficacious behavioural treatment for children with ASD, it is expensive, time consuming and requires the employment of specifically trained behavioural therapists (Roberts & Prior, 2006). For affluent families this may be an effective method of service delivery, however, many families (if not most) cannot afford such interventions. Video-modelling is an efficacious and cost-effective method of service delivery for children with ASD (Bellini & Akullian, 2007). Although effective, video-modelling is a time-consuming activity requiring carers to create video resources for each individual behaviour targeted for change.

Computerized and assistive technology interventions have been identified as a means of service delivery that is cost effective, able to be widely disseminated and able to target many behaviours or skills relevant to children with ASD (Ramdoss, Lang, et al., 2012; Ramdoss et al., 2011; Ramdoss, Machalicek, et al., 2012). Additionally, technology based interventions have been suggested for this population due to the natural affinity that many children with ASD show for technology. Children with ASD have been identified as heavy technology users who spend significantly longer times engaged with screen based technology than their typically developing peers (Kuo et al., 2014; Mazurek & Wenstrup, 2013). Of the
time they spend engaged with screen based technology, the majority is spent playing, or researching, videogames (Kuo et al., 2014). Study 1 (Chapter 6) reported promising findings for the use of specifically designed, videogame interventions for supporting children with ASD. Improvements in social and behavioural functioning following a five-week intervention period suggest that videogames are a feasible method of service delivery. The capacity for videogames to engage children with ASD was further supported by the findings in Chapter 7.

The parents of the children who participated in the Whiz Kid Games intervention reported that all children from the pilot trial spent the majority of their time engaged in screen based technology, or requesting to use screen based technology. All but one parent reported that the majority of their child’s time engaged with screen-based technology was spent playing videogames. The parent who reported their child did not engage with videogames reported that their child spent the majority of their time searching for, and watching “Youtube” clips, or researching one of their fixations (e.g., googling “Thomas the Tank Engine”). Many researchers, therapists, clinicians and educators are now attempting to harness the natural affinity for technology that children with ASD demonstrate to create a fun and engaging intervention programs. A body of evidence has begun to emerge in the research literature supporting the development and use of videogame based interventions for improving social skills, communication, behavioural functioning and daily living skills for children with ASD (see Chapter 4). The following section will discuss the two key findings from this thesis: that game type is an important consideration when designing videogames for children with ASD and behaviour change following the use of videogame based interventions for children with ASD is a feasible outcome.
**Game type an important consideration in designing videogames for ASD**

The systematic review completed in Chapter 4 identified that videogame interventions for children with ASD do not currently have the evidence base to be definitively classified as efficacious. Although videogame interventions cannot claim efficacy, the current literature provides a strong foundation that supports the promise of this type of intervention for improving social skills, communication and emotional functioning for children with ASD. Much of the current body of evidence is based on preliminary analyses of a variety of different types of games. The different game types identified in the review varied from little to no supporting evidence, to demonstrating considerable promise. Results for *arcade style games* and *exergames* were each limited to a single study (Anderson-Hanley et al., 2011; Gordon et al., 2014). Although the authors made strong claims about their ability to improve emotional expression and reduce stereotyped and repetitive behaviours respectively, their studies were based on weak methodological designs. In both cases, authors made their assertions based on small samples and no control group. Results were derived from a within subjects, pre- to post-test designs where neither the participants nor the assessors were blinded to the aims of the study (see Appendix B).

The evidence in support of *collaborative interface games* was stronger than for *arcade style games* and *exergames*, but still lacked the scientific rigour to support their use as independent videogame interventions. Three studies were identified that had drawn upon *collaborative interface gaming* technology in order to improve social skills in children with ASD (Bauminger-Zviely et al., 2013; Gal et al., 2009; Gal et al., 2016). In each of the independent studies the authors found that through the use of *collaborative interface games* they were able to observe a measureable change in their participants. Much like the studies assessing *arcade style games* and *exergames*, the research on *collaborative interface games* was methodologically flawed, making it difficult to come to strong conclusions about their
use. Perhaps the main weakness of the studies evaluating collaborative interface games as an intervention for children with ASD was its dependence on combined human administered social skills training and videogame. There was no delineation in these studies assessing the effectiveness of each of the individual treatment components. The design of collaborative interface games identified in this review using the “DiamondTouch” table requires that the games be administered as part of a treatment package. The inherent reliance of collaborative interface games to include social skills training administered by a human prior to the game component of the intervention suggests that in its current form, it cannot claim efficacy as an independent videogame based intervention.

The most effective game types for improving symptoms in children with ASD identified by the systematic review in Chapter 4 were role player games and point and click games. These games are beneficial for children with ASD as they allow for exposure to challenging situations in a safe and controlled environment. Children are able to engage their avatar in situations that mimic real life scenarios in an attempt to facilitate learning social skills, communicative skills, daily living skills and appropriate behavioural functioning. Although virtual exposure is a key component of role player games interventions parents of children with ASD express concern about its ability to generalize to real life situations (see Chapter 6). Three studies identified in Chapter 4 as a part of the systematic review used role player games as the game component of their intervention (Beaumont & Sofronoff, 2008; Chung et al., 2016; Didehbani et al., 2016). Although the style of role player games (e.g., fictional story vs. virtual reality real life encounters) in each of these studies differed, improvements in social skills were consistent across the three. Their findings are supported by the use of more stringent experimental procedures including control groups, randomised assignment to treatment condition (Beaumont & Sofronoff, 2008; Chung et al., 2016) and assessor blinding (Didehbani et al., 2016). Much like collaborative interface games identified
by this review, *role player games* all used the videogame as a part of a broader treatment package. The difference between the two game types is that *collaborative interface games* inherently required the use of human instruction as a part of the treatment package, whereas the human instruction component for *role player games* could be gamified. The efficacy of using *role player games* independently has not yet been determined as the studies only assessed for overall change and did not account for the individual components of the treatment packages. Although *role player game* interventions are still in their infancy they have demonstrated promise in their ability to improve social skills for children with ASD.

*Point and click games* were the focus of the majority (*n* = 11) of the studies included in the systematic review (see Chapter 4). *Point and click games* are usually static wherein the user is presented with a choice (i.e., are two faces making the same expression, or different) and required to move their mouse or cursor to click on the appropriate response. Seven of the studies were based on a treatment package approach, which utilised videogames as a secondary component to the main intervention (e.g., video lessons on facial expressions). Four studies assessed the effectiveness of *point and click games* for improving social skills, communication and emotional identification as an independent intervention. Although one study did not measure any difference following the use of their *point and click game “ECHOES”* (Bernardini, Porayska-Pomsta, & Smith, 2014), the remaining studies each reported improvements in their target variables (see Chapter 4). This is consistent with the findings of the *Whiz Kid Games* pilot trial which was composed of a suite of *point and click games*. Although claims of efficacy cannot be made for *Whiz Kid Games* specifically, the improvements found in these studies reinforce the potential of this *point and click* type game to improve social skills and behavioural functioning. The combined improvements from independent *point and click games*, *point and click games* as part of a treatment package and
the Whiz Kid Games pilot, suggest that this may be the most effective game type for change in social skills, communication and emotional functioning amongst children with ASD.

**Behaviour change as a result of videogame interventions**

**Social skills**

Videogame interventions for children with ASD are often designed to improve a specific deficit common in children diagnosed with this condition. The type of game that is used is often representative of the symptoms that are being targeted. For example, *role player games* and *point and click games* designed for children with ASD are often targeted at improving social skills for children with ASD (Beaumont & Sofronoff, 2008; Chung et al., 2016)(Thomeer et al., 2015). *Role player games* in particular are often used to improve social skills because of their ability to expose individuals to social situations in a safe and controlled environment. The child is able to manipulate an avatar through a virtual world and interact with other characters in the game. This allows children with ASD to learn, make mistakes and practice the skills they learn in a non-judgemental environment where they are not subject to the criticism of others. *Point and click games* provide a similar medium for the child, but present the game in a more static way. For example, the child may be presented with a scenario (e.g., “it is polite to look someone in the eyes when someone is looking at you”) and then make the appropriate response (e.g., click on the eyes of the character).

Some parents of children who participated in the Whiz Kid Games pilot highlighted concern regarding their children’s ability to generalise the target skills. Although they reported being willing to try “anything” to support their child’s development, they were sceptical about the ability of videogames to improve real life deficits. Although some parents expressed concern about the ability of their children to generalise learning from videogames, improvements were observed on the overall measure of social skills using the SRS-2.
Although findings from the *Whiz Kid Games* pilot trial are yet to be confirmed with a more rigorous efficacy trial, a number of other studies have been published that reported generalisation of learning from videogames to real life (Beaumont & Sofronoff, 2008; Chung et al., 2016)(Thomeer et al., 2015). Like the *Whiz Kid Games* pilot trial, this is typically assessed using the SRS-2 or an equally valid psychometric assessment of social skills such as the SSQ or the SCQ. Due to the heterogeneous methodological designs, lack of high quality research and wide variety of games there is not yet sufficient evidence to claim efficacy for videogames interventions to improve social skills for children with ASD. Nevertheless, the body of evidence amassing in the literature supporting the promise of these interventions urges the need for further investigation.

**Behavioural problems**

The literature’s current focus for videogame interventions appears to be restricted to facets of behaviour such as social skills, communication and emotional functioning (see Chapter 4). An area of improvement that has not yet been addressed by the academic literature is the potential of videogames for improving behavioural problems in children with ASD. Behavioural problems in ASD often manifest in the form of antisocial or aggressive behaviours, tantrums, elopement and self-injurious behaviours (Stewart, McGillivray, Forbes, & Austin, 2016). Outlined in the diagnostic criteria in the Diagnostic and Statistical Manual for Mental Disorders, 5th Edition (DSM-5) behavioural problems often result from when children’s insistence on sameness is violated (APA, 2013).

The *Whiz Kid Games* intervention includes two games related to “coping with change”. These games present children with common real life situations presenting a violation to their need for sameness and routine. The child is able to make an initial independent choice (e.g., what clothing to wear for the day) for the first part of the level. The
child then must make a partially forced choice (e.g., cannot choose the same clothes as the previous day and must pick fresh clothes). Adhering to the principles of reinforcement theory (Keller, 1969), following a correct answer the child is then positively reinforced in various ways such as statements such as “change is good”, or being presented with a spinning star. Following an incorrect answer, participants are presented with negative reinforcement in which the incorrect stimuli is removed to increase the likelihood of the correct response being chosen. These games were specifically designed in order to support children with ASD learning to adapt when their routine or need for sameness is violated. Results from the *Whiz Kid Games* pilot trial found that after the five week intervention period, children who participated in the games improved significantly on a measure of behavioural functioning, the DBC-P. The DBC-P is an emotional-behaviour measure which includes subscales of social and communicative functioning that was designed specifically for children with disabilities such as ASD or intellectual disabilities and has strong normative data for children with ASD. Although these results are preliminary and need to be confirmed with a larger scale efficacy trial, the improvements in behavioural functioning highlight the promise of videogame interventions for improving these variables.

A key limitation related to the improvements in behavioural functioning from the *Whiz Kid Games* pilot was the small control group that was not assessed concurrently with the intervention group. Although the analysis included a wait-list control condition in which no change was observed from pre- to post-testing over a five week period, the inclusion of the wait-list control groups experimental data makes it difficult to argue the findings represented a genuine improvement. Although observed improvements may be representative of learning from using *Whiz Kid Games*, improvements could also explained by parents allowing their children frequent access to an enjoyable medium (i.e., videogames). Children with ASD commonly present with symptoms of stress and anxiety (White, Oswald,
This anxiety has been linked in many cases to children with ASD’s insistence on sameness and circumscribed interests (Rodgers, Glod, Connolly, & McConachie, 2012). Parents reported (Chapter 7) that their children experienced higher levels of anxiety often resulting in tantrums following the removal of circumscribed interests, particularly videogames. It is possible, that simply allowing their children to play videogames on a regular basis reduced conflict in the parent child dyad, and lowered the child’s level of anxiety. In order to account for these variables, further research into the feasibility of videogame interventions improving behavioural functioning for children with ASD need to include a not only a TAU control group, but also a leisure videogame control group. The inclusion of an additional “leisure videogame” control group would allow researchers to control for the impact of children engaging in an enjoyable videogame, compared to a videogame intervention. The inclusion of the third TAU control group allows researchers to make conclusions regarding the potential benefit of enjoyable videogame use as well as specifically designed videogame interventions in reducing deficits in children with ASD.

**Family functioning and Parenting Stress**

The entirety of the current scientific literature on videogame interventions for children with ASD measure primary outcomes specifically targeted by the games themselves. These games appear to have promising foundations for teaching social and communicative skills, emotional functioning and for improving behavioural difficulties. However, little is known about the secondary impact of the games on the child’s environment. Parents of children with ASD often report higher levels of stress and more conflict in their familial relationships than parents of typically developing children (Davis & Carter, 2008). Much of this stress has been attributed to the difficulties of raising a child with ASD and their behavioural difficulties (Stewart et al., 2016). As videogames have been found to lead to measurable change in
primary outcomes for children with ASD, it is possible that this change would be reflected in secondary variables such as family functioning and parenting stress.

Although participants improved on measures of social skills and behavioural functioning following the Whiz Kid Games pilot there was no change observed in either parenting stress or family functioning over the five-week intervention period. This may represent a genuine lack of improvement, or may be better explained by the short intervention period and lack of follow up data. Improvements in the primary outcomes would not have occurred immediately. As change in the primary variables was expected to occur over the five-week intervention period, a potential explanation for the null findings it is likely that there was not sufficient time for these improvements to elicit measurable change in the secondary outcomes. Although the Whiz Kid Games trial attempted to obtain follow-up data from the participants, only four participants completed the follow-up test battery. Insufficient follow-up data renders it impossible to make conclusions that following improvements in social and behavioural functioning change did, or did not occur in parenting stress and overall family functioning. Replication studies of the Whiz Kid Games intervention attempting to measure change in secondary variables such as parenting stress and familial functioning must emphasize the importance of obtaining strong follow-up data. Obtaining follow-up data should allow researchers to make stronger conclusions about the potential efficacy of videogame interventions to impact secondary outcomes such as family functioning and parenting stress.

Limitations and Future Directions

Whiz Kid Games

The Whiz Kid Games pilot trial indicated positive findings regarding the games’ ability to improve social skills and behavioural functioning in children with ASD. The
improvements coupled with moderate to strong effect sizes add weight to the effectiveness of this intervention. However, conclusions from this study must be interpreted with caution due to the limitation in the study design. This study aimed to complete a randomised controlled trial including a wait-list control group and interventions group with five-week follow-up data. Difficulties in recruitment made it impossible to fulfil the requirements of the original methodological design. In order to provide a strong enough sample to assess for effects from the intervention, participants completing the post-waitlist phase of the trial were invited to enter an intervention phase, and data from those that agreed were added to the total ‘intervention group’ data. Control data was collected over a five-week period but was not sufficient to allow for a more sophisticated statistical analysis of the data. Although recruitment is a common difficulty when attempting to conduct intervention research with children with ASD, in order to assess whether the findings of this pilot are true effects it is essential that a fully powered efficacy trial is conducted. This trial would need to include three conditions: a TAU control group, a leisure videogame control group and a specifically-designed videogame based intervention group. The TAU control group is necessary to make conclusions about the efficacy of videogame interventions that are not part of a treatment package. The leisure videogame control group is necessary to make conclusions regarding the efficacy of videogame interventions eliciting social and behavioural change, compared to secondary improvements observed following reductions in stress and anxiety.

An additional limitation of the current pilot trial of the Whiz Kid Games intervention for children with ASD was the lack of a cognitive measure. Although improvements in cognitive functioning following the use of Whiz Kid Games was not expected, controlling for different cognitive levels may account for the lack of engagement by some participants. The ASD spectrum ranges from significant cognitive impairment to above average intelligence (Charman et al., 2011). The magnitude of this variation leads to difficulty creating
videogames that support the child being challenged, but also being successful. Including a
cognitive measure would additionally strengthen the data by allowing comparisons to be
made between differing cognitive levels. Although *Whiz Kid Games* was originally developed
for children with ASD who require substantial to very substantial support, it may also be
effective in supporting children who require little support or may be too easy decreasing the
likelihood of engagement.

Although completing *Whiz Kid Games* in a naturalistic environment allows for
researchers to make assumptions regarding the ecological validity of the intervention, it also
limits their ability to control for environmental factors that may influence the child’s use of
the videogame intervention. An example of this was observed in the qualitative data with a
parent reporting two of their children sat together while one child (the participant) played
*Whiz Kid Games*. The addition of another child suggests that the participant may have been
working collaboratively with their sibling whilst playing *Whiz Kid Games*. The support of a
sibling may be a positive factor, helping the participant to engage in the intervention and
complete levels that may have otherwise been too difficult for them facilitating improvement
that may have otherwise not occurred. Although there are benefits to the child completing the
intervention in the family home, it is unclear whether the benefit of completing this
intervention in a comfortable, naturalistic environment outweighs the risks related to the lack
of control.

**Conclusions**

It is unsurprising that children with ASD engage well with videogame interventions.
Videogames represent a safe, controlled and rule-based environment that is easy and fun for
children with ASD to engage with. These games allow these children to train and build their
confidence in a virtual world prior to attempting *in vivo* these skills in a social environment.
They are already heavy technology users often spending the majority of their spare time
engaged with screen based technology (Clark, Austin, & Craike, 2015). Of this time, they spend most of it engaged in videogames (Kuo et al., 2014; Mazurek et al., 2012; Mazurek & Wenstrup, 2013). As videogames are already extremely engaging for children with ASD, there is a strong potential for this medium to be utilised for intervention.

Findings from the systematic review (Chapter 4) suggest there is a body of research highlighting the promise of videogames for improving social skills and emotional functioning in children with ASD. These findings were reinforced by an additional body of literature assessing videogames as part of a larger treatment package (i.e., using multiple intervention strategies) which found similar promising effects for improving social and emotional functioning. The findings from this review were consistent with the findings from the pilot trial of Whiz Kid Games (Chapter 6) which demonstrated promising improvements in social skills, communication and behaviour. Pairing the findings from the review and pilot trial revealed a consistent (although not unambiguous) evidence-base indicative of a potential for videogames to improve behavioural functioning, communication, and social skills in children with ASD. This evidence-base clearly justifies development and research of new mode of intervention delivery for this population.

There is a growing body of evidence indicating that videogame interventions for children with ASD may be effective. Improvements in both social skills and social communication from the pilot trial of Whiz Kid Games (Chapter 6) demonstrated evidence in support of this effectiveness; however, this pilot study provided only preliminary evidence due to the limited number of participants, lack of cognitive measures, and the uncontrolled naturalistic setting. Nevertheless, the findings provide a strong basis for a larger, fully powered RCT of the intervention.
References


trauma-based conceptualisation. *Advances in Mental Health*, 1-11.

doi:10.1080/18387357.2015.1133075


## Appendix A: Prisma Checklist

<table>
<thead>
<tr>
<th>Section/topic</th>
<th>#</th>
<th>Checklist item</th>
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<tbody>
<tr>
<td><strong>TITLE</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>1</td>
<td>Identify the report as a systematic review, meta-analysis, or both.</td>
<td>1</td>
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<tr>
<td><strong>ABSTRACT</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Structured summary</td>
<td>2</td>
<td>Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.</td>
<td>Abstract document</td>
</tr>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>3</td>
<td>Describe the rationale for the review in the context of what is already known.</td>
<td>3-4</td>
</tr>
<tr>
<td>Objectives</td>
<td>4</td>
<td>Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).</td>
<td>4</td>
</tr>
<tr>
<td><strong>METHODS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>5</td>
<td>Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.</td>
<td>4</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>6</td>
<td>Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.</td>
<td>4-5</td>
</tr>
<tr>
<td>Information sources</td>
<td>7</td>
<td>Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.</td>
<td>4-5</td>
</tr>
<tr>
<td>Search</td>
<td>8</td>
<td>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.</td>
<td>4-5</td>
</tr>
<tr>
<td>Study selection</td>
<td>9</td>
<td>State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).</td>
<td>4</td>
</tr>
<tr>
<td>Data collection process</td>
<td>10</td>
<td>Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.</td>
<td>5-6</td>
</tr>
<tr>
<td>Data items</td>
<td>11</td>
<td>List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.</td>
<td>5</td>
</tr>
<tr>
<td>Section/topic</td>
<td>#</td>
<td>Checklist item</td>
<td>Reported on page #</td>
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<tr>
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</tr>
<tr>
<td>Risk of bias in individual studies</td>
<td>12</td>
<td>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</td>
<td>5-6</td>
</tr>
<tr>
<td>Summary measures</td>
<td>13</td>
<td>State the principal summary measures (e.g., risk ratio, difference in means).</td>
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<tr>
<td>Synthesis of results</td>
<td>14</td>
<td>Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I²) for each meta-analysis.</td>
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<tr>
<td>Risk of bias across studies</td>
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<td>Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).</td>
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<tr>
<td>Additional analyses</td>
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<td>Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.</td>
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</table>

### RESULTS

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<tr>
<td>Study selection</td>
<td>17</td>
<td>Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.</td>
<td>6-7</td>
</tr>
<tr>
<td>Study characteristics</td>
<td>18</td>
<td>For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.</td>
<td>Table 1 &amp; 2</td>
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<td>Risk of bias within studies</td>
<td>19</td>
<td>Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).</td>
<td>Table 3</td>
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<tr>
<td>Results of individual studies</td>
<td>20</td>
<td>For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.</td>
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<tr>
<td>Synthesis of results</td>
<td>21</td>
<td>Present results of each meta-analysis done, including confidence intervals and measures of consistency.</td>
<td>6-12</td>
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<tr>
<td>Risk of bias across studies</td>
<td>22</td>
<td>Present results of any assessment of risk of bias across studies (see Item 15).</td>
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<tr>
<td>Additional analysis</td>
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<td>Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).</td>
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### DISCUSSION

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<tr>
<td>Summary of evidence</td>
<td>24</td>
<td>Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).</td>
<td>12-14</td>
</tr>
<tr>
<td>Limitations</td>
<td>25</td>
<td>Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).</td>
<td>12-14</td>
</tr>
</tbody>
</table>
## Conclusions

Provide a general interpretation of the results in the context of other evidence, and implications for future research.

## FUNDING

| Funding | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | NA |


For more information, visit: [www.prisma-statement.org](http://www.prisma-statement.org).

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### Appendix B: Risk of bias assessment

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<th>Author</th>
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<th>Therapist blinding</th>
<th>Assessor Blinding</th>
<th>Measures of key outcome (85%)</th>
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<th>Between-group comparisons</th>
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<td>Tanaka et al., 2010</td>
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<td>Young &amp; Posselt, 2012</td>
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Appendix C: Plain language statement for parents and guardians

PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Parents/Guardians

Plain Language Statement

Date: 22/07/2014

Full Project Title: An Evaluation of an Online Intervention for Children with Autism Spectrum Disorder (DHRHC 2013-304)

Principal Researcher: Assoc. Prof. David Austin

Associate Researchers: Mr. Leigh Elliott, Prof. Nicole Pinehorst, Assoc. Prof. Kylie Gray, Mr. Bill Trikoupi and Mr. James Marshall

We would like to invite you and your child to join a project that will ascertain whether computer-based games can lead to behavioral improvements for children with autism spectrum disorder. The games have been designed collaboratively between ten autism spectrum disorder experts to target specific behavioral difficulties that are commonly observed in these children.

If you agree to your child participating in this project and to fill out the questionnaires, you will need to sign a consent form granting permission for their participation. Before signing the consent form, please take your time to go over this document.

Children who participate in this program will be required to attempt to play the online video-games for approximately 10 minutes every weekday for five weeks. Children are not restricted to the 10 minute time period and are encouraged to play the games as long as they wish. The games have been developed to give clear instructions on gameplay, and help walk the child through completing the games with verbal (spoken) and visual prompts so that children of all ability levels can participate. The games have varying tasks that need to be completed and increasing levels of difficulty to help challenge the child, while ensuring they are still successful.

Before your child begins using the game we would like to ask you to complete number of questionnaires regarding your child's current behaviors and social abilities as well as family functioning and parental stress. More specifically, we will be asking questions regarding their awareness in social situations, communication abilities, autistic mannerisms, disruptive behaviors and social interactions. We will ask these questions.
again on completion of the five-week trial. We will also check up on you three months after completing the project and ask these questions again.

Each of the games will target a different behavioral difficulty that is common for a child with autism spectrum disorder. These games include teaching children to cope with change, recognize emotions, group objects, follow schedules, find a route, make eye contact and wait their turn. The games have been specifically designed to engage the child and encourage them with music and visual reinforcements for getting the correct answer. If the child does not get the right answer they are encouraged verbally and visually so the right answer and on clicking the correct answer they are then reinforced.

There is no danger involved in engaging in the computer games or answering the questions regarding your child’s behavior. The games have been designed to be supportive and aid the child in making the right decisions, rewarding them when the right decision is made.

We will not be revealing your child’s name, or test results. The weekly results from your child’s gameplay will only be seen by the research team. All the information about your child is kept securely in a locked cupboard and in secure computer files. Later, when we record the findings from the project we will not report any names, so no-one will know who participated in the project.

We will keep all personal information private and confidential. However, if at the end of the project you wish to know about your child’s progress, we can make a time to meet with you both and discuss the things they did well, and where they might still experience difficulties with their behavior.

Participation in this project is voluntary. If you do not wish for your child to participate in this project you are not obliged to. If you do decide to take part and change your mind later you are free to withdraw your child from the project at any stage. Your decision whether your child participates in the project or not, or whether you chose to withdraw from the project at any time, will not affect your relationship with Deakin University in any way.

If you feel concerned about the project at any time, or if you have any questions you can contact Leigh via mobile: 0412 173 210 or email: leigh.elliot@deakin.edu.au. If you wish for your child to participate in the program, please sign the attached consent form and return it to us in the envelope provided. We will then make a time to meet with you.

Yours Sincerely,

David, Leigh, Nicole, Kylle, Cassandra, Bill and James.

Complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

The Manager, Research Integrity, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125. Telephone: 9251 7129, research-ethics@deakin.edu.au.

Please quote project number [2013-304].

Plain Language Statement & Consent Form for Parents/Guardians

(Form 67/LC 2013-304); version 7.20/6/2014

Page 2 of 4
Appendix D: Parent and Guardian Consent Form

PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Parents/Guardians

Consent Form

Date: 22/07/2014

Full Project Title: An Evaluation of an Online Intervention for Children with Autism Spectrum Disorder.

Reference Number: DUHREC 2013-304

I have read and I understand the attached Plain Language Statement.

I freely agree to participate in this project according to the conditions in the Plain Language Statement.

I freely agree for my child to participate in this project according to the conditions in the Plain Language Statement.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.

Participant’s Name (printed) ........................................................................................................................................

Signature ........................................................................ Date ........................................

Assoc. Prof. David Austin,
Deakin University, School of Psychology, Faculty of Health,
211 Burwood Hwy, Burwood, 3125
Tel – 03 9251 7227; Fax – 03 9244 6858

Plain Language Statement & Consent Form to Parents/Guardians
[DUHREC 2013-304]: version 2: 22/07/2011
Appendix E: Parent and Guardian Withdrawal of Consent Form

PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Parents/Guardians

Withdrawal of Consent Form

(To be used for participants who wish to withdraw from the project)

Date: 22/07/2014

Full Project Title: An Evaluation of an Online Intervention for Children with Autism Spectrum Disorder

Reference Number: DUHREC 2013-304

I hereby wish to WITHDRAW my consent to participate in the above research project and understand that such withdrawal will NOT jeopardise my relationship with Deakin University.

Participant’s Name (printed) ..........................................................

Signature .......................................................................................... Date ................................

Please mail or fax this form to:

Assoc. Prof. David Austin,
Deakin University, School of Psychology, Faculty of Health,
221 Burwood Hwy, Burwood, 3125
Tel – 03 9251 7127; Fax – 03 9264 0858

Plain Language Statement & Consent Form to Parents/Guardians

DUHREC 2013 304; version 2; 22/07/2014

Page 4 of 4
Appendix F: Plain language statement for Organizations

PLAIN LANGUAGE STATEMENT AND CONSENT FORM
TO: Organizations

Plain Language Statement

Date: 22/07/2014
Full Project Title: An Evaluation of an Online Intervention for Children with Autism Spectrum Disorder (DLUHREC 2013-304)
Principal Researcher: Assoc. Prof. David Austin
Associate Researchers: Mr. Leigh Elliott, Prof. Nicole Rinchart, Assoc. Prof. Kylie Gray, Mr. Bill Tribulas and Mr. James Marshall

We would like to invite you and your members to join a project that will ascertain whether computer-based games can lead to behavioral improvements for children with autism spectrum disorder. The games have been designed collaboratively between ten autism spectrum disorder experts to target specific behavioral difficulties that are commonly observed in these children.

If you agree to us advertising this project through your organization, you will need to sign a consent form granting us permission to do so. Before signing the consent form, please take your time to go over this document.

Children who participate in this program will be required to attempt to play the games for approximately 30 minutes every weekday for five weeks. Children are not restricted to the 10 minute time period and are encouraged to play the games as long as they wish. The games have been developed to give clear instructions on gameplay, and help walk the child through completing the games with verbal (spoken) and visual prompts so that children of all ability levels can participate. The games have varying tasks that need to be completed and increasing levels of difficulty to help challenge the child, while ensuring they are still successful.

Before using the game we will ask parents/guardians a number of questions regarding their child’s current behaviors and social abilities. More specifically, we will be asking questions regarding their awareness in social situations, communication abilities, autistic mannerisms, disruptive behaviors and social interactions. We will ask these questions again on completion of the five week trial. We will also check up with parents/guardians six weeks after completing the project and ask these questions again.

Plain Language Statement & Consent Form to Parents/Guardians
[DLUHREC 2013-304], Version 2, 22/07/2014
Each of the games will target a different behavioral difficulty that is common for a child with autism spectrum disorder. These games include teaching children to cope with change, recognize emotions, group objects, follow schedules, find a route, make eye contact and wait their turn. The games have been specifically designed to engage the child and encourage them with music and visual reinforcements for getting the correct answer. If the child does not get the right answer they are encouraged verbally and visually to try again until they get it right, and on clicking the right answer, they are then reinforced.

There is no danger involved in engaging in the computer games or answering the questions regarding the child's behavior. The games have been designed to be supportive and aid the child in making the right decisions, rewarding them when the right decision is made.

We will not be revealing children's names or test results. The weekly results from children's gameplay will only be seen by the research team. All the information about the child is kept securely in a locked cupboard and in secure computer files. Later, when we record the findings from the project we will not report any names, so no-one will know who participated in the project.

We will keep all personal information private and confidential. However, if at the end of the project parents/guardians wish to know about their child's progress, we can make a time to meet with them both and discuss the things they did well, and where they might still experience difficulties with their behavior.

Participation in this project is voluntary. If you do wish for us to advertise this project with your organization you are not obliged to. If you do decide to take part and change your mind later, you are free to withdraw from the project at any stage. Your decision whether to advertise the project or not, or whether you chose to withdraw consent at any time, will not affect your relationship with Deakin University in any way.

If you feel worried about the project at any time, or if you have any questions you can contact Leigh via mobile: 0412 179 210 or email: leigh.elliott@deakin.edu.au. If you wish for us to advertise the program with your organization, please sign the attached consent form and return it to us in the envelope provided. We will then make a time to meet with you.

Yours Sincerely,

David, Leigh, Nicole, Kylie, Cassandra, Bill and James.

Complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

The Manager, Research Integrity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7328, research.ethics@deakin.edu.au Please quote project number: 2013-504.

Plain Language Statement & Consent Form for Parents/Guardians

[DUHREC 2013-504]: Version 2 22/07/2014

Page 2 of 3
Appendix G: Organization Consent form

PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Organizations

________________________
Organisational Consent Form
________________________

(to be used by organisational Heads providing consent for staff/members/patrons to be involved in research)

Date: 22/07/2014

Full Project Title: An Evaluation of an Online Intervention for Children with Autism Spectrum Disorder

Reference Number: DUNREC 2013-304

I have read and I understand the attached Plain Language Statement.

I give my permission for patron of ________________ to participate in this project according to the conditions in the Plain Language Statement.

I have been given a copy of Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal the participants’ identities and personal details if information about this project is published or presented in any public form.

I agree that

1. The institution/organisation MAY / MAY NOT be named in research publications or other publicity without prior agreement.

2. I / We EXPECT / DO NOT EXPECT to receive a copy of the research findings or publications.

Name of person giving consent (printed) ________________________________

Signature __________________________________________ Date ____________

Main Language Statement & Consent form to parents/guardians
[DUNREC 2013-304] revised 7/22/07/2014
Please mail or fax this form to:

Assoc. Prof. David Austin,
Deakin University, School of Psychology, Faculty of Health,
221, Burwood Hwy, Burwood, 3125
Tel – 03 9244 7227; Fax – 03 9244 6036
Appendix H: Organization Withdrawal of Consent Form

PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Organizations

Withdrawal of Consent Form

(To be used for participants who wish to withdraw from the project)

Date: 22/07/2014

Full Project Title: An evaluation of an online intervention for children with Autism Spectrum Disorder

Reference Number: DUHREC 2013-304

Thereby wish to WITHDRAW my consent to participate in the above research project and understand that such withdrawal WILL NOT jeopardise my relationship with Deakin University.

Participant's Name (printed) ......................................................

Signature ........................................................................ Date

Please mail or fax this form to:

Assoc. Prof. David Austin,
Deakin University, School of Psychology, Faculty of Health,
221 Burwood Hwy, Burwood, 3125
Tel: 03 9251 7227; Fax: 03 9244 6858

Plain Language Statement & Consent Form to Parents/Guardians
[DUHREC C 2013-304].version 2/ 22/07/2014