THE WORK OF PLAY: HOW VIDEO GAMES AFFECT SOCIAL INTERACTIONS FOR CHILDREN WITH AUTISM SPECTRUM DISORDER

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ABSTRACT

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This study examines the differences in play behaviors demonstrated by children with Autism Spectrum Disorder (ASD) when they engage in play with typically developing (TD) peers. Pairs of elementary school students, ages eight to 11, engaged in play in three settings: typical school recess, facilitated play led by adults, and kinetic technology play using an XBox Kinect video game console. Pairs consisted of one participant with ASD and a TD peer buddy who played together multiple times in each setting. Positive social interactions between the participants were observed and tracked. Visual analysis showed significance between the three conditions in eliciting positive social interactions for children with ASD and also for TD peers, specifically that more positive social interactions occurred within the kinetic technology play setting. Participant surveys showed mixed preferences for play conditions, most preferring either recess or kinetic technology play. This study contributes to our understanding of the way students with ASD engage in play with peers and highlights the potential benefits of video games in promoting positive play interactions for students with ASD, particularly in the school setting.

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INTRODUCTION

It is well known that children with Autism Spectrum Disorder (ASD) experience social deficits. Research abounds in this area, citing multiple social and play skill deficits as key markers for the diagnosis of ASD (Bauminger, Solomon, Aviezer, Heung, Brown, & Rogers, 2008; Macintosh & Dissanayake, 2006; Nah & Poon, 2011; Sigman & Ruskin, 1999; Stichter, Herzog, Visovsky, Schmidt, Randolph, Schultz, & Gage, 2010; Stone & Caro-Martinez, 1990; Weiss & Harris, 2001). Diagnostic criteria for ASD from the American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-V) (2013) includes persistent deficits in communication and social interaction across multiple contexts. Specific deficit areas identified in people with ASD center around elements of social understanding including sharing, collaborating, negotiating, cooperation, self-control, and understanding rules/norms/constructs (Bauminger et al., 2008; Macintosh & Dissanayake, 2006; Nah & Poon, 2011; Sigman & Ruskin, 1999; Stone & Caro-Martinez, 1990).

Given the difficulty of succeeding in a world that typically requires frequent social interactions, researchers, educators, and parents, have emphasized the importance of developing interventions to build effective play and social behaviors in children with ASD (Pierucci, Barber, Gilpin, Crisler, & Klinger, 2015). One common belief is that children who have effective peer models for social behaviors will learn some of these skills via immersion. This has led many parents to advocate for their children with ASD to attend school alongside typically developing (TD) peers, a practice referred to as inclusion (Goodall, 2015; Symes & Humphrey, 2010).

Children with ASD in School

For a variety of reasons, including the belief in the advantages of peer modeling, more and more children with ASD are being placed in general education public schools (Goodall, 2015; Symes & Humphrey, 2010). Inclusion, as an educational practice, attempts to have all children educated together, regardless of developmental ability, with support structures in place (Goodall, 2015). However, arguments abound about the actual benefits of inclusion, particularly within the ASD community. At the heart of this debate is whether inclusion is successful in supporting the social needs of students with ASD (Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011; Dybvik, 2004; Farlow, 1996; Fryxel & Kennedy, 1995; Harrower & Dunlap, 2001; Hauck et al., 1995; Horne, Timmons, & Adamowycz, 2008; Lord & Hopkins, 1986; Zanolli, Daggett, & Adams, 1996).

Proponents of inclusion argue that, if approached correctly, schools should meet the needs of the child and not expect a child to adapt to an environment that is already in place (Goodall, 2015). In inclusive schools all children are considered part of the school community. Some researchers found children with ASD can learn from their typical peers, display more appropriate behavior, and increase their social skills (Goodall, 2015; Reiter & Vitani, 2007). Other research regarding the benefits of inclusive environments has been less conclusive (Chen, 2010; Majoko, 2016; Symes & Humphrey, 2010).

Unfortunately, the potential social benefits of inclusion are not realized in many schools due, in part, to a lack of emphasis on teaching TD peers how to support students with ASD (Able et al., 2015; Mojoko, 2015). Additionally, finding common interests and activities for children with ASD to interact with TD peers can often be challenging (Chen, 2010). Symes & Humphrey (2010) found students with ASD in general education settings experienced higher levels of rejection, lower levels of peer social support and higher levels of bullying than peers with a specific learning disability, and peers with no disabilities. Children with ASD in inclusive environments tend to have fewer friends and poorer friendship quality than peers without disabilities (Majoko, 2016). Researchers also found that physical proximity to typical peers may not enhance social experiences for many students, and children with ASD may not mimic the behavior of typical peers (Chamberlain, Kasari, & Rotheram-Fuller, 2007; Kasari et al., 2011; Locke, Rotheram-Fuller, & Kasari, 2012; Rotheram-Fuller, Kasari, Chamberlain, & Locke, 2010; Sperry, Neitzel, & Engelhardt-Wells, 2010).

In some cases, inclusion can create an entirely opposite effect and children with ASD can become targets for bullying behaviors (Kasari et al., 2011; Dybvik, 2004; Farlow, 1996; Fisher & Taylor, 2016; Fryxel & Kennedy, 1995; Harrower & Dunlap, 2001; Hauck et al., 1995; Horne et al., 2008; Lord & Hopkins, 1986; Zanolli et al., 1996). Researchers also found that bullying behaviors occur most often during less structured times of the school day such as lunch and recess when the opportunity for social interactions is typically at its highest for children (Able, Sreckovic, Schultz, Garwood, & Sherman, 2015; Chen, 2010; Odom & Strain, 1986; Odom & Watts, 1991).

Building Peer Relationships

School stakeholders agree that interventions addressing social skills for children with ASD are necessary in inclusion environments (Able et al., 2015; Mojoko, 2015). Research also shows that peer group relationships and social support are key indicators of effective social inclusion (Symes & Humphrey, 2010). Moreover, when schools train TD peers on how to interact with and support students with ASD, they increase interactive play (Carter, Hughes, Copeland, & Breen, 2001; Celiberti & Harris, 1993; Hundert, Rowe, & Harrison, 2014; Wolfberg & Schuler, 1993). Similarly, identifying and training TD peer buddies for students with ASD has also been found to be an effective way to increase social support, therefore decreasing bullying behaviors (Hundert et al., 2014).

One method that is supported by research is the use of facilitated or integrated play to promote positive peer interaction for students with ASD and TD peers (Carter, Common, Sreckovic, Huber, Bottema-Beutel, Gustafson, Dykstra, & Hume, 2014; Cogher, 1999; Gunn, Trembath, & Hudry, 2014; Kok, Kong, & Bernard-Opitz, 2002). Facilitated play is led by a trained adult who provides prompting and support throughout the play experience. Although adult-supported play has been seen as effective in supporting joint attention and engagement for students with ASD, it also has drawbacks (Carter et al., 2014; Cogher, 1999; Gunn et al., 2014; Kok et al., 2002). Facilitated play requires guidance by an adult which may have negative impact on budgeting/scheduling for schools and less potential engagement for typical peers, particularly as they enter the intermediate grades and begin to desire more independence from adults.

The movement to include students with ASD in general education settings, along with the serious concerns regarding bullying issues, is prompting school leaders to consider how to create meaningful environments in which students can positively interact. Technology interventions have been used successfully in other areas of deficit for students with ASD such as for functional behavioral support, academic support, and executive functioning support. However, researchers are now beginning to consider technologically based interventions as a way to facilitate more positive peer interactions for students with ASD (Carter et al., 2014; Cogher, 1999; Gunn et al., 2014; Kok et al., 2002).

Technology as an Intervention Tool

The body of literature on interventions for children with ASD across deficit areas is substantial and growing quickly. Much of it supports the use of technology as an effective tool for students with ASD to support functional behavior and academic instruction. Many children with ASD seem innately drawn to technology (Colby, 1973; Goldsmith & LeBlanc, 2004).

Murray (1997) found that technological interventions provided a controlled, predictable setting that allowed students with ASD to minimize distractions and stimuli. Murray (1997) also found that children with ASD perceived technological interventions to be highly motivating. Similarly, parents and doctors also report that children with ASD have a high motivation to use technological devices and that this interest may be an asset in intervention design (Colby, 1973; Goldsmith & LeBlanc, 2004).

Odom, Thompson, Boyd, Hedges, Dykstra and Duda (2015) completed a meta-analysis of literature around the use of technology in interventions and instruction for adolescents with ASD. Their research, reviewing more than 30 recently completed studies, supports the use of technology in intervention and instruction for adolescents with ASD. These findings support other recent studies that have identified various technologies as effective intervention tools for school-aged children with ASD (Bouck, Savage, Meyer, Tabe-Doughty, & Hunley, 2014; DiGennaro Reed, Hyman & Hirst, 2011; Fletcher-Watson, 2014; Ramdoss, Machalicek, Rispoli, Mulloy, Lang, & O'Reilly, 2012).

Schools have effectively used technologies such as video modeling, interactive white boards, computer-aided instruction (CAI), and educational apps to build students' academic and functional life skills (Huang, 2005; Murray, 1997; Goldsmith & LeBlanc, 2004; Knight, Spooner, Browder, Smith, & Wood, 2013). Research also highlights the role of video gaming in supporting students with ASD in these same areas of deficit (Blum-Dimaya, Reeve, Reeve, & Hoch, 2010; Finke, Hickerson, & McLaughlin, 2015). Similarly, TD peers between the ages of 8-18 are also drawn to technology, and specifically to the use of video games, with 91 percent of children between the ages of two and 17 reporting that they play video games according to a survey completed by the NPD Group, a national consumer market research company (Reisinger, 2011). The increasing popularity of video games for children has led many schools to consider ways to integrate gaming into education.

Purpose of Study and Research Questions

Given the social deficits of children with ASD outlined above, there is a clear need for interventions focused on promoting positive social interactions with TD children. The promise of technology in supporting children with ASD in specific skill areas, and the popularity of technology, and video games specifically, begs the question of how technology may support social interactions between students with ASD and TD peers. Little research exists regarding how video games can be used as a potential social intervention for students with ASD. Likewise, there is a need for research regarding how engagement with TD peers around technology, specifically playing video games together, could impact social interactions for students with ASD.

Therefore, this research aims to consider the potential benefits of video game play in increasing positive social interactions between students with ASD and TD peers. Specifically, the study investigates the benefits of video game play as compared with a common intervention, facilitated play, and as compared with traditional recess. To uncover the potential benefits of video game play on social interactions between children with ASD and TD peers, this research addresses the following questions: (a) Which play condition (traditional recess, facilitated play, or kinetic technology play) is most effective in eliciting positive social interactions for students with ASD and TD peers, and (b) Which play condition do students with ASD and their TD peers report as being most enjoyable?

Benefits of Research

The data captured in this research provide new information about how technology, and interactive video gaming specifically, may be effective in supporting social interactions for students with ASD in general education settings. This research adds to the body of work on targeted interventions for social and play skill development that integrate TD peers. It may lend an additional perspective on the role of gaming in education and its potential impact on students with special education needs such as ASD. It also informs our understanding of how children's social interactions may change across conditions, and therefore, how practitioners can use more effective play settings to promote positive interactions between students with ASD and TD peers.

An additional benefit of this research may be the practical implications, namely related to personnel/staffing and budgeting, for schools. Schools that use facilitated play need to rely on a trained adult, typically a social worker or counselor, to facilitate these sessions. This research considers another option where children with ASD can engage effectively in play with TD peers without an adult's direct support. In the following chapter, I provide a review of research that addresses the previously discussed topics in more detail and helps to provide a framework for this study.

LITERATURE REVIEW

In this literature review I will discuss the key research in the areas relevant to this study including information on the following: (a) social behaviors for children with ASD; (b) social interventions for children with ASD; (c) the role of technology in social development for children with ASD; and (d) the rise of video gaming in education. The review of literature was conducted by searching a variety of databases on key terms such as *Autism*, *gaming*, *social/play skills and ASD*, *peer buddy*, and *technology and ASD*. The databases included were primarily ProQuest, Google Scholar, and Mendeley Literature Search.

Social and Play Development and ASD

Children with ASD have a variety of deficits across developmental areas. These deficits are highly variable in children, leading Dr. Stephen Shore, author and ASD advocate, to coin the phrase, "If you've met one person with Autism, you've met one person with Autism" (http://www.autismempowerment.org/understanding-autism/autism-spectrum-disorder/). That said, there are two main areas of functioning that are impacted in all people with ASD: social communication and interaction, and restricted or repetitive patterns of behaviors (Barnard-Brak, Ivey-Hatz, Ward, & Wei, 2014). Therefore, deficits in social skills and social awareness are a universal marker of ASD, regardless of a child's capability in academics, functional life skills, or behavioral needs (American Psychiatric Publishing [APA], 2013). This section will first discuss how children with ASD may have delayed or impaired development in both social skills and play skills and how these deficits impact social development and connection within an education setting. The section will close with a discussion of how these deficits may be linked to bullying issues for children with ASD.

Social skill development. People with ASD may experience challenges across a variety of areas, however a hallmark of the disorder is pronounced impairments in adaptive social skills which allow children to navigate many aspects of daily life including play experiences with friends and following social norms or rules (Anderson, Oti, Lord, & Welch, 2009; Gillham, Carter, Volkmar, & Sparrow, 2000; Klin, Jones, Schultz, Volkmar, & Cohen, 2002; Kraijer, 2000; Syriopoulou-Delli, Agaliotis, & Papaefstathiou, 2016). Typically, people with lower IQ scores also show lower adaptive social skills. In people with ASD, deficits in these adaptive social skill areas are not necessarily accompanied by a lower IQ. This potential lack of connection between IQ and social skill deficits highlights an uneven developmental profile unique to ASD (Anderson et al., 2009; Liss, Fein, Allen, Dunn, Feinstein, Morris, & Waterhouse, 2001; Loveland & Kelley, 1988; Schatz & Hamdan-Allen, 1995).

Impairments in social skill development can be identified as early as the first year of a child's life by considering foundational social skills such as eye contact, response to name, spontaneous imitation, and understanding and expressing emotion. When compared with expected developmental norms, children with ASD typically display decreased abilities in these areas (Anderson et al., 2009; Osterling, Dawson, & Munson, 2002; Werner, Dawson, Osterling, & Dinno, 2000). As children grow to school age, these impairments often become more pronounced as social skills become a more prominent aspect of daily life. For example, school-aged children with ASD often experience challenges with the social aspects of language and communication, fail to understand social cues, and have difficulty responding to or initiating social interactions (Anderson et al., 2009; Bacon, Fein, Morris, Waterhouse, & Allen, 1998; Celani, Battacchi, & Arcidiacono, 1999).

Unfortunately, these difficulties with adaptive social skills can have a far-reaching negative impact for people with ASD. Barnard-Brak et al. (2014) found children with ASD have significantly poorer self-regulation and social interaction skills than peers diagnosed with an intellectual disability. Social isolation and bullying issues may also impact children with ASD (Chen, 2010). Other studies have shown that children with social skill deficits, unrelated to IQ, struggle academically and report poorer outcomes as adults (Anderson et al., 2009; Howlin, Goode, Hutton, & Rutter, 2004). As well, adults with ASD who continue to struggle with adaptive social skills may experience more psychiatric complications such as depression and anxiety (Bauminger & Kasari, 2000; Eaves & Ho, 2008; Muller, Schuler, & Yates, 2008). Conversely, greater successes with learning adaptive social skills have been related to more success as an adult including establishing friendships and living and working independently (Howlin et al., 2004). Therefore, interventions during childhood are critical to help people with ASD develop these adaptive social skills.

Play development. Researchers found that play can facilitate language development, increase cognitive skills, and provide opportunity for social interaction (Pierucci et al., 2015). However, children with ASD have impairments in the quality and sophistication of play (Baron-Cohen, 1987; Blanc, Adrien, Roux, & Barthelemy, 2005; Rutherford & Rogers, 2003) and they participate in less symbolic play, meaning they may not use toys in creative or pretend ways and instead participate in repetitive or stereotyped play (Tsao, 2008, Wolfberg, DeWitt, Young, & Nguyen, 2015). Thomas & Smith (2004) found children with ASD might lack social motivation, social understanding, and flexibility, which are key characteristics in the development of play skills. Children with ASD are also less able to participate in joint attention which impacts play skills such as turn taking, following directions, and even making eye contact (Tsao, 2008, Wolfberg et al., 2015).

Given these issues, it becomes clear that children with ASD experience specific impairments in play skills (Jarrold, 1997; Lewis, 2003; Tsao, 2008). Therefore, play therapy is often used as an intervention for children with ASD to support these areas (Goldstein & Cisar, 1992; Fox & Hanline, 1993; Ingersoll & Dvortsak, 2009; Stahmer, 1995l, Wolfberg et al., 2012; Wolfberg et al., 2015). “Interventions that focus on teaching play skills or using play as a meaningful context for social and language interventions could become an important and necessary part of an overall intervention program” (Tsao, 2008, p. 42). In fact, improving skills such as joint attention, turn taking, and imitation can have an impact on language and social development later in life (Dawson, Toth, Abbott, Osterling, Munson, Estes, & Liaw, 2004; Mundy, Sigman, & Kasari, 1990; Tsao, 2008).

Social and play development and education. Social inclusion is a core element of human rights recognized in multiple publications by the United Nations including the UN Convention on the Rights of the Child (United Nations, 1989), the UN Declaration on Human Rights (United Nations, 1948), and the UN Convention on the Rights of Persons with Disabilities (United Nations, 2006). In the United States, public schools must abide by the Individuals with Disabilities Education Improvement Act (IDEA) of 2004 that includes the requirement of providing the least restrictive educational environment (LRE) for students with disabilities. To promote the concept of social inclusion, the LRE can often be the general education classroom if students are provided with the appropriate supports (Leach & Duffy, 2009).

However, the benefits of inclusion are much debated. Previous research examining the effectiveness of a general education placement for children with ASD found that students in this placement showed increases in social engagement skills and built more friendships than students in special education exclusive environments (Fryxell & Kennedy, 1995; Hunt, Farron-Davis, Beckstead, Curtis, & Goetz, 1994). That said if teachers and TD peers are not provided with appropriate support, the developmental challenges that children with ASD face can become a barrier for success in the general education setting (Leach & Duffy, 2009). Students with ASD who participate in an inclusive setting are most successful with the following supports: highly structured environments, positive approaches to instruction and discipline, empathy from adults and peers, reduced sensory inputs, and consistency (Roberts, Beadle-Brown, & Youell, 2011).

Perhaps the downfall of many inclusion efforts is that although children with ASD receive instruction in a general education setting, they lack a connection to the classroom's social structure (Chamberlain et al., 2007; Kasari et al., 2011; Locke et al., 2012; Rotheram-Fuller, Kasari, Chamberlain, & Locke, 2010). As Sperry, Neitzel, & Engelhardt-Wells (2010) argued, being there is not enough. Therefore, it is imperative that TD peers play a role in creating inclusive social environments for children with ASD. Research shows that TD peers can have success connecting socially with children with ASD while maintaining a strong and positive role in the classroom (Locke et al., 2012). However, TD students are more likely to prefer interaction with TD peers if they have not received direct training on how to socially include students with ASD (Sperry et al., 2010).

Bullying and children with ASD. Bullying behaviors have garnered more attention in education and the media over the last several decades, and it has been well documented that students with disabilities, including ASD, are often targets of these behaviors (Able, Sreckovic, Schultz, Garwood, & Sherman, 2015; Chen, 2010; Kasari et al., 2011; Dybvik, 2004; Farlow, 1996; Fisher & Taylor, 2016; Fryxel & Kennedy, 1995; Harrower & Dunlap, 2001; Hauck et al., 1995; Horne et al., 2008; Lord & Hopkins, 1986; Odom & Strain, 1986; Odom & Watts, 1991; Zanolli, Daggett, & Adams, 1996). Wolfberg et al. (2012) found that from the earliest years, children with ASD are at risk from being excluded from essential peer play experiences. Sreckovic, Brunsting, and Able (2014) completed a meta-analysis of bullying issues in relation to children with ASD and found that most studies reported bullying issues across a monthly span. Results varied in reported frequency of bullying behaviors toward children with ASD with most studies reporting between 30%-77% of children with ASD had been bullied within the previous month as reported by teachers and the students themselves. Fisher and Taylor (2016) found that 22 of 30 interviewed participants with ASD reported having experienced bullying behaviors including verbal, physical, and relational victimization.

Not surprisingly, children with ASD are particularly vulnerable to bullying behaviors due to their social skill deficits (Sreckovic et al., 2014). Fisher and Taylor (2016) interviewed high school children with ASD about their perceptions on why they were bullied. Participants noted that their personal attributes, including interests and lack of shared interests, as well as lack of interaction with peers were potential reasons for the bullying behavior. Perhaps even more alarming is that Sreckovic et al. (2014) found that children with ASD who are the targets of bullying may experience deterioration of social skills or communication skills, sleep issues, self-injury, and loss of other developed skills such as self-care and control of aggressive tendencies. Given these serious concerns regarding the frequency and impact of bullying on children with ASD, it is critical to consider social skill interventions for children with ASD as well as training and supports for TD peers.

Social Skill Interventions for Children with ASD

Given the documented deficits in social skill development for children with ASD, it is critical to provide specialized support to target play interactions with TD peers. However, for a number of reasons, there have been few interventions investigated that focus on play, and specifically play with TD peers (Wolfberg, Bottema-Beutel, & DeWitt, 2012). Wolfberg and Schuler (2006) found the same lack of research and hypothesized the following:

> "Particularly when dealing with children whose behaviors defy developmental expectations, play is more likely to be viewed as a luxury only to be targeted when more basic deficiencies have been remedied. Moreover, the [field's] current emphasis on accountability, quantification and empirically validated programs may have inadvertently discouraged the pursuit of play in a broader developmental and cultural context" (p. 182).

That said, the research that exists shows that play-related activities have been found to be successful in building children’s social skills (Vaughn et al., 2003). The National Research Council (2001) found social, language, and symbolic play skills are the most common focuses of early intervention for children with ASD. For example, interventions designed to build joint attention skills are popular for children with ASD (Jones & Carr, 2004; Mundy & Crowson, 1997). Baker (2000) found that children with ASD were able to learn play skills such as joint attention when taught play behaviors based on thematic rituals or interests and were able to generalize their new skills to different settings. The type of intervention strategies used to teach new skills differs based on philosophy and the needs of the child with ASD. Discrete-trial training and facilitated play, discussed more below, are two interventions widely used to support play skills in children with ASD. As well, for students with ASD who are educated alongside TD peers, peer-training programs are an effective intervention to increase positive social supports and are also discussed in this section.

Discrete trial training (DTT). One of the most well-researched intervention strategies used to develop play skills is the DTT approach which has been successful in teaching early play skills such as object manipulation as well as more complex play themes (Cardinal et al., 2017; Lifter, Sulzer-Azaroff, Anderson, & Cowdery, 1993; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002). DTT involves teaching a person in simplified and structured steps in an effort to break down a skill into steps and then build it up using discrete trials to teach each step, one at a time (Smith, 2001). Researchers found that through DTT, children with ASD can learn and follow scripts, which help to improve their peer interactions.

Young, et al. (2016) completed two studies utilizing TD peers to deliver intervention via DTT. In the first study, six elementary aged TD children were trained to use DTT to support children with ASD on academic tasks. The study showed that the training for typical peers was effective in increasing integrity of the DTT protocol. In the second partner study, five of the six peer tutors used the DTT protocol to support children with ASD with whom they had no prior experience. The results showed that the peer tutors were able to generalize the DTT training and therefore, the children with ASD made rapid improvements in the target training areas. As a measure of social validity, Young et al. (2016) examined social engagement during unstructured times before and after the intervention and found substantial increases in duration of engagement. This pair of studies is significant in considering how peers may support children with ASD in academic tasks while also building opportunities for meaningful interaction.

Facilitated play and integrated playgroups. Tsao (2008) argued that, “the element of effective strategies for prompting social, language, and play skills of children with autism is to incorporate social, language, or communication skill training in play contexts involving TD peers within highly structured interactions" (p. 44). Facilitated play is one intervention that focuses on connecting children with disabilities such as ASD with TD peers. Facilitated play relies on the instruction of a trained facilitator and uses incidental teaching during multiple, more free form, play experiences (Soorya et al., 2015). Facilitated play has been found to produce gains in appropriate communication and play in children with ASD (Kok et al., 2002).

Facilitated play is similar in many ways to other forms of guided play therapy such as structured play and integrated playgroups, where trained adults guide children with ASD through play with TD peers (Wolfberg et al., 2012). These research-based interventions vary in details such as size of group and training provided to TD peers, but all rely on facilitated peer play as a method for improving play skills in children with ASD and in building understanding in TD children. Yang, Wolfberg, Wu, and Hwu (2003), studied the impact of integrated playgroups on two elementary-aged students in Taiwan. One playgroup took place at school and the other in a child's home and 17 to 21 group play sessions were analyzed. Researchers observed children's cognitive/symbolic and social dimensions of play using a single-subject A-B design. Findings indicated that the children with ASD made notable gains in social and symbolic play via the playgroup intervention. Parents also shared observations that their children with ASD were able to generalize the skills learned during the playgroups. As researchers study ways to integrate play for children with ASD and TD peers, they must also consider how to train these TD peers to increase understanding of ASD and how to effectively interact with and support peers with ASD.

Peer training. Many schools have attempted to identify ways to connect TD peers with students with ASD through formal training models. For example, Peer-mediated Instruction and Intervention Strategies (PMII) is a research-based approach designed to "systematically teach typically developing peers ways of successfully engaging children with ASD in positive social interactions" (Sperry et al., 2010, p. 256). PMII includes specific guidelines for the selection of appropriate TD peers, training and supporting the TD peers, implementing structured teaching sessions for TD peers, and implementing peer-mediated experiences in classrooms and other school settings as well as across the day for a child with ASD (Sperry et al., 2010). PMII and similar approaches are ways to scaffold social interaction between students with ASD and typical peers and are particularly important in the less structured portions of an elementary school day such as lunch and recess (Able et al., 2015).

Battaglia and Radley (2014) studied case examples of children with ASD who interacted with peers who volunteered to be trained in ways to support the children with ASD in social interactions and play. Case examples of two elementary-aged children with ASD showed, via observation and survey scales, that training for peers in initiating play with children with ASD and in accepting requests from children with ASD to play, were effective in increasing social engagement between children with ASD and TD peers. A common thread found throughout research on inclusion and peer buddy support strategies is the need for structure and training for the TD student in order to make an inclusive setting socially supportive for a student with ASD.

The Role of Technology in Play for Children with ASD

Given the wide array of strengths and challenges for children with ASD, and the influx of new methods and approaches, research has been integral in testing interventions and educational strategies. Technology-based interventions have garnered interest in many schools given the response and engagement of students with ASD when utilizing technology (Goldsmith & LeBlanc, 2004; Murray, 1997; Reffert, 2008). As technology advances, so do the opportunities to use technology to support the development of play and social skills for children with ASD.

Currently, the bulk of research relating to technology and students with ASD centers on academic instruction, functional skills, and behavioral supports. However, some research has begun to consider technology interventions in relation to play and social skill development. Prompting devices, video modeling, and CAI have all shown positive results for children with ASD (Goldsmith & LeBlanc, 2004) and are discussed in further detail below. For the most part, these interventions interject technology into traditional play settings, which is very different from looking at technology as a condition in which children play. That said, it is still useful to understand how technology has begun to be considered in supporting the play skills of students with ASD.

Tactile prompting. Tactile prompting was the earliest venture into examining the research behind using technology to advance play skills in students with ASD. Taylor and Levin (1998) found using a tactile prompt was successful in increasing verbal initiations for children with ASD as compared with no prompting or verbal prompting. The tactile prompt submitted a vibration after a preset interval to remind the student to initiate verbally. Shabani, et al. (2002) found some support for the use of tactile prompting to increase verbal initiations for children with ASD. This research helped to support the initial use of technology as a way to increase verbal interaction during play with peers.

Video modeling. The use of video technology is widely accepted as effective for students with ASD across multiple settings and domains (Becker & Watry-Christian, 2016; Cardinal et al., 2017; Goldsmith & LeBlanc, 2004; Sturmey, 2003). In fact, in January 2003, the *Journal of Positive Behaviors Interventions* dedicated a special issue to the use of video with students with ASD. Video modeling has been used in academic instruction, as a behavioral support for students, and has also been studied as an intervention to teach play and social skills (Boudreau &

D'Entremont, 2010; D'Ateno, Mangiapanello, & Taylor, 2003; Goldsmith & LeBlanc, 2004). Video modeling has been found to be immediately effective in teaching play skills by modeling expected and appropriate actions for students (Boudreau & D'Entremont, 2010; D'Ateno et al., 2003).

Boudreau & D'Entremont (2010) researched the use of video modeling to increase play skills with four-year old boys with ASD. In this study, the children watched video models of an adult playing with a toy set and showed increases in modeled actions and scripted verbalizations as a result of the intervention. Maione & Mirenda (2006) studied the impact of video modeling and video feedback as a social language intervention for a five-year old child with ASD. They found that video modeling was effective in increasing social language with a TD peer in two of three play activities. Social language, both scripted and unscripted, was increased in the third play activity with the use of video feedback and prompting. Kimball, Kinney, Taylor, & Stromer (2004) found that the combination of technology-based activity schedules and video modeling were effective in building social skills, such as play initiation. Students were successful in following their interactive activity schedules, which were supplemented with video models of desired social behaviors such as play initiation.

Computer aided instruction. Computer aided instruction (CAI) also has a wealth of research supporting its effectiveness (Gal, Bauminger, Goren-Bar, Pianesi, Stock, Zancanaro, & Weiss, 2009; Goldsmith & LeBlanc, 2004; Hansen, 2015). CAI is a broad-reaching category that can include the use of software tools, graphics and simulations to teach skills (Hansen, 2015). Early research raised concerns about the use of CAI with children with ASD due to potential social withdrawal and encouragement of repetitive or compulsive behaviors (Bernard-Optiz, Sriram, & Nakhoda-Sapuan, 2001). However, CAI environments can be a useful tool in supporting social skills development for children with ASD (Herrera, Plasencia, Labajo, Jordan, & de Pablo, 2004; Parsons, Mitchell, & Leonard, 2005; Piper, O'Brien, Ringel, & Winograd, 2006; Revel, Nadel, Maurer, & Canet, 2002; Silver & Oakes, 2001). As well, continued advancements in computer technology have demanded additional research on CAI as an effective intervention.

Gal et al. (2009) conducted a study about the use of CAI, in this case the use of a co-located touch table interface, to facilitate collaboration and social interaction between students with high functioning ASD. Students were paired and asked to collaborate to narrate a story through the use of an interactive StoryTable system to test the enforced collaboration theory. Gal et al. (2009) found students with ASD were more likely to initiate positive social interaction with peers after the StoryTable intervention and that their levels of shared play increased.

Bauminger-Zively, Eded, Zancanaro, Weiss and Gal (2013) completed a study with 22 children with ASD on the impact of two computer programs to teach collaboration and social conversation. Using a variety of measurement tools such as a dyadic drawing task, the researchers found that the programs helped children with ASD improve in the socio-cognitive area particularly in finding solutions to social problems and a more appropriate understanding of collaboration and social conversation.

Ben-Sasson et al. (2012) found positive results in increasing the frequency of positive social interaction and collaborative play for six dyads of children with ASD when using an "enforced collaboration" mode of a virtual puzzle game. The enforced collaboration required the dyads to move puzzle pieces together and was found to be more effective than the free play mode that allowed children to move pieces independently.

Additional research is currently exploring the use of a range of technologies to support social skill interventions for children with ASD. For example, Kim et al. (2013) completed a study that examined social behaviors of 24 children with ASD between the ages of four and 12 in triadic groups including an adult, the child, and either a robot or touchscreen video game. The study showed that that children spoke as much with the robots as with the adults, and more than toward the video game. These findings may indicate the potential for use of "social robots" as an intervention for children with ASD.

Kinsella, Chow and Kushki (2017) reviewed the use of a Google glass application called Holli, a wearable technology that serves as a social skills coach to children with ASD by listening to conversations and prompting the user with socially appropriate responses. Fifteen children (average age of 12) were able to utilize the prompts in a 10-turn interaction with a researcher while engaged in a conversation at a restaurant. Although this type of new interface requires more research, this study shows the potential promise of technology to support peer-to-peer interaction. This body of new research including robotics and wearable technology is promising when considering the use of a variety of technologies to facilitate the development of play skills for children with ASD.

However, considering how technology can be used as an intervention is markedly different than considering how play behaviors may naturally change for children with ASD in a technology-based condition. As discussed in the next section, one newer approach, the use of video game technology, often considered a subset of CAI, may also provide promising avenues for research in this area, namely because it does not consider technology as an individual intervention, but instead as a typical environment in which children play with one another.

The Rise of Video Gaming

Research addressing video gaming in early education for TD students began to surface in the early 2000s when game-based learning environments began finding their way into K-12 education. Studies found many advantages of these environments for TD students (Gee, 2007; Greenfield, 2010). Gaming in education promotes higher-order thinking skills and improved social skills (Dondlinger, 2007; Steinkuehler & Duncan, 2008). As well, gaming can increase interactivity, engagement, and motivation, as well as the opportunity for deep immersion in problems and scenarios, and the creation of three-dimensional learning spaces (Barab et al., 2010; DeKanter, 2005; Gee, 2003). Video gaming is finding a foothold in education as gaming systems become more interactive, physical, and collaborative (Cohen, 2011; Saez-Lopez, Miller, Vazquez-Cano, & Dominguez-Garrido, 2015).

While schools are experimenting with technology interventions to support students with ASD, gaming as an educational tool for TD students is also gaining traction (Connolly, Boyle, Hainey, McArthur, & Boyle, 2012; Durkin, Boyle, Hunter, & Conti-Ramsden, 2013; Griffiths, 2002; Rosas, Nussbaum, Cumsille, Marianov, Correa, Flores, & Salinas, 2003; Saez-Lopez et al., 2015; Squire, 2006; Subrahmanyam, Greenfield, Kraut, & Gross, 2001). Some schools adopted elements of gaming into their instruction, and others, such as Quest to Learn in New York, have gone as far as using gaming theory to define their core curricula (http://www.q2l.org/; Cohen, 2011). With the rise of the gaming movement in education, it is important to consider the early research on how gaming impacts students with ASD.

Video games in schools. Interactive video games such as the Nintendo Wii have begun to be used in classrooms for a variety of purposes. Hawkins (2009) found schools have incorporated the Wii into physical education classrooms to encourage more physical activity at school. The Wii is a motion-sensing platform that allows users to display movements that correspond with a typical activity (e.g., bowling or golf). The Wii can provide physical activity for students who use the platform in the classroom and can also provide cognitive engagement for students via Nintendo's Big Brain Academy (Maldonado, 2010). Research on kinetic video games, such as the XBox Kinect, found that competition within these types of games improves children's psychological responses (affect and rate of perceived exertion) compared with single player games (Lisón et al., 2015).

The Wii has also found a home in Music classes, in use with English Learners (EL) students, and in relation to social studies and science content with games such as *Endless Oceans* and *Age of Empires II; The Age of Kings* (Maguth, List, & Wunderle, 2014; Maldonado, 2010). The Wii may also provide scaffolding for students in a differentiated and engaging way, and specifically by embedding social language and interactive responses into game play (Maguth et al., 2014; Maldonado, 2010).

Platforms such as the XBox Kinect motion-sensing system mirror the functionality of the Wii and are picking up steam in education. For example, the Steuart W. Weller Elementary School in Ashburn, VA has been profiled by many media outlets including *USA Today*, to share their use of the XBox Kinect platform specifically to support the social interaction of students with ASD. A teacher, Lynn Keenan, who is involved in the project in Ashburn, shared the following (Faur, 2014):

> "Communicating with each other, giving each other directions, giving compliments... I can teach social skills and communication with board games and with other games but the students are so much more motivated to take part in games like this, and with games like the Kinect we get a lot more out of them" (p. 1).

Researchers highlight concerns around video games specifically, including addiction issues, aggression, heath issues, and lowered school performance (Blunt, 2007; Ferguson, 2010; Young et al., 2012). However, enough research exists to support the potential positive benefits of gaming in education for school districts and educational researchers to take notice.

Video games and ASD. Unfortunately, despite promising leads in mainstream media, little scholarly research exists on the use or impact of video games on students with special education needs (Ceranoglu, 2010). Durkin et al. (2013) reviewed the emerging literature on the use of gaming for students with special education needs and found many concerns, including accessibility, particularly as games become more complicated and detailed with increasing amounts of information to navigate. As well, video games often require logic, knowledge of cause and effect relationships, and navigation skills which may be difficult for students with an intellectual disability (Durkin et al., 2013). However, some children with ASD may also have particular strengths in the areas of logic and game navigation, allowing them to effectively play a video game (Durkin et al., 2013).

Students with ASD may also interact differently with video games than children with other disabilities, given their established preference for technology (Durkin, 2010; Griffiths, 2002; Kee, 2009; Ploog, Banerjee, & Brooks, 2009). For example, Ploog et al. (2009) found children with ASD are more attuned to prosodic and linguistic parts of speech while interacting with a video game, while their TD peers were solely focused on the linguistic aspects. This may indicate children with ASD are able to process more details, which would potentially allow them to more successfully interact with video games. As well, Durkin (2010) found children with ASD may be more drawn to video game elements given their characteristic focus and attention on preferred activities. They may find interest and motivation in amassing information about specific video game environments and characters.

Finke et al. (2015) published a study examining the behaviors of children with ASD and their use of video games, as well as parental views on video game play. They found children with ASD play video games, but the time, type, and intensity of play did not relate to the severity of a child's ASD symptoms. They also found parents, overall, supported video game play for their children with ASD and that some believed that video game play had a positive impact on their child's development. Indeed, children with ASD are "strongly attracted to screen-based entertainment, including virtual reality displays and video games" (Durkin et al., 2013 p. 81).

Summary and Implications

Technology is changing rapidly and, as it does, it provides more potential opportunity for interaction through play. Single-player, non-interactive video games have morphed into online worlds of multi-player interactivity promoting goal setting, collaboration, and other prosocial behaviors traditionally not associated with video games. In aiming to better understand how students' social behaviors might adapt to a technology-rich play condition, this study provides a first step into the consideration of technology, and video games specifically, as an effective strategy for facilitating positive social interaction between children with ASD and TD peers.

The literature cited above outlines an important pattern. Children with ASD have challenges with social skill and play development and that interventions can potentially support those deficits (Baker, 2000; Jones & Carr, 2004; Mundy & Crowson, 1997). It has also been established that technology has been successful in interventions for children with ASD in other deficit areas and that technology, and gaming specifically, are being adopted into the mainstream of education (Goldsmith & LeBlanc, 2004; Murray, 1997; Reffert, 2008). Therefore, it is important, and the goal of this study, to understand if technology, specifically kinetic technology play, promotes more positive social interactions for students with ASD and TD peers as compared with traditional play such as recess and adult-facilitated play. Additionally, the type of positive social interactions that occur between peers may provide more insight into potential social benefits of kinetic technology play as compared with recess and adult-facilitated play.

If we can determine a play structure or activity that is more conducive for students with ASD to engage positively with typical peers, and that typical peers also find engaging, without the constant support of an adult to facilitate the interaction, we can potentially address some of the concerns regarding inclusion. Students with ASD who can positively engage in play with TD peers could potentially build more social support and establish more friendships. As more children are being diagnosed with ASD and being educated in general education environments, more focus needs to be placed on how to support social interactions with TD peers in ways that benefit all students. Technology, and video gaming specifically, may be this type of resource.

Therefore, as stated previously, the purpose of this study is to better understand the potential benefits of video game play in increasing positive social interactions between students with ASD and TD peers as compared with another common intervention, facilitated recess, and as compared with traditional recess. The study considers the interactions between pairs of children with ASD and TD peer buddies as they engage in play during traditional recess, facilitated play, and kinetic technology play using an XBox Kinect system, a motion-sensing input device that allows players to use their bodies to navigate games, as opposed to a traditional controller. The following chapter will provide specific detail on the design and research methods.

METHODS

This single-subject study addresses the following questions: (a) Which play condition (traditional recess, facilitated play, or kinetic technology play) is most effective in eliciting positive social interactions for students with ASD and TD peers, and (b) Which play condition do students with ASD and their TD peers report as being most enjoyable?

Pilot Study

To inform the planning for this research, a pilot study was conducted from January 25-February 4, 2016 at Easton Elementary (pseudonym), the site of the dissertation study. One third-grade male student with ASD and one teacher-nominated third-grade male peer buddy participated in the pilot study. Students met for three sessions during the first week to play board games (proxy for a more structured play setting) and the second week to play video games on the XBox Kinect. Students met for approximately 15 minutes per session and sessions occurred in the special education classroom of the student with ASD. Parental permission was granted for each child to participate and each child gave his verbal assent to participate. A social story was provided to the child with ASD to prepare him for the change in his daily schedule due to participation in the study. I coded samples of the pilot sessions using a previously published coding framework, adapted, called the Friendship Observation Scale (FOS) and found the following initial results (Bauminger et al., 2008).

Sessions one through three of the pilot study focused on board game play. Results for one coded session showed four instances of cooperative play, 19 incidents of prosocial behaviors, five incidents of non-verbal behaviors, and no incidents of positive affect for the child with ASD. Most of the time in this session was spent in collaborative play. The child with ASD was attentive to the game and took turns but did not always follow the rules of the game. The pair also showed an average level of fun/enjoyment interacting with one another.

Sessions four through six of the pilot study focused on kinetic technology play. As an example, results for one coded session of kinetic technology play showed one instance of cooperative play, seven instances of prosocial behaviors, no incidents of non-verbal behaviors, and 13 incidents of positive affect for the child with ASD. Like the coded board game session, most of the time in this session was also spent in collaborative play. The child with ASD was very attentive to the game and took turns, including waiting/watching for approximately four minutes while his peer took a turn in the game.

The pilot study results showed a potential difference in the two conditions particularly in the area of affect where the kinetic technology play elicited a higher number of smiles, laughter, and joint laughter (13 instances compared with zero in the board game play). In the prosocial behaviors category, board game play elicited a higher number of responses by the child with ASD to help offered by his peer (19 instances compared with seven in kinetic technology play). Although accepting help is a desirable positive social behavior, this may also be interpreted as the child with ASD needing more prompting to stay on task in the board game play. Both sessions elicited the same type of collaborative play, but the level of fun/engagement was perceived to be higher when the students were interacting with the kinetic technology play condition. Anecdotally, the child with ASD engaged in less scripting/repetitive talk during the kinetic technology play sessions than he did during the board game sessions.

The pilot study was integral to informing the design of this study. Primarily, it provided informal data that supported an initial hypothesis that the kinetic technology play condition may promote different social interactions for students than other play conditions. It also provided insight into the constraints of using a scale designed to measure broader peer interactions (the FOS) and led to additional research and considerations for narrowing the scope of this research to the ultimately defined variable of positive social interactions and to use a present/not present coding structure. The pilot study also informed the procedures developed for this research, including the following:

- It is important to train *all* students on the games to avoid confusion with the game rules.
- Training for TD peers needs to address ways in which peers can model and encourage appropriate social interaction with peers with ASD (e.g., if peer with ASD initiates conversation unrelated to game, it is appropriate to engage in that conversation).
- It is important to ensure that the XBox is set up and ready for play prior to the session starting (e.g., students will not take time to create avatars or navigate the other options such as online chatting).
- When training coders, it is important to develop a coding rule to avoid confusion around delayed echolalia, also known as “scripting”, by the child with ASD. Scripting is the repetition of verbal messages previously heard by someone with ASD, and which he or she repeats after a time delay. For many people with ASD, scripting involves the repetition of words from previously viewed videos, TV shows, games, or books (Kim, 2012). For example, during one session in the pilot study, the child with ASD repeated, “Bye Gordo. Uhhh, Thomas! You can’t catch me” multiple times. This type of scripting should not be included in coding for positive social interactions, even if it appears that the child is repeating a positive message to a peer (e.g., “Hello, let’s play.).

- It is important to position the recording device in such a way that the facial expressions of the child with ASD are easily seen. Lighting in the room is also important to ensure good recording quality.

Research Design

This single-subject design study alternated three play conditions. Four pairs of students participated, each including one student with ASD and a TD peer. Students were paired for the duration of the study. Single-subject designs are widely accepted as an appropriate approach when studying the behaviors of students with disabilities, and particularly those with ASD, because they allow researchers to show causality in a smaller sample and help to establish evidence-based practices (Barlow & Hayes, 1979; Barlow & Hersen, 1984; Creswell, 2009; Gillis & Butler, 2007; Horner, Carr, Halle, McGee, Odom & Wolery, 2005; Kratochwill & Levin, 1992; Sindelar, Rosenberg & Wilson, 1985). Within single-subject designs, individuals or small groups of participants are selected and findings are replicated across others (Gillis & Butler, 2007). This design allows a research to document relationships between independent and dependent variables by considering performance of subjects prior to intervention and during or after an intervention (Horner et al., 2005). Many single-subject designs employ the use of a baseline or no treatment condition as a comparison for the treatment or intervention conditions (Horner et al., 2005).

The adapted alternating treatment design (AATD) is a form of single-subject research, adapted from Barlow and Hayes' (1979) alternating treatment design. In AATD, researchers can demonstrate functional control of the dependent variable, positive social interaction, by extending the baseline/no-treatment condition, traditional recess, while implementing treatment conditions (Sindelar et al., 1985). The baseline or no treatment phase was compared with the change in dependent variable within the two experimental conditions (Sindelar et al., 1985). The AATD is particularly useful when researchers do not expect participant behaviors to return to baseline conditions, or reversal, following intervention. For this study, the adapted alternating treatment design allowed for the evaluation of the relationship between each play condition and positive social interactions between the child with ASD and his TD peer buddy.

In this study, the baseline phase was omitted because the baseline/no treatment sessions were randomly interspersed within the design, which allowed comparisons between the baseline/no treatment sessions and the treatment conditions throughout the study (Barlow & Hayes, 1979). Although it is common with alternating treatment designs to conclude with several sessions of a best treatment to ascertain durability of treatment effects, this study was limited by the school schedule as previously mentioned. Students transitioned out of their pairs following the duration of the Community Builders session and continuing a best treatment phase would have required an adaptation to the pairing system for the upcoming session. Lack of a best treatment structure is a clear limitation of this research and is addressed in the limitations section.

The two treatment conditions, facilitated play and kinetic technology play, were chosen to demonstrate alternative possibilities to traditional recess, the baseline or no treatment condition. The kinetic technology play and typical recess conditions were presented randomly to reduce any potential for carryover effects or confounding variables. The facilitated recess condition followed the school's typical schedule for offering facilitated play, meeting once every other week on Tuesdays or Wednesdays. Data were collected over three months with the aim of collecting five video samples for each pair in each condition. Pair C had multiple absences and therefore, only had four samples collected in the facilitated play condition. Due to video upload malfunctions, two additional videos were lost, leaving Pair B with four samples in the facilitated play condition and Pair C with four samples in the kinetic technology play condition. Four sessions of traditional recess were not included in the analysis because they took place indoors due to weather. This left Pairs A and B with four sessions of recess and Pair D with three. Barlow & Hayes (1979) suggest the need for three to five samples of conditions to be able to interpret preliminary data on the efficacy of an intervention.

Condition Descriptions

Recess. Collecting data on a no treatment condition of typical recess interactions allowed me to contrast both treatments with what students experience in a typical inclusion setting. During the traditional recess condition, students played according to the typical recess procedures used by the school including playing freely on the playground equipment, blacktop area, or fields. Students were directed by the person recording the session to play together for the duration of the recess, approximately 25 minutes and were told that it was acceptable to play with additional children, but that the pair needed to stay together. Although students were directed to play together which is a change from typical recess, the environment was not changed and, therefore, this condition was considered to be no treatment. In the event of inclement weather, the school moves children inside for indoor recess and they play board games or build with blocks or Legos in the school hallways. Due to weather, four of the 20 recess sessions were recorded during indoor recess time. These sessions were excluded from the research findings due to the differences in play between traditional outdoor recess and inside recess activities such as board game play and building games.

Facilitated play. Facilitated play is also known as “Community Builders” within the school. Community Builders is organized by the school’s two licensed Social Workers, two special education teachers trained in working with children with ASD, and one general education teacher who serves as one of the "buddy classes" for two of the participants with ASD. This group designs collaborative games and activities that involve all students in the school's special education programs, and volunteer buddies from the same-aged TD peer population. Activities for the sessions included: (a) people facts scavenger hunt—identifying people in the group who fit various characteristics on a paper; (b) team relay races in the gym; (c) craft design—directed design of a snowman using construction paper, scissors, and glue; (d) Giant Jenga game in groups of six to ten students; (e) collaborative artwork—painting various squares on the same large paper. One additional Community Builders session took place during the research that involved technology based play with the iPads. Due to multiple participant absences and some technical difficulties with the iPads, the recordings for this session were excluded from the data.

Kinetic technology play. The second treatment condition involved using technology in the form of a video game system that required movement. Multiple systems exist that require players to use their bodies to move avatars within the game. The element of movement was critical in this research to better align with the movement associated with traditional recess and to eliminate the learning associated with the use of a video game controller. For this research, the XBox Kinect game console, with motion-sensing technology, was used. In this study, pairs were invited to play an XBox game together during a 25-minute session. The XBox Kinect was set up in a location known to the students; one was set up in the school's sensory room and the other in one of the special education classrooms across the hall. Students were directed to choose from one of the games within XBox Kinect's Adventure game series. These choices included the following: *20,000 Leaks*; *River Rush*; *Rally Ball*; *Reflex Ridge*; and *Space Pop*. Each game was dual-player and involved using the students' bodies to move the bodies of the avatars in the games. For example, in *20,000 Leaks*, participants were required to lean and bend, moving arms and legs to plug “leaks” on a submarine. River Rush required participants to co-navigate a raft by leaning and jumping to follow a river course with obstacles. Students were directed to play together from the list of game options for the entire session.

Timeline

The timeline for this research followed the school’s schedule for the Community Builders, or facilitated play program. Sessions for this program ran from November 1, 2016 through January 24th 2017 and were held every other week with the exception of school holidays. Sessions for the Kinetic Technology Play and Recess conditions were held during this same timeline to avoid confounding variables such as difference in TD buddy and student growth over time in social abilities, communication skills, etc. This timeline was limited by the school’s procedure of assigning new buddies for each new Community Builders session. Therefore, all sessions involving the pairs in this research took place during this specific session of Community Builders.

The lunch recess period for students at the school is 25 minutes each day. Therefore, play sessions were recorded with the goal of achieving 20 minutes of play allowing for time for participants to arrive to the appropriate location and for the students and recorders to locate one another and begin the recording process. All recorded sessions used in the research spanned between 17.5 and 20 minutes due to the timing of student arrival to the play location. Two sessions were recorded but fell under 10 minutes of playtime due to a student forgetting his or her participation on that day. Recordings of these sessions were not analyzed.

Participants

Site information. This study occurred in an elementary school, Easton Elementary, a K-5 school in suburban Chicago, IL that includes a population of approximately 500 students, 47 of who are educated in specialized programs to support students with more extensive special education needs. The school district that houses Easton Elementary serves students in a town of about 75,000 residents educating just over 5,000 students. The school district's population includes three percent low-income students, 15 percent students with disabilities, and nine percent students who are English learners. The district spends approximately $12,000 per pupil per year and employs 380 full-time teachers across its seven elementary schools (K-5) and two middle schools (6-8). One elementary school also houses an early childhood center designed to provide early intervention for students with disabilities.

This is a high-achieving district according to IL state testing, with 68% of students meeting or exceeding standards on the new PARCC test, compared with the state average of 33%. The district provides three instructional programs for elementary-aged students with special education needs. One is focused on students with behavioral needs and is housed at another of the K-5 elementary schools. The other two instructional programs are housed at Easton Elementary. As the names of the instructional programs are unique to the school and district, pseudonyms have been used for the names of the programs to help avoid identification of the school and students.

Easton Elementary provides educational support for students with a range of disabilities through these two academic-based instructional programs that serve children across the district. The Base program (pseudonym) serves students who are two to three years behind grade level and need a more structured approach to instruction including repetition, a slower pace, and review of fundamental academic skills. Students in the Base program have a variety of disabilities including Specific Learning Disabilities, Traumatic Brain Injuries, Intellectual Disabilities, and ASD. Classes are typically six to 12 students with a teacher/teaching assistant to student ratio of 1:2. Easton Elementary hosts three Base classrooms (Kindergarten/first, second/third, fourth/fifth). One of the fifth grade participants in this study, Brandon (pseudonym) came from the Base program.

The second instructional program, Engage (pseudonym), provides structured, individualized support for students with instructional needs related to their receptive and expressive communication abilities. Students in this program have a wide range of academic abilities from two to three years behind grade level to at or above grade level. Typically, their behaviors and sensory needs require more specialized support than can be found in a general education setting. Therefore, the Engage classrooms, of which Easton Elementary has three (first, second, third/fourth/fifth), have a teacher/teaching assistant to student ratio of close to 1:1. Students have specifically designed sensory supports to provide opportunities for regulation and input throughout the day. They have structured schedules, and teachers use research-based methods of instruction including visual supports, video modeling, hands-on activities, and integrated speech therapy. Several students in this program also utilize an augmentative communication device with programs such as Proloquo2Go or LAMP. These programs are used with a technology device such as an iPad and allow students to choose picture cues of things they want to communicate. The device then reads the word the child has selected. Most students in the Engage program were verbal. Three participants in the study, both 2nd graders, Carl and David (pseudonyms) and the other 5th grader, Alex (pseudonym), came from the Engage program.

All students in both the Base and Engage classrooms are paired with a buddy class from the general education population at their grade levels. They join those students for Specials classes such as Art, Music, and Physical Education (PE). They also join the general education classroom for content-based instruction such as Social Studies and Science activities as much as is appropriate for their ability levels and Individualized Education Plan (IEP) goals. Students in these programs also receive support from a variety of related service providers including Social Work, Speech Language Therapy, Occupational Therapy, Physical Therapy, Adaptive PE, and behavioral support from the Psychologist. Easton Elementary also coordinates with the local special education cooperative, of which the district is a member, to provide additional support through an Autism Coach, parent support, and teacher training.

Teachers hired for the Engage and Base programs maintain specialized certification and have experience working with students with ASD. The district and school support teachers in utilizing a variety of interventions to support students' academic, functional, and social skill development. The teacher in the third through fifth grade Engage classroom holds a Master's degree and has worked at Easton Elementary for three years. The teacher in the 2nd grade Engage classroom holds a Master's degree and has worked at Easton Elementary for six years and was involved in the creation of the program at the District level. The current teacher in the 4th-5th grade Base classroom holds a Bachelor's degree and this is her first year working at Easton Elementary. On the current academic year evaluations, the Engage teachers received an excellent rating. At the time of this research, the new Base teacher had not yet been evaluated.

Children across Easton Elementary, including those in the specialized programs, were exposed to a variety of technology on a daily basis. All classrooms were equipped with interactive whiteboards, document cameras, multiple iPads, desktops, and laptops. One teacher in the specialized programs experimented with using the Nintendo Wii video game system for "brain breaks" with students, using the dancing game and sports games associated with the system. A Technology Facilitator and a Building Support Technician supported teachers at Easton Elementary by responding to technology troubleshooting issues, adding requested apps, and providing training on new technologies for teachers. Therefore, the participants in the study had at least a beginning exposure to a variety of technologies.

Information for participants with ASD. In an effort to provide consistency across the sample, several parameters were used as criteria for selecting participants. All participants had an IEP with the primary eligibility for services listed as Autism and were drawn from the Base or Engage programs. Participation in these programs indicated a more moderate to severe form of ASD as compared with students with ASD who may be able to be successful in a full inclusion general education setting. Although some participants had an augmentative communication device, all had the ability to communicate verbally. Participants were second or fifth graders, and were therefore between seven and 11 years old. All participants had a history of regular participation (at least five 30-minute sessions weekly) with their general education buddy classes (*i.e.,* Art, Music, PE, Social Studies, Science, and Library). At Easton Elementary, twelve students met the above criteria. Parents were sent a letter to solicit interest. I accepted the first four students from the Base and Engage programs who returned their signed parental consent forms.

Information for TD participants. Peer buddies were familiar to the children with ASD as they were drawn from classrooms with which the student with ASD consistently interacts, also known as his or her “buddy class.” Typical peer buddies were selected from a group of approximately 40 volunteers using a teacher survey designed to highlight students with characteristics shown to be effective for peer buddies including the following: prosocial leadership, positive views about people with disabilities, and same age and gender (Jackson & Campbell, 2009). General education buddy teachers at the school were asked to nominate three exemplar peer buddies, including one best peer buddy, as well as three students who would not be recommended to serve as a peer buddy. This feedback ensured that positive peer buddies were chosen for the study (Jackson & Campbell, 2009). Teachers responded to the above questions via a GoogleForm survey (see Appendix A). Peer buddies for this study were drawn from the pool of volunteers from the established general education buddy classes of the children with ASD and cross-referenced with those students who were highlighted by teachers as ideal peer buddies. All peer buddies selected for this study were included on their teacher's feedback form as being one of the exemplar peer buddy options. If multiple students volunteered and were noted by their teacher as an exemplar peer buddy, I chose the volunteer who turned in his or her participation form first.

After students with ASD were selected for participation, they were paired with the TD peer from their existing buddy class with whom they have had previous interaction. All participants provided verbal assent for their participation in the study. More specific details regarding the participants (utilizing pseudonyms throughout the paper) are discussed below.

- "Alex", Pair A, Child with ASD: 5th grade, (10 years old)
- "Alvin", Pair A, TD peer: 5th grade, (11 years old)
- "Brandon", Pair B, Child with ASD: 5th grade, (10 years old)
- "Brenda", Pair B, TD peer: 5th grade, (11 years old)
- "Carl", Pair C, Child with ASD: 2nd grade, (7 years old)
- "Cara", Pair C, TD peer: 2nd grade, (7 years old)
- "David", Pair D, Child with ASD: 2nd grade, (7 years old)
- "Donna", Pair D, TD peer: 2nd grade, (7 years old)

Following participant selection, I facilitated a 30-minute small group training session for peer buddies highlighting effective strategies for being a peer buddy using the PMII model discussed in the literature review. The "peer initiation training" portion of the PMII model focused on teaching peers how to socially initiate an interaction with a child with ASD and how to appropriately respond to the peer with ASD when he or she initiates an interaction. Per the PMII model, the training for typical peers addressed the following areas (Odom & Strain, 1986; Odom & Watts, 1991):

- How to recognize and appreciate individual differences (likes, dislikes, needs, abilities)
- Overview of similarities and differences of characteristics of children with ASD
- Initiation strategies in play settings including how to organize play, make suggestions, and share
- How to provide assistance to the peer with ASD
- How to provide appropriate affection and praise

Each of the selected peer buddies had previously participated as a buddy throughout their classrooms and during "Community Builders." Therefore, the peer initiation training was a refresher of previously shared material.

Measures

The measures in this study focused on the positive social interactions between the student with ASD and his TD peer buddy. The dependent variable, positive social interaction, was evaluated by recording each play session and using partial interval coding, every 20 seconds, to determine if a positive social interaction had occurred on the part of the child with ASD, the TD peer buddy, or both. Play sessions were 17.5 to 20 minutes long and although there is no accepted guideline for a specific partial interval length, the choice to use 20-second intervals was informed by the pilot study. Given the shorter duration of many positive social interactions (e.g., high five, laughter, comment), a shorter interval was preferable. Breaking the coding into 20-second intervals allowed for approximately 60 possible opportunities during a play experience where a social interaction could occur. Using the frequency-ratio approach to calculate the number of positive social interactions noted during these 60 intervals is appropriate because the research questions address frequency of behaviors observed during a session and do not require a deeper level of understanding about exactly when the behaviors occurred. Given the difference in length of recorded sessions (between 17.5-20 minutes), I reported results as a percentage of intervals for each session rather than total number of intervals per session.

I also provided a measure of effect size using Tau-*U*. Although most researchers agree that visual analysis is the most appropriate way to analyze data within single subject designs, the calculation of effect sizes adds confidence to conclusions about differences among treatments (Allison & Gorman, 1993; Rakap, 2016). However, there exists widespread disagreement about the appropriate way to determine effect size for single case studies. There are multiple ways to compute effect size (e.g., Tau-U, PND, SMD, IRD, etc.), however, appropriate procedures for calculating effect size are also in part based upon the type of single case design (e.g., ABAB, multiple-baseline, etc.) (Allison & Gorman, 1993; Lenz, 2013; Parker, Vannest & Brown, 2009; Parker, Vannest & Davis, 2011; Rakap, 2016). Tau-*U* is the percentage of nonoverlap between phases or the percentage of data that show improvement between two phases or interventions (Rakap, 2016). Tau-*U* scores range from 0% to 100% and can be interpreted using the following assessment: 65% or lower: weak or small effect; between 66% and 92%: medium to high effect; and 93% to 100%: large or strong effect (Parker & Vannest, 2009). In this research, the Tau-*U* effect size calculation was appropriate because Tau-*U* combines non-overlap between phases with the trend data from within the intervention phase (Vannest & Davis, 2011). Unfortunately, as an index, Tau-*U* calculations require the use of a statistical package. I have used Vannest et al.'s (2011) web-base calculator for Tau-*U,* which can be found at www.singlecaseresearch.org/calculators/tau-u.

For the purposes of this research, the variable *positive social interaction* includes social initiations or positive social behaviors that begin an interaction with a peer and responses to a peer's social initiations (Davis, Langone, & Malone, 1996; Owen-DeSchryver, Carr, Cale & Blakeley-Smith, 2008). Bauminger et al.'s (2005) previously referenced FOS, and other studies that used an adapted version (Ben-Sasson, Lamash, & Gal, 2012), also helped to inform the definition of positive social interaction including example definitions of the following: (a) affection (shows affection verbally or non-verbally); (b) help (responsive to help from a peer such as redirecting behavior based on a peer suggestion); (c) compromise (shared discussion including at least one verbalization by each participant); and (d) non-verbal behaviors (eye contact, smile, shared laughter). Based upon the previously established definitions of prosocial behaviors as a foundation, in this study, positive social interactions may include greetings, statements, praise, conversation, questions, and gestures. The table below provides more specific details on the positive social interaction variable as defined for this study including example and non-example behaviors.

Table 1. *Description of Dependent Variable: Positive Social Interaction*

Definition	*Examples*	*Non-examples*
The percentage of intervals where the participant has positive social interactions with his or her peer. This includes any greeting, statement, praise, ongoing conversation, question, laughter, etc. This also includes positive gestures such as a high five, hug, handshake, etc. that participants make to their peers.	**Affection:** • Initiates or responds to high five or hug • Shares affection verbally **Help:** • Requests or offers help with a portion of the activity • Encourages peer to take part in the activity • Says peer's name in an attempt to engage him/her in the activity or gain his/her attention • Follows directions given by a peer to engage in the activity (e.g., if the child jumps when directed to jump or moves backwards when directed by peer) **Compromise:** • Answers a peer's question with an on-topic response or discusses the activity with peer in a positive way **Non-verbal Behaviors:** • Shows positive emotion such as smiling or laughter in relation to peer or the activity	**Affection:** • Ignores peer's greeting **Help:** • Does not respond to peer's question or statement • Declines to follow peer's prompts in relation to the play activity **Compromise:** • Engages in verbal "scripting" of unrelated topics • Argues with peer **Non-Verbal Behaviors:** • Plays alongside peer without interacting or completes activity with peer without interacting • Leaves the play area where the peer is

Note: Behaviors must only relate to peer buddies, not others with whom the children may interact during play.

In single-subject design, a traditional method for measuring the social validity of the outcomes of an intervention is subjective evaluation through the use of questionnaires (Kennedy, 2005). In this research, I used a five-question survey to determine which play condition was preferred by the participants. Questions included the following:

1. Which play environment was the most fun (recess, Community Builders, XBox play)? Why?
2. Which play environment helped you get to know your buddy the best? Why?
3. How much did you enjoy playing with your buddy at recess?

   not at all a little a lot
4. How much did you enjoy playing with your friend during Community Builders?

   not at all a little a lot
5. How much did you enjoy playing with your friend when using the XBox?

   not at all a little a lot

Procedures and Data Collection

The pairs engaged in play across three conditions over a 12-week period and were recorded by two videographers who are former educators. One videographer is a former school psychologist and the other is a former school social worker. I trained the videographers in a one-hour session at the research site including reviewing fidelity checklists, training on recording equipment (iPads, external microphones), training on the XBox's basic functions, and scheduling. They were also introduced to the students and given a tour of the school site. Videographers signed a school district confidentiality agreement as well as a confidentiality agreement prepared by me (see Appendix B). Videographers were paid an hourly rate for their participation in the study. They met all requirements for attending sessions, recording, and uploading videos as specified. They also completed IRB-required Human Subjects training sessions.

All study participants were trained on how to use the XBox Kinect system and each game option during 15-20 minute sessions preceding the first day of data collection. A Teaching Assistant familiar with the child with ASD was present for the play sessions. Pairs participated in play sessions during normally scheduled recess times (12:10-12:40 or 12:40-1:10). Special education teachers provided students with ASD a social story to introduce the change in schedule and the expected activity for the day. When students arrived to the setting they were met by the recorders who followed the procedural checklists below to begin play. The procedural checklists were followed for each session of play throughout the research. The recorders turned in these checklists to me to show that they had followed these specific procedures in 100% of the sessions. I also supervised at least 20% of the sessions including at least one session for each pair in each play condition to ensure procedures were being followed appropriately.

Recess sessions procedures and fidelity checklist. This checklist included the following steps:

1. Pairs of children meet researcher at exit door to playground.
2. Researcher gives ground rules. "The goal today is for you to play together during recess. You may also play with additional children in a larger group if you'd like. Please do not run so that you can more easily be recorded. Please remember to follow the school's rules for recess."
3. Researcher begins recording, following children within 5-10 feet of play to ensure audio and video recording is effective, attempting to get a view of children's faces.

4. Recording is centered on the pair of students, with view of their faces, regardless of other students/adults who interact with the pair during the play.
5. After 20 minutes, recording is ended.
6. Students line up to return to their classrooms.

Facilitated play sessions procedures and fidelity checklist. This checklist included the following steps:

1. Pairs of children meet researcher in whatever location is required by the facilitated play schedule (e.g., library, gym, etc.).
2. Children follow guidelines of certified staff members (teachers and social workers) to engage in play together.
3. Researcher begins recording at the start of the session.
4. Researcher stays within 5-10 feet of the play to ensure audio and video recording is effective.
5. Recording is centered on the pair of students, in view of their faces, regardless of other students/adults who interact with the pair during the play.
6. Recording stops approximately 20 minutes later, or at the end of the session.
7. Students return to their classrooms.

Kinetic technology play sessions procedures and fidelity checklist. This checklist included the following steps:

1. Prior to children entering the space, researcher prepares environment.
    a. Move any equipment out of the way to ensure a safe environment to play.
    b. Turn on XBox and insert XBox Kinect Adventures disc.

c. Navigate game to window providing choice of Adventure games. [*Note: This step was included to prevent wasted time for students to navigate through the multiple opening screens included when inserting a new video game disc.]*

2. Pairs of children meet researcher in the sensory room. Teaching Assistant familiar with the student with ASD accompanies children.
3. Researcher explains rules of using XBox.
   a. Stand 5-10 feet away from the television.
   b. [Students] follow directions provided by the game.
4. Researcher begins recording (tripod can be used in this setting), standing 5 feet from the students to avoid being in the field of play, but in view of their faces.
5. Researcher says, "You may now choose a game from the options in XBox Kinect Adventures."
6. Children begin gameplay.
7. Researcher supports students with any technical difficulties with the XBox (recording continues during any troubleshooting).
8. After 20 minutes, researcher tells students they are out of time and tells them to turn off the game. Researcher thanks them for their time.
9. Researcher ends recording.
10. Students return to their classrooms.

Data were collected via video recordings of all sessions of play. Videos were recorded on iPads via the camera app in an effort to capture the participants' facial and body movements and verbal interactions. External microphones were used with the iPads during the outdoor recess sessions to better capture participant verbal interaction. After each session, videos were uploaded to a closed YouTube channel to review for coding. To ensure students attended the play sessions, I emailed their teachers the day before, or the morning of, to remind them of the recording session and where students should report. Six of the Kinetic Technology Play and Recess sessions were missed due to student absence on the specified day. Those sessions were made up on different days in the same three-month period.

Coding process. As the lead researcher, I coded all of the play sessions. Two additional coders who were blind to the conditions reviewed the first 20% of the data, representing one video from each condition from each group. The coders were current members of the Michigan State University Educational Psychology and Educational Technology (EPET) program. I trained the coders in a one-hour online session using a sample video clip (non-experimental session). During the session, the coders were introduced to the variable definition of positive social interaction. We discussed, in detail, examples of positive social interactions as defined in the previous section. We also discussed the nature of parallel play and shared that side-by-side playing (e.g., swinging, moving to the XBox game) without verbal or physical interaction should not be counted as a positive social interaction. Coders were given access to a secured playlist via a closed YouTube channel. All videos were coded in 20-second intervals indicating if a positive social interaction occurred, from the child with ASD, the typical peer, or both.

Inter-observer agreement (IOA). To ensure reliability of my coding, I compared my coding responses and those of the two additional coders for 20% of sessions for each pair in each treatment setting (*i.e.,* one video per pair, per play condition). IOA was calculated by dividing the number of agreements of the codes across all three coders by the number of agreements plus disagreements and multiplying by 100. The results of the three coders' data meet the threshold of Cohen's Kappa (Cohen, 1960), where agreement is 80% or greater, for all but one pair in one condition. Pair A's recess video initially received a 65% IOA across the three coders. In reviewing the video, it was noted that there were parts where the sound was not ideal, likely due to the amount of wind outside or a malfunction of the external microphone. No other recess videos appeared to have the same sound issue, despite some being taken on the same day.

Therefore, the three coders evaluated an additional video for Pair A in the recess play condition and we achieved an 80% agreement rate. I determined that no further training or adjustment was needed to address the initial lower agreement for Pair A in the recess condition. The overall 1:1:1 coder agreement across 20% of data was 82%, therefore meeting the Cohen's Kappa standard. As well, each pair's total and each play condition's total also met the 80% agreement threshold. Specifically, IOA for each pair included the following levels: Pair A-80%; Pair B-86%; Pair C-81%; and Pair D-82%. IOA for the facilitated play condition was 84%. IOA for the kinetic technology play condition was 80% and IOA for the recess condition was 83%. With the knowledge that the IOA was at or above the standard, I moved forward with coding the remaining 80% of videos using the same coding standards.

Data Analysis

I analyzed the coded data to answer the first research question, which play condition (traditional recess, facilitated play, or kinetic technology play) was most effective in eliciting positive social interactions for students with ASD and TD peers. I used visual data analysis to compare play settings for each pair by graphing the average number of positive social interactions for each student in each play condition. I reviewed the occurrence of positive social interaction based on the percent of intervals where the participant had positive social interaction with a peer (number of intervals including a positive social interaction divided by the total number of intervals). Visual analysis, used frequently within single-subject research designs, allows researchers to come to a conclusion about the reliability or consistency of an intervention's effects by graphing data and visually examining the results (Kazdin, 1982). I calculated the stability of the data using Gast and Ledford's (2014) standard of 80-90% of data points falling within a 25% range of the mean level. I reviewed the trend of the data by calculating a trend line to determine the direction of the data path. The trend line indicated if the data was accelerating, decelerating, or remaining consistent (zero). Results of the data including range, mean, median, stability, trend, and Tau-*U* effect size are reported in the following section.

To address the second research question, which play condition students with ASD and their TD peers reported as being most enjoyable, I analyzed the student survey responses. This also provided a measure of social validity within the single-subject research design. Social validity is the "estimation of the importance, effectiveness, appropriateness, and/or satisfaction various people experience in relation to a particular intervention" (Kennedy, 2005). In this case, the survey provided a measure of validity regarding the interaction between the child with ASD and the TD peer as reported by the students themselves. Results of the surveys are shared in the following section.

RESULTS

Play Activities

Each pair participated in a variety of activities throughout this research. During the kinetic technology play, each pair rotated through different games throughout each session. Each game took less than 5 minutes and most pairs played each game at least once during each session. As stated previously, the games included the following: *20,000 Leaks*; *River Rush*; *Rally Ball*; *Reflex Ridge*; and *Space Pop*. The following table shows the types of activities each pair participated in for the recess and facilitated play sessions.

Table 2. *Types of Activities for Each Pair in Recess and Facilitated Play Conditions*

Session	Recess	Facilitated Play
	Pair A	
1	Swinging	People scavenger hunt
2	Swinging	Relay races
3	*	Snowman craft
4	Swinging, playing catch	Giant Jenga
5	Swinging, playing catch	Collaborative painting
	Pair B	
1	Basketball, bouncing ball against wall	Relay races
2	*	Snowman craft
3	Basketball, catch	Giant Jenga
4	Basketball, catch	Collaborative painting
5	Basketball, swinging	*
	Pair C	
1	Swinging, playing in leaves	People scavenger hunt
2	Playing on playground equipment	Snowman craft
3	Playing on playground equipment, chasing/tag	Giant Jenga
4	Chasing/tag, going down the slide	Collaborative painting
5	Playing in snow	*
	Pair D	
1	Swinging, walking around playground	People scavenger hunt
2	Playing with leaves, playing on playground equipment	Relay races
3	*	Snowman craft
4	Playing chase/tag, playing on playground equipment	Giant Jenga
5	*	Collaborative painting

Note: The * designates a session that was discarded from analysis due to indoor recess, student absence, or video loss.

Positive Social Interactions

I began by examining data trends, through visual analysis, across sessions for participants with ASD. The following figures show the data for each child with ASD, for each session across conditions. The graphs are followed by a discussion of the results for each child.

Figure 1. *Average Percent of Positive Social Interactions for Alex and Brandon (5th Graders)*

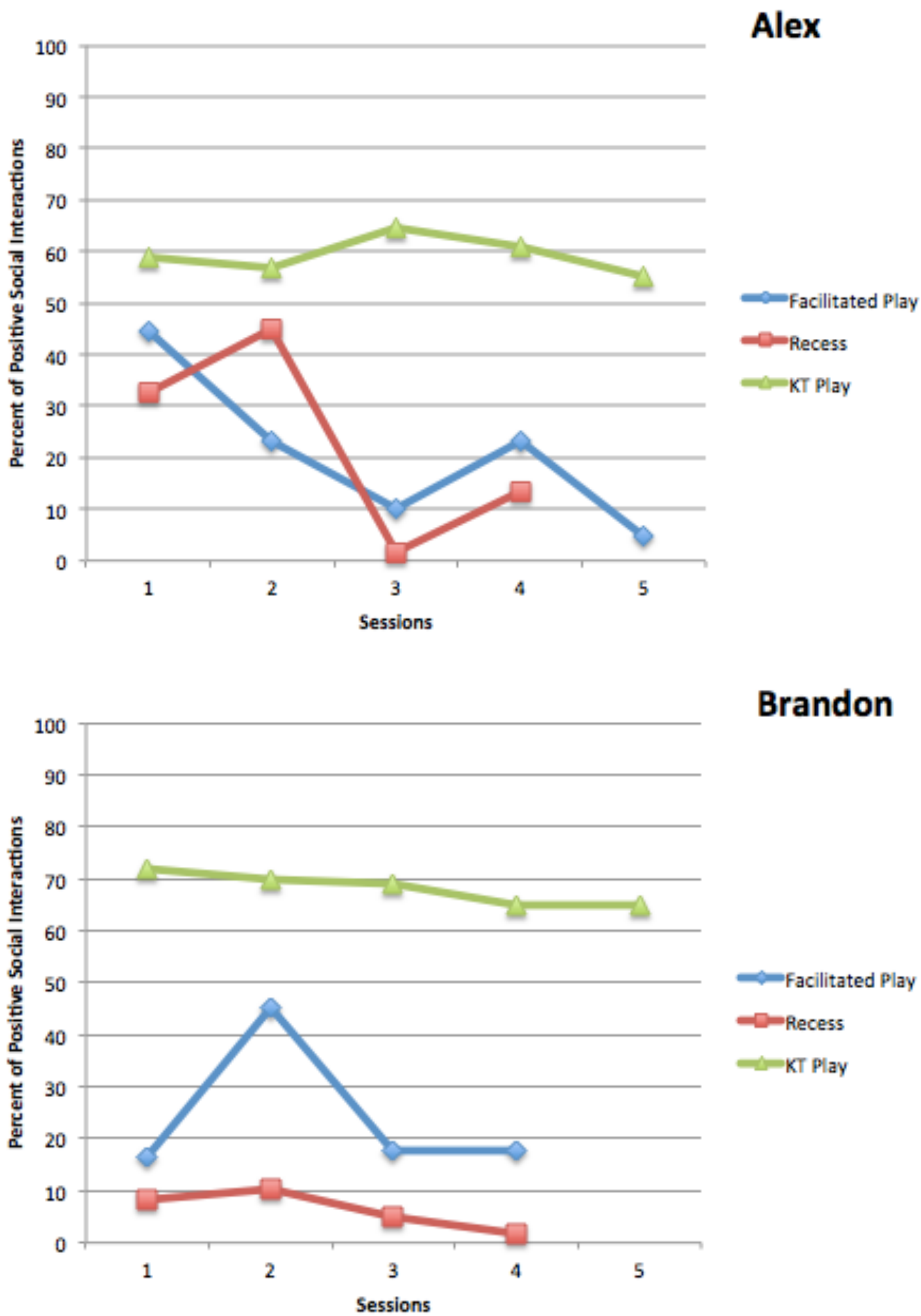
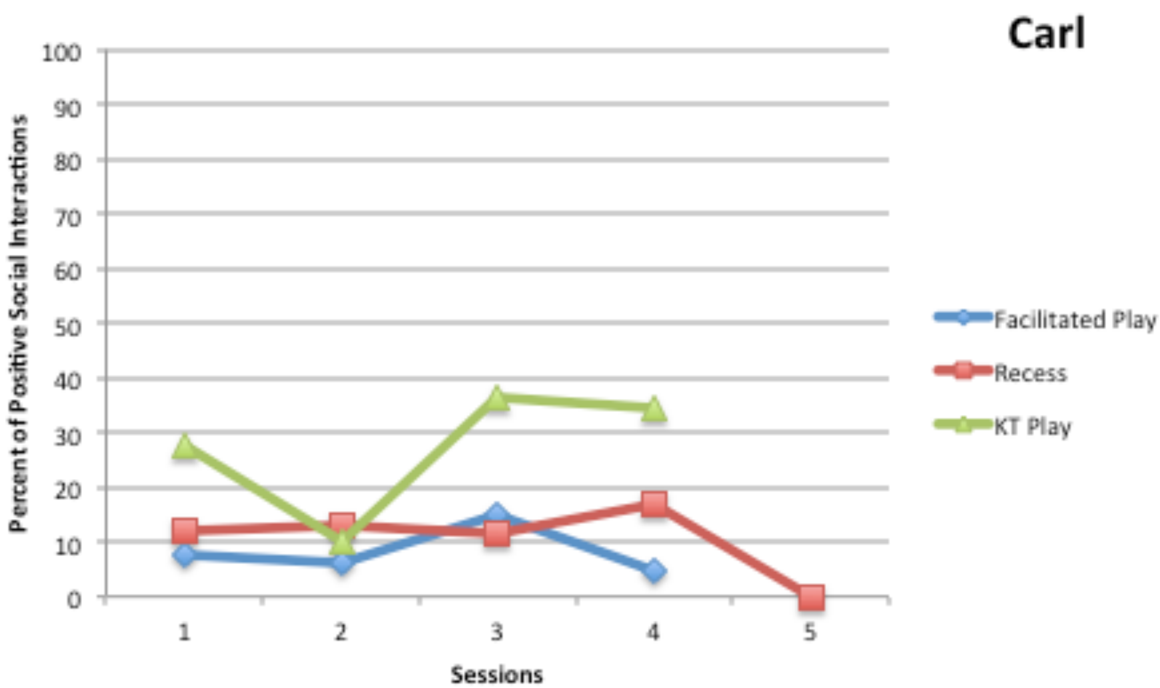
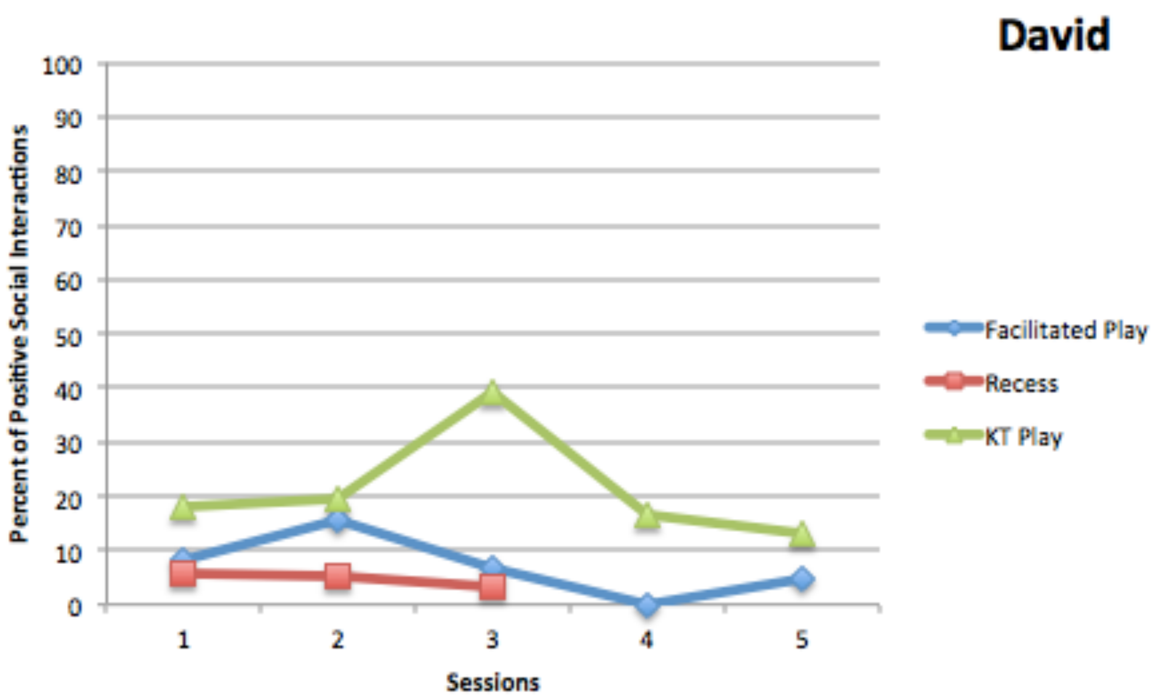


Figure 2. *Average Percent of Positive Social Interactions for Carl and David (2nd Graders)*





Alex. Alex presented the highest number of positive social interactions within the kinetic technology play condition (average = 59% of the possible intervals recorded in this condition). Recess was less effective, eliciting an average of 23% of positive social interactions. The facilitated play condition was least effective, eliciting an average of 21% of positive social interactions.

Brandon. Brandon presented the highest number of positive social interactions within the kinetic technology play condition (average = 68%). Facilitated play was less effective, eliciting an average of 24% of positive social interactions. The recess condition was least effective for Brandon, eliciting an average of 21% of positive social interactions.

Carl. Compared with Alex and Brandon, Carl showed lower overall positive social interactions across all conditions. Carl also presented with the highest number of positive social interactions in the kinetic technology play condition (average = 27%). The recess condition was less effective, eliciting 11% of positive social interactions. The facilitated play condition was least effective, eliciting only eight percent of positive social interactions.

David. Like Carl, David presented with lower overall positive social interactions across conditions, however, kinetic technology play elicited the highest overall for David as well (average = 21%). Like Carl, the recess condition elicited the second highest average of positive social interactions at 11% and the facilitated play condition was least effective at only 7% of positive social interactions.

Due to the nature of social interactions involving at least two people, it was also critical to understand which play condition (traditional recess, facilitated play, or kinetic technology play) was most effective in eliciting positive social interactions between students with ASD and TD peers. To assess this, I calculated the total number of positive social interactions for each child in every pair for all sessions in each of the three conditions (i.e., the number of 20-second intervals including a positive social interaction divided by the total number of 20-second intervals in the session). For the facilitated play condition, the paired mean positive social interaction was 25% (SD =12.1). For the recess condition, the paired mean was 19.8% (SD =15.3). For the kinetic technology play condition, the paired mean was 55% (SD = 26.4). Results, including range, mean, median, stability, trend, and Tau-*U* for each pair are presented below.

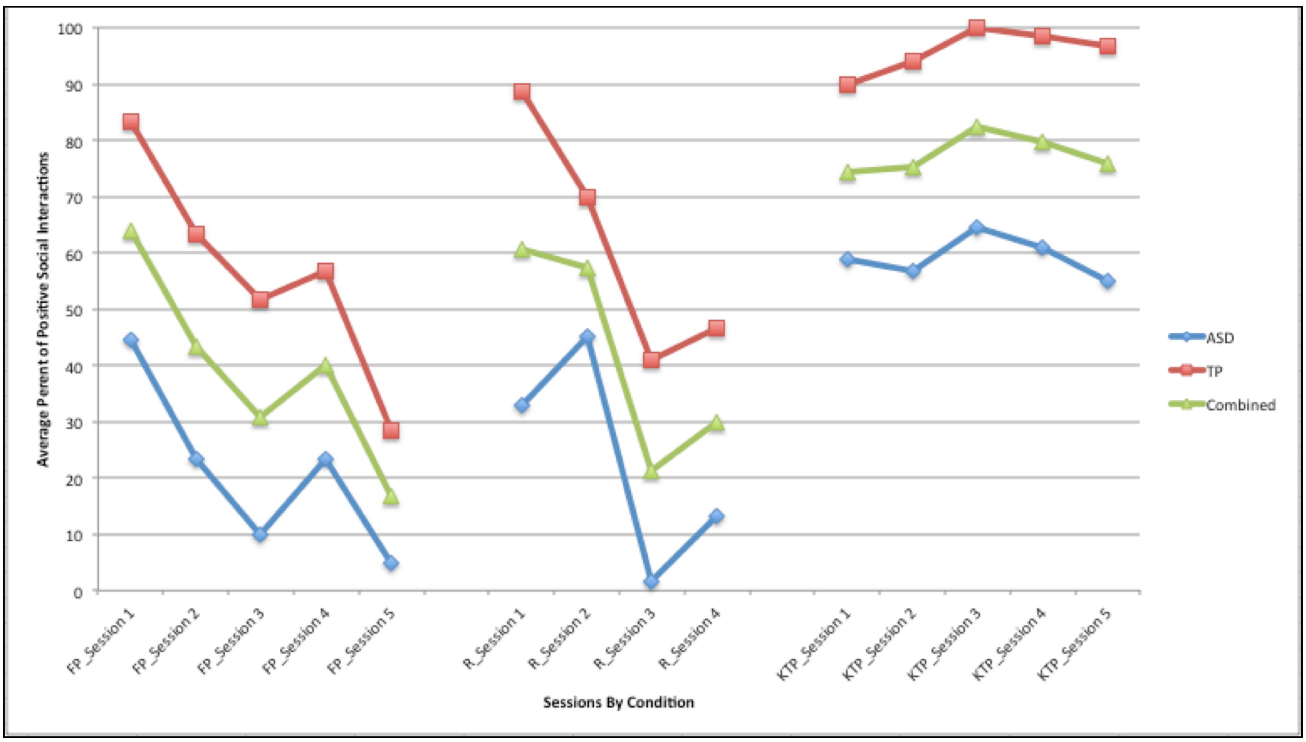
Table 3. *Data Analysis Summary of the Impact of Play Conditions on Positive Social Interaction*

Measure	Recess Baseline	Facilitated Play Condition	Kinetic Technology Play Condition
		Pair A	
Range	21.3%-60.7%	16.7%-63.9%	74.4%-82.3%
Mean	42.4%	38.9%	77.5%
Median	43.8%	40%	75.8%
Stability	Variable	Variable	Stable
Trend	Decelerating	Decelerating	Accelerating
Tau-*U**	--	0%	100%
# of sessions	4	5	5
		Pair B	
Range	10.5%-18.3%	22.1%-54.8%	76.3%-80%
Mean	15.3%	31.5%	78.1%
Median	16.1%	24.5%	78.4%
Stability	Stable	Variable	Stable
Trend	Decelerating	Zero	Decelerating
Tau-*U**	--	100%	100%
# of sessions	4	4	5
		Pair C	
Range	9.2%-18.3%	8.5%-19.7%	16.7%-46.7%
Mean	13.4%	15%	30%
Median	13.3%	15.9%	28.3%
Stability	Stable	Stable	Variable
Trend	Decelerating	Decelerating	Accelerating
Tau-*U**	--	20%	90%
# of sessions	5	4	4
		Pair D	
Range	6.5%-10.2%	0%-23.1%	19.4%-46.7%
Mean	8.3%	14.7%	34.4%
Median	8.2%	16.7%	35.2%
Stability	Stable	Stable	Stable
Trend	Decelerating	Decelerating	Decelerating
Tau-*U**	--	60%	100%
# of sessions	3	5	5

Note: * denotes Tau-*U* between the recess and kinetic technology play conditions and between the recess and the facilitated play conditions.

Alex (child with ASD) and Alvin (TD peer). Alex and Alvin are 5th grade students aged 10-11. They played together five times in each condition, for a total of 15 sessions. The following graph shows the percent of positive social interactions for each session for the children in Pair A as well as their combined average. FP designates the facilitated play condition; R the recess condition; and KTP the kinetic technology play condition.

Figure 3. *Positive Social Interactions for Pair A Across Play Conditions*



Alex and Alvin both showed higher levels of positive interaction throughout all of the kinetic technology play sessions. Alex showed higher levels of positive social interactions in the kinetic technology play condition as compared with the other two conditions, ranging between 55% and 65%. Alvin also demonstrated positive interactions more commonly in the kinetic technology play condition, ranging from 90% to 100% of the time. Kinetic technology play sessions also showed a consistently smaller range in number of positive social interactions, varying only 10% for both participants. Comparatively, the variation in the facilitated play condition ranged 40% for Alex and 57% for Alvin, and in the recess sessions ranged 44% for Alex and 49% for Alvin. Means and standard deviations for each condition are presented in the table below.

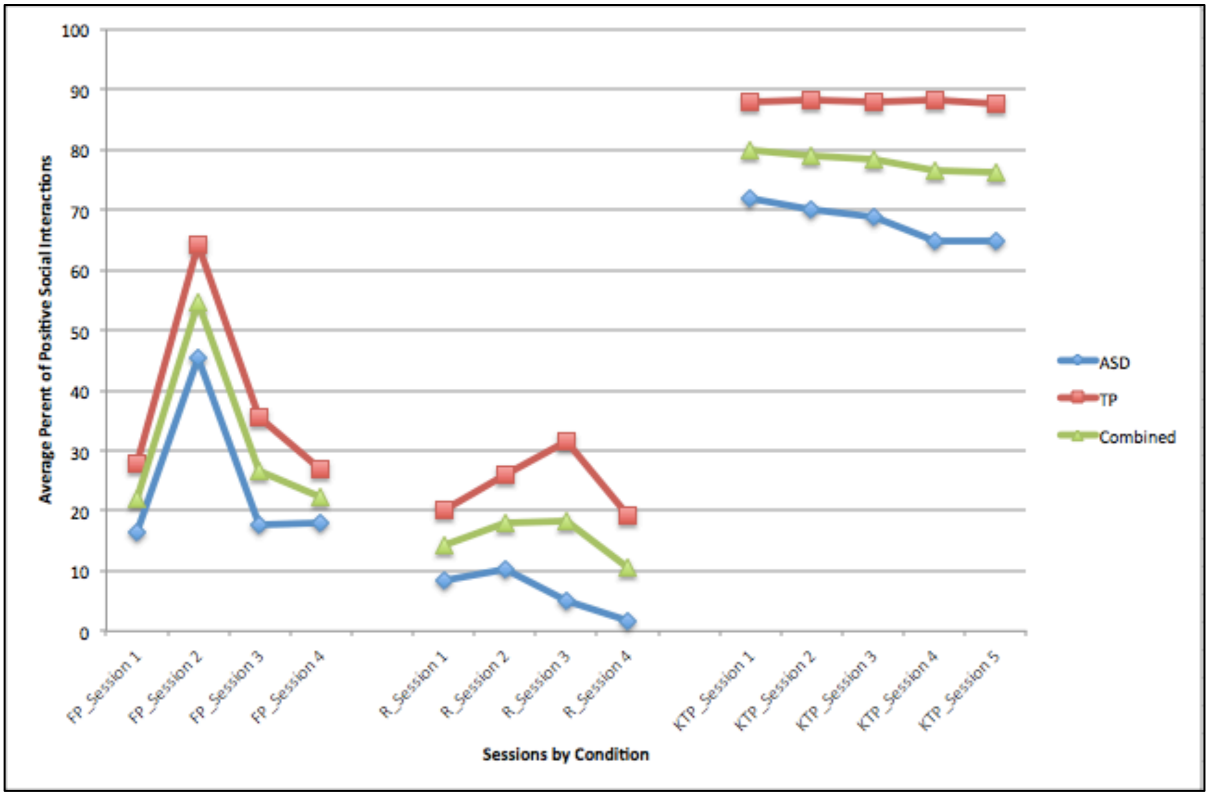
Table 4. *Means and Standard Deviations of Positive Social Interactions for Pair A*

	Facilitated Play Condition		Recess Condition		KTP Condition	
Participant(s)	Mean	SD	Mean	SD	Mean	SD
Alex (Child with ASD)	21.17	15.37	22.89	16.82	59.23	3.71
Alvin (TD Peer)	56.71	19.81	64.23	19.93	95.78	4.04
Alex and Alvin Combined	44.51	17.35	43.56	17.24	77.50	3.34

Note: Mean was calculated by summing the total number of 20-second intervals containing a positive social interaction divided by the total number of 20-second intervals during the play session. Sessions typically spanned 20 minutes.

Brandon (child with ASD) and Brenda (TD peer). Brandon and Brenda are also 5th grade students who are 11 years old. They played together 14 times during the study, missing one facilitated play session due to absence. The following graph shows the percent of positive social interactions for each session for the children in Pair B. FP designates the facilitated play condition; R the recess condition; and KTP the kinetic technology play condition.

Figure 4. *Positive Social Interactions for Pair B Across Play Conditions*



Like Alex and Alvin, Brandon and Brenda also showed more consistent positive social interactions during kinetic technology play as compared with the other two conditions. Brandon's positive social interactions in kinetic technology play ranged from 65-72% while Brenda's ranged from 87-89%. Positive social interactions in the recess and facilitated play conditions showed a wider range and lower overall mean than the kinetic technology play condition. Ranges for the facilitated play sessions were 29% for Brandon and 38% for Brenda. One notable exception was the second recess session that had a higher mean of 83% and 90% for Brandon and Brenda respectively. The second recess was an indoor recess session due to the extremely cold weather and Brandon played a board game with Brenda called *Headbandz* that involved asking one another questions to get clues about a picture. The other four sessions of recess were on the playground. Means and standard deviations for each condition are presented in the table below.

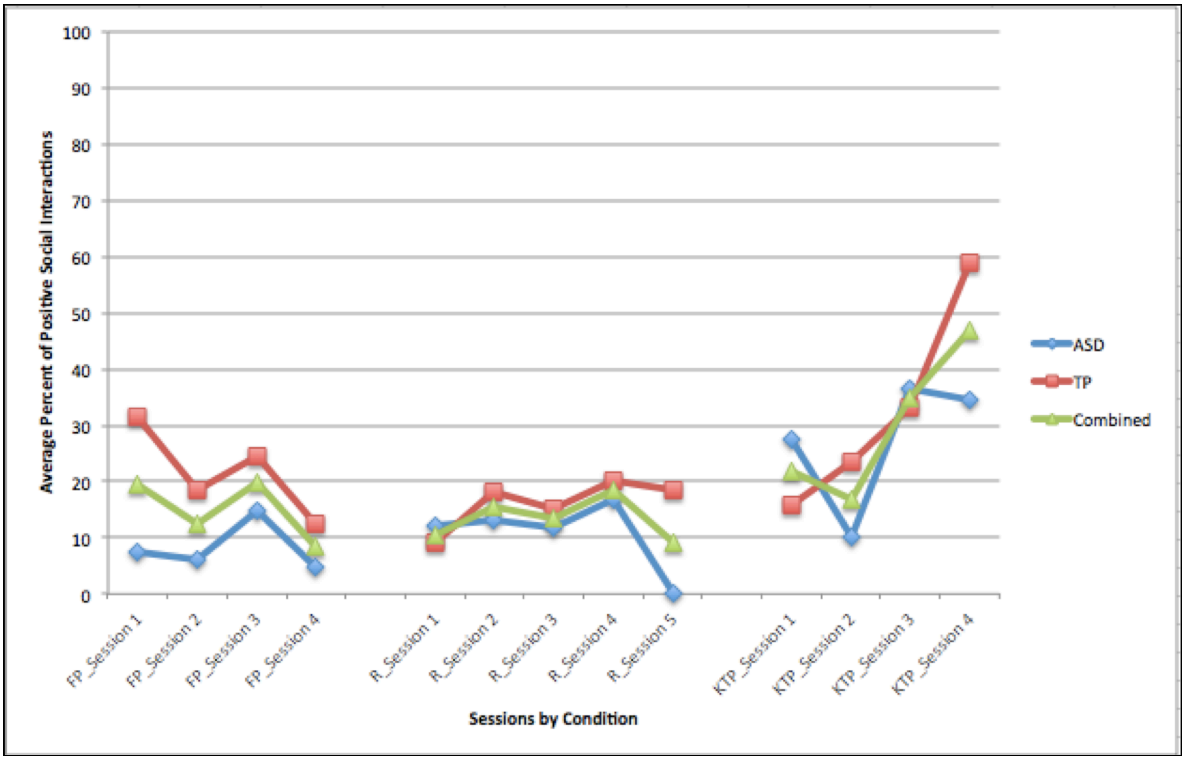
Table 5. *Means and Standard Deviations of Positive Social Interactions for Pair B*

	Facilitated Play Condition		Recess Condition		KTP Condition	
Participant(s)	Mean	SD	Mean	SD	Mean	SD
Brandon (Child with ASD)	24.32	14.04	21.45	33.91	68.18	3.14
Brenda (TD Peer)	38.57	17.48	37.24	29.58	88.16	0.27
Brandon and Brenda Combined	32.45	15.68	29.35	31.61	78.17	1.59

Note: Mean was calculated by summing the total number of 20-second intervals containing a positive social interaction divided by the total number of 20-second intervals during the play session. Sessions typically spanned 20 minutes.

Carl (child with ASD) and Cara (TD peer). Carl and Cara are seven year-old students in the second grade. They played together 14 times, missing one facilitated play session due to absence. However, due to video difficulty, one session of kinetic technology play was unable to be coded, leaving the pair with 13 viable play sessions to analyze. The following graph shows the percent of positive social interactions for each session for the children in Pair C. FP designates the facilitated play condition; R the recess condition; and KTP the kinetic technology play condition.

Figure 5. *Positive Social Interactions for Pair C Across Play Conditions*



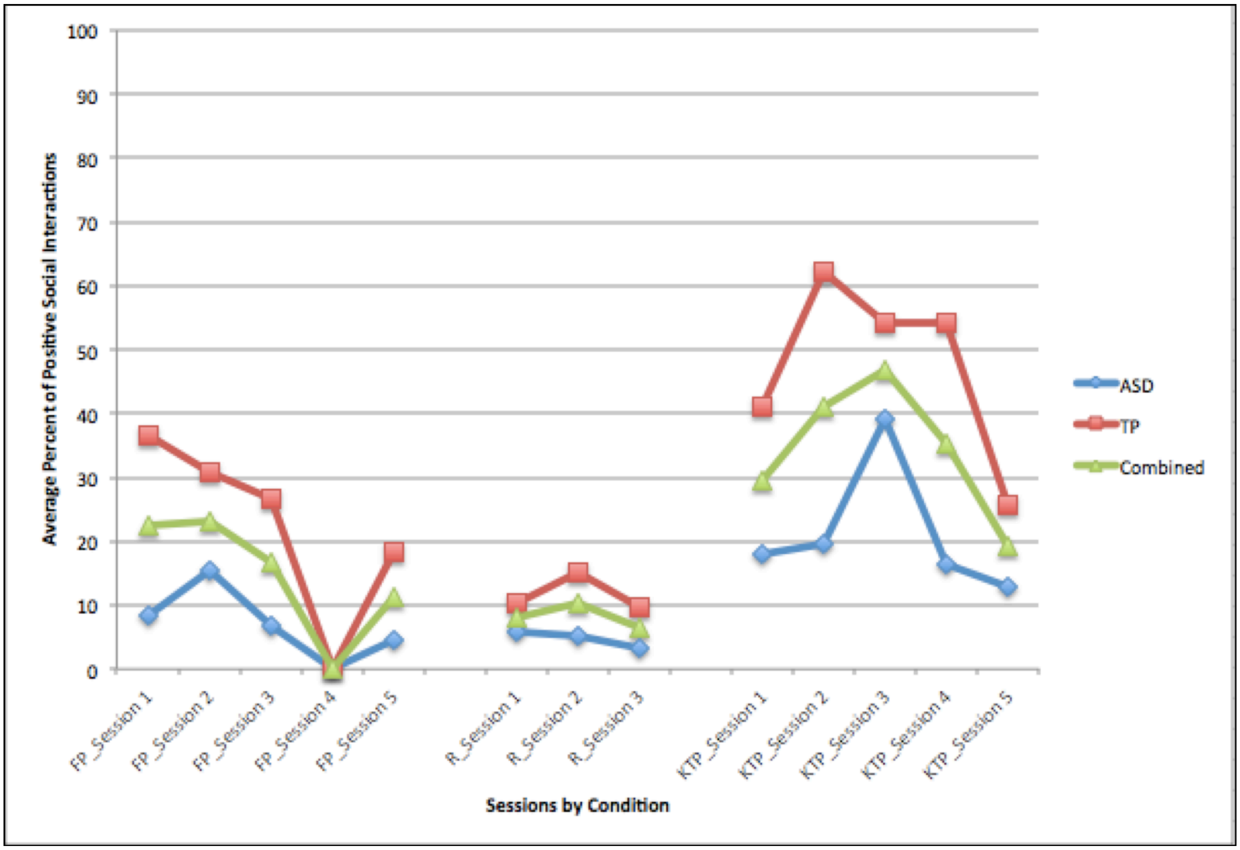
Overall, Carl had fewer instances of positive social interactions than either Brandon or Alex, but like the previous pairs, Carl and Cara showed higher levels of positive social interaction during kinetic technology play. Three of the four samples of play in the kinetic technology play condition for Carl and Cara elicited more positive social interactions, ranging from 27% to 37%, than either of the other conditions. One recess session showed no instances of positive social interaction on Carl's behalf. Means and standard deviations for each condition are presented in the table below.

Table 6. *Means and Standard Deviations of Positive Social Interactions for Pair C*						
	Facilitated Play Condition		Recess Condition		KTP Condition	
Participant(s)	Mean	SD	Mean	SD	Mean	SD
Carl (Child with ASD)	8.23	4.49	10.71	6.3	27.08	12
Cara (TD Peer)	21.71	8.22	16.12	4.33	32.91	18.81
Carl and Cara Combined	14.97	5.52	13.42	3.68	29.99	13.53

Note: Mean was calculated by summing the total number of 20-second intervals containing a positive social interaction divided by the total number of 20-second intervals during the play session. Sessions typically spanned 20 minutes.

David (child with ASD) and Donna (TD peer). Like the participants in Pair C, David and Donna are seven year-old 2nd graders. They played together for 15 sessions including five sessions in each condition. The following graph shows the percent of positive social interactions for each session for the children in Pair D. FP designates the facilitated play condition; R the recess condition; and KTP the kinetic technology play condition.

Figure 6. *Positive Social Interactions for Pair D Across Play Conditions*



Like Carl and Cara, David and Donna had fewer overall instances of positive social interactions than Alex/Alvin and Brandon/Brenda. Although the average positive social interactions were more variable across all settings than for Pairs A and B, Pair D showed higher levels in the kinetic technology play condition, ranging from 13-39% for David and 26-63% for Donna. Means and standard deviations for each condition are presented in the table below.

Table 7. *Means and Standard Deviations of Positive Social Interactions for Pair D*

	Facilitated Play Condition		Recess Condition		KTP Condition	
Participant(s)	Mean	SD	Mean	SD	Mean	SD
David (Child with ASD)	6.99	5.64	10.98	9.89	21.23	10.32
Donna (TD Peer)	22.46	14.24	18.05	10.27	47.47	14.29
David and Donna Combined	14.72	9.51	14.51	10.02	34.35	10.56

Note: Mean was calculated by summing the total number of 20-second intervals containing a positive social interaction divided by the total number of 20-second intervals during the play session. Sessions typically spanned 20 minutes.

To discover if participant views matched the above data, I reviewed participant survey responses regarding their feelings on the different play environments. Each participant filled out a survey after the final session. Results are reviewed below.

Participant Survey

To address the second research question, which play condition do students with ASD and their TD peers report as being most enjoyable, I used data from the social validity measure, the participant survey. Each participant was surveyed using five questions. All participants with ASD were able to read and write as demonstrated by their classwork and IEP goals, therefore all participants were asked to elaborate in writing as to why they chose answers throughout the survey. Responses to each survey question are outlined below with "*" indicating which answer each participant chose on the survey.

Table 8. *Participant Responses: "Which play environment was the most fun?"*

Participant	Facilitated Play Condition	Recess Condition	KTP Condition
Alex (Child with ASD)		*	
Alvin (TD Peer)		*	
Brandon (Child with ASD)		*	
Brenda (TD Peer)		*	
Carl (Child with ASD)	*		
Cara (TD Peer)			*
David (Child with ASD)			*
Donna (TD Peer)			*

Note: The * represents the condition chosen by each participant as "the most fun."

Participants in Pair A both chose recess as the most fun setting. The typical peer noted that recess was more fun "because I liked making new games and there was more interacting." Both children in Pair B also chose recess as the most fun condition. The child with ASD in Pair B noted that he liked going on the swings. His typical peer shared that recess was the most fun "because I love playing basketball and so does [Brandon]." Pair C participants showed a split preference. The child with ASD did not elaborate as to why he chose facilitated play as the most fun play condition. His typical peer buddy noted kinetic technology play as her choice "because [Carl] was more excited." Finally, Pair D participants both agreed that kinetic technology play was the most fun play condition. The child with ASD in Pair D did not elaborate, but his typical peer buddy noted that kinetic technology play was her favorite because, "I like helping [David] to play games."

All participants were also asked which play condition they felt helped them to get to know their buddy the best. Overall responses, indicated with "*", to this question are outlined below.

Table 9. *Participant Responses: "Which play environment helped you get to know your buddy the best?"*

Participant	Facilitated Play Condition	Recess Condition	KTP Condition
Alex (Child with ASD)		*	
Alvin (TD Peer)		*	
Brandon (Child with ASD)			*
Brenda (TD Peer)		*	
Carl (Child with ASD)	*		
Cara (TD Peer)			*
David (Child with ASD)			
Donna (TD Peer)	*		

Note: The * represents the condition chosen by each participant as the one that helped them get to know their buddy best. David did not provide an answer to this question on his survey.

Again, participants were asked to elaborate on their answer to this question. Pair A participants again both chose recess as their preferred condition. Although the child with ASD did not elaborate as to why he chose recess, his typical peer buddy noted that he chose recess, "because there was more interacting and I asked him many questions during recess." Pair B participants were split on this question. The child with ASD did not elaborate as to why he chose kinetic technology play, however his typical peer buddy noted that her preference for recess was "because I never knew [Brandon] could throw the tennis ball that far." Pair C participants were again split in their preferences. The typical peer buddy in that pair noted that she found the kinetic technology play condition to help her get to know her peer best, "because he was eager to do it." In Pair D, the child with ASD was not able to choose an answer for this question. His TD peer noted that she enjoyed the facilitated play condition in helping her get to know her buddy "because I like to see what [David] can do."

The final three questions asked participants to note how much they enjoyed playing with their friend in each condition overall. Results for each environment are noted below, using "*" to show the participants' answer choices. Participants were not asked to elaborate on their choices for these questions.

Table 10. *Participant Responses: "How much did you enjoy playing with your friend during **recess**?"*

Participant	Not At All	A Little	A Lot
Alex (Child with ASD)			*
Alvin (TD Peer)			*
Brandon (Child with ASD)		*	
Brenda (TD Peer)		*	
Carl (Child with ASD)			*
Cara (TD Peer)		*	
David (Child with ASD)			*
Donna (TD Peer)		*	

Note: The * represents the answer option chosen by each participant.

All participants noted enjoyment in playing with their peer during recess, with 50% selecting "a little" enjoyment and 50% selecting "a lot" of enjoyment. Three of the children with ASD selected that recess play brought "a lot" of enjoyment while only one TD peer selected "a lot." All participants in both Pair A and Pair B noted the same level of enjoyment for the recess condition. Next, participants were asked about enjoyment in the facilitated play sessions. Participant responses, marked by "*" are provided in the following table.

Table 11. *Participant Responses: "How much did you enjoy playing with your friend during **Community Builders**?"*

Participant	Not At All	A Little	A Lot
Alex (Child with ASD)			*
Alvin (TD Peer)		*	*
Brandon (Child with ASD)			*
Brenda (TD Peer)		*	
Carl (Child with ASD)		*	
Cara (TD Peer)			*
David (Child with ASD)		*	
Donna (TD Peer)			*

Note: The * represents the answer option chosen by each participant. Community Builders is the name used to describe facilitated play at the school. Alvin marked both "a little" and "a lot" on his survey response for this question.

The TD peer in Pair A, "Alvin", wrote in a response on his survey of "something in between" "a lot" and "a little" for his rating of enjoyment during facilitated play. Again, the participants were split almost 50%-50% between "a lot" of enjoyment and "a little" enjoyment during facilitated play. Participants in Pair C and Pair D were reversed between the typical peer and the child with ASD from the first question about recess to the second about facilitated play. None of the participants rated the same level of enjoyment within their pairs for this condition.

Finally, participants were asked about their enjoyment level with the kinetic technology play. Participant results, indicated by "*" are provided in the following table.

Table 12. *Participant Responses: "How much did you enjoy playing with your friend when using the **XBox**?"*

Participant	Not At All	A Little	A Lot
Alex (Child with ASD)			*
Alvin (TD Peer)		*	
Brandon (Child with ASD)		*	
Brenda (TD Peer)			*
Carl (Child with ASD)			*
Cara (TD Peer)			*
David (Child with ASD)			*
Donna (TD Peer)			*

Note: The * represents the answer option chosen by each participant.

Participants showed more consistency in this answer, with 75% rating "a lot" of enjoyment playing in the kinetic technology play condition. There was also the same within-pair agreement in response to the kinetic technology play environment as to the recess condition.

Overall, participants appeared to enjoy the kinetic technology play condition most, with recess and facilitated play closely following. Participants did not rate any of the environments as "not at all" enjoyable, which demonstrates at least a minimal level of positive interest in each play condition. There are some inherent contradictions to note in the responses. For example, the child with ASD in Pair B noted in the first question that the recess condition was the most desirable for helping him get to know his buddy, but then rated only "a little" enjoyment in playing at recess with his peer buddy, while he rated the facilitated play condition as eliciting "a lot" of enjoyment. Likewise, the TD peer in Group B noted that recess was both the best condition for getting to know her buddy and the most fun overall, but then rated playing as recess as eliciting only "a little" enjoyment. Similarly, the child with ASD in Pair C selected facilitated play as the most fun condition and also the environment that helped him get to know his peer the best, but then rated only finding “a little” enjoyment in playing at facilitated play while both of the other conditions were rated as “a lot” of enjoyment. Finally, it is important to note that when elaborating as to why they chose conditions as the most fun or the best setting to get to know their buddy, TD peer responses often centered on perceptions of their buddy’s enjoyment. I consider the potential causes and implications of these potential contradictions in the discussion section.

DISCUSSION AND IMPLICATIONS

The goal of this study was to determine if the kinetic technology play condition elicited more positive social interactions between children with ASD and TD peer buddies when compared with traditional recess and facilitated play. The study proposed to answer two questions: (a) Which play condition (traditional recess, facilitated play, or kinetic technology play) is most effective in eliciting positive social interactions for students with ASD and TD peers, and (b) Which play condition do students with ASD and their TD peers report as being most enjoyable? The findings support that the kinetic technology play condition was more effective in eliciting positive social interactions between children with ASD and TD peers when compared with facilitated play and traditional recess. This suggests kinetic technology-based interventions, and movement-based video games specifically, may be important when considering how to support positive interactions between children with ASD and TD peers.

Positive Social Interactions Between Conditions

Overall, the results of this study suggest play in the kinetic technology play condition helped children positively interact more often than in either the recess or facilitated play conditions. However, despite the research supporting facilitated play as an effective intervention, there was no significant difference found in play interactions when comparing traditional recess and facilitated play, suggesting that recess is just as effective as facilitated play in eliciting positive social interactions between children with ASD and TD peers. Moreover, when examining trends in positive social interactions over the course of the research, the kinetic technology play condition remained the most constant for Pairs A and B while those pairs saw positive social interactions drop as sessions continued in the recess and facilitated play conditions. Pairs C and D had more inconsistency of frequency of positive social interactions throughout each condition. This suggests that participants' positive social interactions within the kinetic technology play condition, at least for the older participants in the study, could remain relatively consistent over time, while positive social interactions may decrease over time in the recess and facilitated play conditions.

Types of positive social interactions. As I watched the video recordings, I noted some interesting patterns of social interaction that I had not anticipated at the onset of the study. Specifically, there was some consistency in the type of positive social interaction displayed by the pairs across conditions. Considering the types of interactions displayed within each condition may provide additional insights into why the kinetic technology play condition was most successful. I therefore conducted a secondary analysis, which I report here, to augment the primary research findings by adding information about the nature of interactions. In this analysis, I noted the *types* of positive social interactions students displayed. Four types of positive social interactions were identified in the definition of the dependent variable. These included affection, helping behaviors, non-verbal behaviors, and compromise.

Types of affection seen between pairs most commonly included high fives and hugs as well as initial greetings and saying goodbye. Examples of help seen between pairs most commonly included the TD peer giving verbal or physical prompts or direction to the child with ASD and the child with ASD following those prompts/directions. Instances of compromise most commonly included negotiations about which games to play whether to view the photos taken by the XBox console while children played the games. Examples of non-verbal interactions included smiles directed at the peer or shared laughter.

Helping behaviors observed within the research across conditions included the TD peer giving directions or prompts to the child with ASD and the child with ASD complying with those directions or prompts. Helping behaviors were the most common positive social interaction observed during the kinetic technology play condition as TD peers helped the child with ASD follow the rules of the video game (e.g., jumping during the white water rafting game). TD peers also had several instances of providing hands-on support to children with ASD such as helping them to flap their arms correctly by guiding their arms.

Compromise during the kinetic technology play sessions included choosing what game to play and how many times to play each game. In Pair A, compromise between Alex and Alvin also included whether to look at photos of the two playing that appeared on the screen after the game was finished. In Pair C, Carl also initiated some compromise interactions by asking questions such as “Try again?” During recess, compromise for the participants included choosing an activity and considering when to switch to a new activity.

Non-verbal positive social interaction behaviors most often included smiling at a peer and sharing laughter. For example, during one of the kinetic technology play sessions, Carl, the child with ASD in Pair C pretended to fall, which would cause Cara to say his name and laugh. He did this multiple times during one kinetic technology play session. Also, Cara and Carl had multiple instances of shared laughter and smiling at one another during recess play compared with fewer instances during kinetic technology play and still fewer instances in facilitated play. This type of positive interaction did not occur more often in the kinetic technology play condition for all pairs, indicating that non-verbal behaviors may be less dependent upon play setting than other types of positive social interaction, or that the kinetic technology play condition was less effective at eliciting non-verbal positive social interactions.

Affection behaviors included high-fives, greetings, and farewells. For example, there were many instances where Alvin and Brenda initiated a high five to Alex and Brandon respectively during the kinetic technology play condition as compared with fewer high fives observed during facilitated play and recess for both pairs. Carl and Cara showed affection by holding hands and had more physical positive interactions while playing at recess than in the kinetic technology play or facilitated play conditions. In Pair D, “affection” interactions across conditions most often included high fives and David thanking Donna for playing with him. Overall the affection interactions for Pair D were low across conditions. These data suggest the kinetic technology play session was more effective in eliciting affectionate interactions, perhaps in celebration of a completed goal (e.g., earning coins or popping bubbles in a game). Students were much less likely to high five or hug one another when accomplishing a task in the facilitated play sessions such as completing a collaborative piece of art, taking a turn in Giant Jenga, or checking off a box in a people scavenger hunt. The results suggest if schools wish to increase appropriate showings of affection between TD peers and children with ASD, kinetic video game play may be an effective intervention.

These results are not surprising given the social skills deficits for children with ASD discussed earlier. Often outward displays of emotion are rare among children with ASD (Bauminger et al., 2008; Nah & Poon, 2011; Sigman & Ruskin, 1999; Stichter et al., 2010). To see some of these behaviors exhibited by the younger participants may indicate the younger TD peer buddies enjoyed the play with their peer with ASD while older students may have enjoyed the play, but viewed themselves more in a helping role, representing an uneven play dynamic. The difference between the older and younger pairs in relation to the amount and types of positive social interactions raises a question about the impact of age on peer interaction and interventions.

The art of compromise. In both the recess and kinetic technology play conditions TD children were observed to most often concede to the preference of the children with ASD. For example, at recess, the older participants typically chose one activity and stuck with it for the entire recess period (e.g., swinging on swings, playing basketball or catch). Younger participants most often chose to chase one another around the playground equipment. Interestingly, the compromise behaviors among all pairs during the recess condition involved when to include other children in the play. For example, the TD peer in Pair A asked multiple times if the peer with ASD would consider switching from swinging to a game of catch. The child with ASD declined each time and the pair remained swinging. As a compromise, the TD peer asked if they could play catch while on the swings and the peer with ASD agreed. Therefore, for the remainder of the time, the TD peer threw a tennis ball back and forth with the peer with ASD who was sitting in the swing. Similar compromise interactions were witnessed during the kinetic technology play, with the TD often asking which game the child with ASD would prefer to play. Some negotiations took place where the TD peer pushed back on the child with ASD to switch games.

There are several implications of this data. Primarily, in training TD peers to be peer buddies, it is important that the adult facilitator discuss interactions included in compromising and particularly that the TD peer need not always concede to the wishes of the child with ASD. This practice at compromise may help the child with ASD practice how to navigate following the interests of another child. As well, discussing which game to play on the XBox appeared to be a more even negotiation than trying to compromise on activities played at recess, potentially because of habitual behaviors adopted by the children with ASD for how to navigate recess.

The role of the adult facilitator. All pairs had fewer instances of helping behaviors in the facilitated play sessions and during the recess sessions as compared with the kinetic technology play sessions. These data indicate children are more able to positively interact when trying to accomplish a task (e.g., earn points in a game) than when they are left with less structured expectations such as recess. During the facilitated play sessions, TD participants were observed to more often wait for adult support to help direct the behavior of the children with ASD. Perhaps the presence of adult facilitators may inadvertently hinder the positive social interactions between children with ASD and TD peers, at least in how the TD peers offer help.

Little compromise behavior was observed during the facilitated play sessions as activities were set and explained by the facilitating adults. This may indicate that although adults can support the interactions between children with ASD and TD peers, children may rely more heavily on adults to give direction, leaving little room for more naturally occurring compromise. These observations suggest that although adult coaching can be valuable in teaching specific social skills, when adults facilitate interactions between children with ASD and TD peers, both children rely more heavily on adult direction and experience fewer positive social interactions with one another.

Age. Although age was not a specific research focus identified in the research questions, it is worthwhile to note that the older participants, the fifth graders in Pairs A and B, had a much higher level of positive social interactions across the conditions. Although the kinetic technology play condition still elicited a higher number of positive social interactions for all pairs, for participants in Pairs C and D, the second grade students, the positive social interactions ranged from zero to 47%. For Pairs A and B, the range was higher, from 11-86%. These data suggest younger children with ASD as well as their TD peers have had less opportunity to develop and practice social and play skills.

The younger children, in Pairs C and D, had a higher number of non-verbal positive interactions than the older Pairs A and B. This may indicate that younger children who have more limited verbal skills and play experience rely on more basic displays of positive interactions, including smiling and laughter. The younger participants in Pairs C and D also showed greater overall variability in their positive social interactions within each condition. As the older children showed a steadier average of interactions, particularly in the kinetic technology play condition, the younger children had a wider average range of positive social interactions in the kinetic technology play condition. Therefore, the age of the student may play a role in determining the effectiveness of any play intervention, including those involving video games or other technology.

The role of movement. The recess and kinetic technology play conditions both invited a great deal of movement for the participants as compared with the facilitated play. Of the facilitated play sessions, only two of the three activities required students to actively move as a part of the activity. The higher levels of positive interaction observed in the kinetic technology play condition may indicate the importance of coupling opportunities for peer interaction with physical movement in pursuit of a goal, such as achieving a high score in a game. The movement observed during outdoor recess was not goal-oriented and often the movement was dictated by the child with ASD who had clear preferences of movement-based activities (e.g., swinging, bouncing a ball). As well, the sessions of facilitated play that included movement with a goal such as the people scavenger hunt and the relay races produced higher numbers of positive social interactions when compared with other facilitated play activities that did not require much movement. The data from this research suggest that movement may have a positive impact on the number and type of positive interactions, particularly when it is coupled with a common goal.

Indoor recess outliers. As stated previously, four of the 20 recess sessions were moved indoors due to inclement weather. Data from those four sessions varied, with two of the indoor sessions resulting in much higher observations of positive social interaction than the other recess sessions. For example, Pair B played a board game during indoor recess in one session that required questions and answers and therefore provided prompting for more positive social interactions. Dewey, Lord and Magill (1988) found children with ASD associated rule-governed games with more fun and more complexity when playing with TD peers. It may be an interesting future avenue of research to consider how non-technology based games, such as traditional board games, compare with game systems such as the XBox Kinect in eliciting positive social interactions. It may also be important for educators to consider the nuances of an indoor recess environment for children with ASD and how they may increase or decrease the potential for social interactions with TD peers, both positively and negatively.

Participant Preferences

Participant preferences provided interesting details with which to consider the other results. For example, despite the frequency of positive social interactions seen in the kinetic technology play condition, half of the participants chose recess as the most fun play environment, while only three chose the kinetic technology play. The four participants who chose recess as the most fun were those in Pairs A and B, the older students. They indicated that they enjoyed recess the most because of shared interest in the outdoor games such as swinging and basketball. Interestingly, outdoor recess was the most integrated with the entire grade level and therefore, other peers often joined the pairs in their play. For example, the participants in

Pair A were almost always joined by a third peer, not included in the study, while playing at recess. This peer would join them on the swings or in playing catch. This peer was presumably close friends with the TD child. The involvement of other peers may have created some additional enjoyment for the TD peers, leading them to select recess as most enjoyable.

Reponses to the question of which play condition helped participants get to know their peer best were very scattered with three choosing recess play, two choosing facilitated play, and two choosing kinetic technology play (with one participant declining to answer). The older TD peers remained consistent in their selection of recess as being the best environment to get to know peers and both elaborated that recess allowed them more time to talk, ask their peer questions, and learn about things their peer could do. The data again suggest the importance of training for TD peer buddies, particularly in interacting with students with ASD during unstructured times when bullying behaviors are more likely to occur (Able et al., 2015; Chen, 2010; Odom & Strain, 1986; Odom & Watts, 1991).

All of the participants indicated “a little” or “a lot” of enjoyment playing with their peer within all of the play conditions. The fact that children did not select “not at all” when asked how much they enjoyed playing in each condition suggests that peer buddy interventions are viewed as at least somewhat positive from the perspectives of children with ASD as well as TD peers. The kinetic technology play condition had the most consistent responses from students with six of the eight participants indicating that they had “a lot” of enjoyment playing with their friend while using the XBox. Preferences for the other two conditions were split with half of participants selecting “a little” enjoyment and half selecting “a lot” of enjoyment. This indicates that, for the majority of the participants, kinetic technology play was the most enjoyable play environment. It would be appropriate to expect that there would be a positive relationship between and increase in frequency of positive social interactions and student enjoyment, so the results from the student surveys validate the data collected about positive social interactions. In both cases, the kinetic technology play condition was more favorable.

Limitations

There were a number of limitations associated with this study as outlined below. A major limitation of this study is that it only meets the What Works Clearinghouse Standards with Reservations, at most. In order to meet standards without reservations, a study requires five repetitions of an alternating sequence. The data collected in this study, due to scheduling and school constraints, include only four alternating sequences for three pairs of participants and only three alternating sequences for another pair (Kratochwill et al., 2013). Of note, the case with only three alternations would not meet standards even with reservations. This limitation reduces the confidence one can have in these results.

Variables present in the daily lives of the children with and without ASD (e.g., health and wellness, classroom variables, attendance, etc.) could also potentially impact some of the results. Although single subject designs allow a researcher to make causal inferences based on data, the generalizability of any one study is limited. Replication is required to establish stronger evidence for the generalizability of these findings (Barlow & Hersen,1984). Furthermore, children with ASD are a particularly heterogeneous group, with varying needs and abilities and therefore, may all react to an intervention differently.

Researcher subjectivity could also be a concern. I have established relationships with the participants in this study as well as in-depth knowledge of their abilities and deficits. I attempted to counteract this potential subjectivity by using blind coders and recorders unfamiliar with the participants.

The study was limited by the duration and schedule of the facilitated play condition as it was offered in the school. As previously discussed, the facilitated play option was offered by staff members every other week and buddy pairs were changed each session. I matched the timeline of this study to the facilitated play sessions as scheduled by the school. Unfortunately, due to school scheduling conflicts and student absences, I was unable to record a full five sessions for all pairs. Moving into the next session of the facilitated play program to collect data would have compromised the study as participants with ASD traditionally change partners each session. This would have introduced an unacceptable confound, as the pairs in latter sessions would be different than the pairs in earlier sessions.

Another limitation was the impact that weather had on the recess condition. Once the data for sessions that had to be moved indoors were coded, it became clear that the indoor recess activities were too different from outdoor recess play and a decision was made to exclude the data from these sessions. For example, indoor recess options typically included little to no physical movement. Most activities were board games or building with blocks or Legos. The behaviors elicited by these types of activities are very different from the structure of outdoor recess. When these data were excluded, the number of recess sessions were reduced to three or four for some pairs.

As stated previously, this study did not include a best treatment phase due to the school's schedule and likelihood that ASD participants would be paired with different buddies each cycle. Therefore, the stability of the results of the kinetic technology play may be considered questionable and future research would need to be completed to ascertain if the results of increased positive social interaction in that condition remained consistent over time.

Implications

The intent of this research was to consider a potential play intervention for children with ASD and TD peers and to provide data on whether this intervention was effective in eliciting positive social interactions. Findings led to important implications for future research as well as implications for educational practice.

Implications for future research. As stated previously, the body of literature on interventions for children with ASD is growing quickly. To further this line of research regarding the impact of technology on social interactions between children with ASD and TD peers, future researchers may consider how other forms of technology impact social interactions between children with ASD and TD peers. Potential technologies may include the use of tablets and various apps and web-based collaborative activities. Researchers may consider the ubiquity of tablets and laptop devices in K-12 schools and how to capitalize on these devices, which are already familiar to most students. For example, multiple entry-level coding applications exist (e.g., Kodable, codeSpark Academy, and Scratch Jr) that require minimal technological knowledge and may allow for students to collaborate on games, aiming to accomplish a common goal. Similarly, the Osmo, an app that interacts via a tablet's camera, allows users to manipulate physical shapes and letters to direct movement of avatars on the tablet. Although these technology options, like the video game play, have the potential to allow for interaction between students, a key consideration for researchers pursuing this topic would be the level of skill required to operate these applications and how that may impact children with disabilities.

Other technologies such as the Sphero, a robotic ball operated by simple code via an app, and Fisher Price's Think & Learn Code-a-pillar, a robotic caterpillar that requires children to add different segments to direct the robot where to go via code, may be more effective in combining technology with the physical movement required by the kinetic video games. Both technologies require children to move with the devices as the robots follow the paths determined by the child's codes. This element of movement may help engage the children but also may require a higher level of skill than the kinetic video game play. As technology continues to evolve, and schools continue to add new devices and applications, it is worth considering how these new technologies may help to elicit positive social interactions between children with ASD and TD peers.

Given the differences observed between the older and younger pairs of students, it also may be worthwhile to consider how age relates to peer interactions across a variety of areas. An area of specific interest may be how a child's age impacts the use of technology, and video gaming specifically, as an intervention or peer-connected play opportunity for children with ASD. Age-related research may also consider the timeline for social skill development and how that may or may not relate to children with ASD who attend general education schools with a focus on inclusion. Age may play a key role in future research as negative behaviors toward children with disabilities tend to increase with age, creating a stronger need to identify common areas of interest between children with ASD and TD peers. Whether these common interests are related to technology or other areas (e.g., Star Wars pop culture, board games), it may be useful for researchers to consider how age impacts all social interactions between students with ASD and TD peers when presented with activities of a common interest.

Younger TD peers also appeared less confident in directing and supporting their buddies with ASD, so research targeting the training of younger peers may be of interest as well. Similarly, when adults were present, the younger pairs in this study appeared to be more dependent upon adult direction to facilitate peer interactions and, therefore, additional research may be warranted to consider how the effectiveness of facilitated play programs may be impacted by age of the child. Overall, the age of children, both with and without disabilities, has a clear impact on their play development and ability to interact socially. Continuing to tease out the impact of age on various interventions, both with and without technology, will inform further understanding of the best ways to support children with disabilities in inclusive environments.

Another possible avenue of future research may be the difference between traditional recess and indoor recess, which at may schools involves board game or building play. Given the outlier data points discovered in this study related to indoor recess activities, future research may consider how board game play or other non-adult facilitated games compare with video gaming as a platform for peer interaction. One key variable to consider in this research would be the identification of how activities not facilitated by adults compare with one another as potential interventions for children with ASD to develop positive interactions with their typical peers. For example, in most schools, indoor recess is supervised by adults but not specifically facilitated, and children choose their activities from a set of available games and materials.

The additional variable to consider in future research along this avenue would be the impact of movement within these activities. It may be interesting for researchers to pursue the difference in adult-facilitated play involving movement (e.g., the adult-led relay races in this study) with non-adult-facilitated play involving movement such as a group basketball game played at recess. Similarly, it would be worthwhile to consider how these activities further compare with interventions that do not necessarily involve movement (e.g., board games, listening to music) but may or may not be facilitated by an adult. These two key variables, adult facilitation and movement, considered together, may powerfully inform future practice for educators seeking to create inclusive settings for children with disabilities.

Implications for practice. Primarily, this study shows video game technology may be a potential asset for schools in finding ways to improve social interactions between children with ASD and TD peers. Children find video games enjoyable and they provide an environment that encourages positive social interaction, particularly in helping behaviors and affectionate behaviors. Educators may want to consider how to incorporate game consoles such as the XBox Kinect or Nintendo Wii as an alternative play environment for students who struggle during less-structured recess. XBox and Wii consoles are typically available for $300-$500 including several basic games. They are also mobile and easy to hook up to existing televisions or projectors. As well, many children are familiar with these platforms from use at home. These factors indicate that kinetic technology play may be a viable intervention tool for many schools to consider based on budget and ease of implementation as well as children's interest and engagement.

This study also highlights the importance of peer buddies and training for TD peers about how to interact with and support children with ASD to help ensure a positive inclusive experience and minimize bullying behaviors. TD peers who are trained in how to positively interact with children with ASD, or other disabilities, may show more empathy and understanding toward those students. This was witnessed by the responses of TD participants in this study who indicated that they enjoyed getting to know things about their partner with ASD such as his talents and interests. TD peers in this study also expressed enjoyment about the opportunity to play with their peers with ASD. That level of understanding and openness is essential if the social promises of inclusion are to be realized.

This research also informs the practice of how to support children with ASD and TD peers of different ages, namely the need for additional support for younger children in how to positively interact with one another. Although the younger children in this study shared positive feedback about their experiences playing together, their overall lower levels of positive social interactions compared with the older participants suggest that younger students may not be developmentally ready for some types of social interventions. Or, perhaps, the expectations of educators need to be adjusted in terms of what constitutes a successful level of positive social interactions for younger students in Kindergarten, first, and second grade as compared with students in third, fourth, and fifth grade who may be more developed in their social interactions. Either way, age is a factor that warrants consideration as schools put interventions and structures in place to encourage positive interactions between children with ASD and TD peers.

This research also informs educational considerations regarding traditional recess as a way for children with ASD to interact with peers. Research is clear that bullying behaviors can happen more often within unstructured settings and this study supports that even when asked to play with a trained peer buddy, children with ASD experienced lower levels of positive social interactions during traditional recess. Educators may consider the potential impact of adding a degree of structure to traditional recess by way of regularly paired peer buddies, smaller games or activities facilitated by older students or staff, or alternatives to outdoor physical play if they wish to enhance the positive social interactions of children with ASD and TD peers. As educators seek new research-based interventions for children with ASD, and as technology continues a firm foothold in educational practice, it is imperative that educational researchers continue to evaluate the effectiveness of a variety of approaches, particularly in connection with how children with ASD are educated in an inclusive environment.

APPENDICES

APPENDIX A

Peer Buddy Nomination Survey via GoogleForms

Peer Buddy Nomination Form

Your opinions will be used to help select an effective peer buddy for a student participating in a research study about play. Ultimately, peer buddies will be drawn from interested students whose parents agree for them to participate in the study. Please answer the questions below without concern regarding which children may agree to participate. Thank you for your help!

* Required

Please name FIVE students in your class who you feel would recommend as peer buddies for a student with Autism. *

Your answer

Which THREE children from your class would you NOT recommend as a peer buddy for a student with Autism? *

Your answer

In your opinion, which of the above five students would be the "best" peer buddy for a student with Autism? *

Your answer

Please write your name.

Your answer

APPENDIX B

Confidentiality Agreement for Recorders

Agreement for Contract Work

I agree to complete the required number of recording sessions (14) as well as 1 30-minute training session at Windsor School, 1315 E. Miner Street, Arlington Heights, IL. The rate of pay will be $50 per hour, to not include transportation time or extra planning time outside of the recording hours. Pay will be approximately $725 and will be payed in cash. I understand that claiming this income on my taxes is my responsibility.

All sessions will be from 12:10-1:10 on the following dates:
Training session: October 21 (time TBD--30 min.)
November 1, 3, 4, 7, 10, 11, 14, 15, 17, 28, 29
December 1, 2, 13

I agree to the confidentiality requirements of this study including not communicating with anyone else other than Ginny Hiltz about the research, students, or other things I observe during my time at Windsor School (unless related to criminal activity). I will not share the videos I record with anyone other than uploading to the private YouTube channel as outlined. I will also sign a copy of the school district's confidentiality agreement.

I agree to contact Ginny Hiltz as far in advance as possible by phone, 773-547-5900, if I am unable to attend an assigned recording time so that arrangements for coverage can be made. I understand that I will not be paid for sessions that I do not attend.

I further agree to utilize the provided 32GB iPad Mini 2 (Mindy) or 32GB iPad generation 2 (Rachel) for recording purposes during this assignment and will not use it for any other purposes. I agree to return the iPad, case, external microphone and lightning to USB cable to Ginny Hiltz at the conclusion of the recording sessions. I agree to reimburse Ginny Hiltz for the cost of the iPad or other equipment if it is damaged or lost while in my possession.

________________________________ ________________________
Signature Date

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