Autism Spectrum Disorder and Video Gaming: A Comparison of Within Game Social Behaviors

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Abstract

Little research exists on the effectiveness of technology-based interventions for those diagnosed with Autism Spectrum Disorder (ASD), though much of what is described in the current literature outlines significant improvements in social interaction and communication skills in individuals with ASD. A small amount of research is dedicated to exploring social behaviors during video game play of individuals with ASD. Participants in the current study were placed into two groups, (ASD and non-ASD) and played the video game *Fortnite* for 40 minutes, while being video-recorded and the screenplay captured. The current study examined various social behaviors present during video game play, with a comparison between ASD and non-ASD individuals. Results showed that there appeared to be differences in the amount of time the two groups spent playing the video game *Fortnite*, in the number of cooperative acts completed, and in reciprocal and non-reciprocal communications displayed in the game. Possible differences in volume and brightness settings between groups were noted as well. Though not without its limitations, this research is the first step in building knowledge for a better understanding, of how ASD individuals' social behaviors, compare to those without ASD, when looking at a virtual environment.

Autism Spectrum Disorder and Video Gaming: A Comparison of Within Game Social Behaviors

Introduction

Autism Spectrum Disorder (ASD) can be described as an "epidemic," (Kroncke, A.P., Willard, M., Huckabee, H., 2016,) as early studies outlined by the World Health Organization describe the existence of ASD to be 4-5 in 10,000 before 1985, while Steyaert (2008) outlines the prevalence in 2002, to be 1 in 150 children. Finally, Autism Speaks, an Autism advocacy organization based in the United States, describes the prevalence of Autism Spectrum Disorder in 2018 (data taken from a 2014 census, where individuals identified if they had been diagnosed by a clinical psychologist) to be 1 in 59 children, a 15% increase from 2 years previous (Autism Speaks, 2018). Steyaert (2008,) summarizes the ratio of ASD of male to female as 4:1. It is important to note though, that the American Psychiatric Association (2013) outlines that it remains uncertain if this increase in prevalence is due to the enlargement and development of changes in diagnostic criteria, increased knowledge and awareness of the disorder, variance in methodology of studies, or a "true increase in the frequency of Autism Spectrum Disorder" (American Psychiatric Association, pg. 55, 2013).

History

Not long after "ASD" was identified in 1943, the cause of "Autism" was associated with detached parenting, a concept that was introduced by Bruno Bettelheim. Bettelheim suggested that mothers of children with "Autism" refused to provide affection to their child, and therefore lacked the quality of warmth. Because of this, the famous term, "refrigerator mother," became prominent in the media of that time (Kroncke, 2016). In 1964 though, Bernard Rimland, who had a son with "Autism," presented the first firm argument stating that "Autism" was not in any way related to the parent-child bond, but rather, a biological condition (Project Autism, n.d.).

Though the concepts relating to a diagnosis of "Autism" were of interest during the early part of the twentieth century, it was only in 1980 that "Autism" was added to the *Diagnostic and Statistical Manual of Mental Disorders-Third Edition* (DSM-III,) as "Infantile Autism." In 1987 this was replaced by "Autistic Disorder," which gave a more extensive explanation of the diagnosis (Project Autism, n.d.). It is important to note though, that "Autism" never became an official diagnosable disorder until 1994 when the DSM-IV was released (Kroncke, 2016).

Diagnosis on a Spectrum

Autism Spectrum Disorder (ASD) is currently described as a neurodevelopmental disorder in the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (DSM-V,) which was released in 2013. A neurodevelopmental disorder is classified as a group of conditions that appear early in the developmental period. They initiate impairments of "personal, social, academic, or occupational functioning" (American Psychiatric Association, pg. 31, 2013). Other deficits include a limitation in learning, poor control of executive functions, and impairments in social skills or intelligence. (American Psychiatric Association, 2013).

Although the DSM-V is a categorical classification of mental health disorders, it is recognized that not all individuals with ASD fit within the barriers of a specific set of conditions, therefore, a dimensional approach to ASD is introduced in the fifth edition of the DSM (Spectrum News, 2011). In light of this, changes made from the DSM-IV to the DSM-V reflect a more inclusive and sensitive approach in that this disorder is contextualized on a continuum with mild to severe impairments, rather than being defined as separate and distinct disorders (American Psychiatric Association, 2013).

Other distinctions made between the DSM-V and previous editions is in the domain of diagnostic criteria. In the DSM-IV, Autism was described as fulfilling three domains: "impairments in social interactions, impairments in communication, and restricted and repetitive patterns of behavior and interests" (Steyaert, pg. 1092, 2008). In the Fifth edition of the DSM, there are only two diagnostic criteria (A & B); below you will find a table that outlines these criteria, and the various ways in which they may be displayed.

Table 1
Diagnostic Criteria of Autism Spectrum Disorder

A. Persistent Deficits in Social Communication and Interaction	B. Restrictive & repetitive behaviors, interests or activities
Deficits in social-emotional reciprocity	Stereotyped or repetitive movements, use of object, or speech.
Deficits in non-verbal communication	Insistence on sameness in routines and patterns of behavior.
Deficits in developing and maintaining relationships.	Highly restricted interests/interests of abnormal intensity or focus.
	Hyper or hypo-reactivity to sensory input

(American Psychiatric Association, 2013.)

Autism Spectrum Disorder can also be displayed in three diagnosable severity levels: requiring support, requiring substantial support and requiring very substantial support. The major differences between these levels is in the apparentness of the deficits to members of society, and if the deficits interfere with the individuals overall functioning. (American Psychiatric Association, 2013).

Calder, Hill, & Pellicano (2013) outline that studies typically show that most adults with ASD have very few friends and suggest that individuals with ASD do not know how to form friendships. In an effort to better understand friendship and communication in children with

ASD, Calder et al., (2013) conducted their own study with 12 children diagnosed with ASD from nine London (England) based primary schools (Calder et al., 2013).

Results stated that all children with ASD were able to name another individual as his or her friend, but, tended to rate their friendships lower on the quality of closeness. Children with ASD also performed lower on tasks that required them to understand the mental states of others (Calder et al., 2013).

When researchers asked participants "what a friend means to them," (Calder et al., pg. 297-298, 2013) children with ASD would tend to lack emotional connectedness. An important finding that Calder et al., (2013) reported is that children with ASD typically had fewer friendships than typically developing children, and they were also more likely to make friendships with typically developing peers, rather than another child with a disorder such as ASD. Most importantly though, a conclusion that they did not reach, was that individuals with ASD cannot form friendships (Calder et al., 2013). Researchers concluded that it is possible for individuals with ASD to form friendships, but that there is a wide variety in the "degree and nature" of those friendships (Calder et al., 2013).

Literature Review

Interventions for Autism Spectrum Disorder

Tachibana et al., (2018) conducted a meta-analysis comparing individual and group interventions for children in preschool with ASD. Individual interventions are said to be more advantageous due to individuality being a priority, but these can also be quite costly as well. Group interventions however can also be very helpful, depending on the skill or task that you are trying to improve. An advantage of group interventions is that participants get to engage with other individuals in a group setting, no matter what skill your intervention is trying to measure or build. This, in turn, allows children to develop social skills, something that is a high priority and severe deficit for individuals diagnosed with ASD (Tachibana et al., 2018). There is also an increasing amount of research that has reported success in interventions involving the inclusion of peers for social interaction skills in children with Autism. Cueing systems, role playing, and using scripts have all been noted as strategies to increase social participation for children with Autism including their peers (Kamps et al., 1997).

The Role of Technology in Interventions

Reports of children and adolescents with ASD most often describe a unique fascination with technology, including screen-based media activities such as television, computer, and video games more often than other leisure activities. Researchers are examining whether technology interventions may be particularly helpful in working in the ASD field (Mazurek, Shattuck, Wagner, and Cooper, 2012).

Van Schalkwyk et al., (2017) designed a study that focused on the use of “Facebook” with individuals diagnosed with ASD. Hypothesizing that this social media site would facilitate social engagement in teens with ASD, they set out to understand patterns of social media use,

friendship quality, and anxiety levels in adolescents with ASD. Based on parent rating, it was found that social media usage (how much time they spent on social media) was a factor in determining the quality of their friendships (Van Schalkwyk et al., 2017).

A study conducted by Susan Hedges from the University of North Carolina, discussed technology use by high school students with Autism Spectrum Disorder. The survey indicated that over 84% of her sample size of over 200 participants, brought a piece of technology with them to school, most of which was a smartphone, followed by a tablet, game, I-pad, or laptop. 97% of participants stated that they used technology at school, and 96% said they are good at using technology, and that it made learning fun, and easier. One respondent even stated that technology is the best invention of society as it gives them joy and curiosity to learn great things. Finally, 94% of participants reported that they used technology to communicate and socialize. The researcher did not show a comparison to the typically developing population as her focus was to understand the usage of technological devices within the ASD population (Hedges, n.d.).

Technological devices are portable, (and almost unlimited,) which means intervention times can vary and take place whenever and wherever it is most convenient for the individual. This provides those who live in rural communities an opportunity to access services, as the only requirement for use is access to the internet. In addition, the proliferation of touch screen technology provides easier access to those with ASD as the consistent layout of these devices helps with coordination of learning. Also, as mentioned before by previous authors such as Tachibana et al., 2018, technology devices provide a sense of motivation to learn. Finally, technology reduces the amount of frustration felt by those with ASD by providing an easier (and more enjoyable) way to practice fine motor skills, and writing, an academic skill that is often particularly challenging for those with ASD. Authors also noted that less frustration leads to

more motivation to learn (Gal et al. et al.2016). Computer aided learning is also considered a positive intervention method and can lead to improvements in individuals if it is incorporated correctly and efficiently. This type of learning has the ability to generalize skills in social communication, thought processes and perspective taking (Ennis-Cole & Parkman, 2012).

Technological interventions with ASD individuals aimed at improving communication and social interaction are particularly prominent. Multi-user "tabletops" are an example of a type of technology that can be set to meet the specific needs of a child, and can be used to help improve vocabulary and communication abilities. The screens of these "tabletops" are large enough to allow multiple individuals to play together, therefore contributing to the development of social skills. "StoryTable" is a popular game that is a major part of the tabletop intervention. In this game, a child is invited to play with puppets which represent a family of bears and where they live. They use this context as a way to create stories about the family of bears, which increases linguistic capabilities of children (Gal et al., 2016).

Kist and Morgan (2017) examined what the immersion in a virtual world meant for a participant named Jason (pseudonym) who has ASD. Jason explained that the experiences he was having with a community of virtual game players, seemed to improve his social ability. Motivated by this statement, authors followed Jason for a total of four years, and found increased communication skills and increasing involvement in online gaming and discussion boards with other individuals (Kist & Morgan, 2017). Jason described how technological innovations such as online gaming or chat rooms are an excellent way for individuals with ASD to improve their social skills because they do not have to worry about figuring out body language, eye-contact, and other social cues. Though there are parts of social interaction lost without understanding these social cues, society must understand that social interaction for certain populations, such as

the ASD population can be defined differently, and that these individuals learn how to socialize in different ways than the rest of the population. The authors concluded that the use of technology with Jason's online relationships provided him with a more socially enriched life. It is important to note though, that because there was only one participant, these results are very limited in their implications for research with the ASD populations and video gaming (Kist & Morgan, 2017).

A study conducted by Gal et al., (2016) consisted of 14 boys, aged 8-12 years, who met DSM-IV criteria for ASD. Intervention tools consisted of the "StoryTable" application, which was implemented via a touch screen tabletop. This application included a collaborative puzzle game, and a collaborative collage. Data was collected by analyzing the various social behaviors that were present, or not present, while individuals completed the puzzle and collage with other participants, and how the participants went about completing the puzzle or collage. Analysis of collected data revealed that for the puzzle game, there were significant positive differences in social interaction and collaborative play at the three test times, with significant differences in negative social interaction behaviors as well. For the collage task, there was increased interaction between the pre and post-test test times (Gal, et al., 2016).

An unpublished case study that was reviewed by authors Nelson and Mom (2016,) offers another perspective on technology in interventions for those diagnosed with ASD. The case study described a boy named Riley who struggled with speech. Over time, the use of the I-pad seemed to lead to improvements in Riley's ability to verbally communicate with others (Nelson & Mom, 2016).

Over a few years, the use of the I-pad created astounding improvements in Riley's ability to verbally communicate with others, which his mom had worried about before introducing the I-

pad to Riley. She thought that by using a technology device, it would decrease his desire to vocalize thoughts, feelings, behaviors, and his ability to communicate. Riley's mom described the I-pad as having a "monumental" role on his growth and development of communication and interaction skills (Nelson & Mom, 2016).

Even though there are many researchers describing the positive impact that technological innovations can have on those diagnosed with ASD, studies on ASD populations often have sample sizes that are quite limited. Therefore, effectiveness and generalization to various contexts is lacking as studies rarely compare social behaviors during video game play. Researchers also mention a potential negative aspect of technology interventions, which are spending too much time using these sources of media, and possibly developing problematic usage of game play. In conclusion, they should be treated with caution, and used in balance with other mediums (Mazurek, 2013).

Applications for Autism

Emerging literature is now supporting the use of visual strategies delivered in electronic formats such as tablet computers for increasing social skills in those diagnosed with ASD. These strategies have multiple advantages over traditional interventions such as increased motivation and attention, and cost-effectiveness. (Murdock, Ganz, & Crittendon, 2013).

Doenyas, Simdi, Ozcan, Cataltepe, & Birkan (2014) discuss a project called "Fatih Projesi" formulated by the Turkish government to implement tablet computers into schools. The intervention was based on previous studies showing that teaching through a technological device such as an I-pad has numerous advantages such as more attentiveness, more motivation, and an increased vocabulary in children. Compared to other behavioral or traditional methods, technological innovations can also supply immediate gratification (Doenyas et al., 2014).

Doenyas et al., (2014) completed a pilot study to test how effective I-pad applications were for educational purposes in children with Autism: They wanted to know if children with Autism could learn from a technological device such as the I-pad (Doenyas et al., 2014).

The skill that authors chose to focus on while using the I-pad intervention pilot study was sequencing, which is an important concept stemming from expressive language, and often used in socialization, interaction, communication, reading, and speaking. Three Turkish boys of various ages with ASD were chosen to participate in this study; they were 4, 11, and 15 years old. They tested the application on each child, and then compared their performance prior to their exposure to the application. There were five sequencing stories that participants were exposed to: "brushing teeth, making a sandwich, getting on and riding a bike, taking a jacket out of the closet and putting it on, and pouring orange juice into a cup and drinking it." Participants completed each activity twice and were required to put cards in the correct order to match the steps of the activity. It is important to note that the child had an opportunity to play the games without any prompts or reinforcers so that researchers could measure independent performance. There was one initial testing to determine ability, three teaching sessions, and one final testing which measured the effectiveness of the intervention (Doenyas et al., 2014).

Results indicated that each participant improved from the first testing to the final testing. Participants demonstrated their highest scores during the teaching sessions, which could suggest that the intervention itself, created positive improvements in the participants. It should be noted that one participant did worse than others after exposure, but authors attribute this difference to the participants young age of four. Authors also indicate that due to the individuality of Autism generalization to other individuals with Autism should be made with caution (Doenyas et al., 2014).

Wilkinson et al., (2018) outline work from Callaghan Innovation, a New Zealand government agency. They designed an app called "Talk with Me," to encourage individuals with ASD to interact socially outside of the home setting. It was concluded that this app increased social interaction as well as attention and independence, and created a sense of enjoyment in these individuals (Wilkinson et al., 2018).

Wilkinson et al., (2018) explored these ideas further by investigating usage of the application in a home setting (Wilkinson et al., 2018). Participants were recruited via email from a metropolitan area in New Zealand. After written consent was received by all members involved, a proof of concept study was designed which aimed to explore whether the app "Talk with Me," when used as a communication and conversational tool, had the potential to increase these skills in the home environment. Each participant family (a total of 8 were included in analysis, with participant children ranging in age from 3-11) was given access to the app "Talk with Me," for a specified period of time. There were no limitations set to often they were allowed to use the app, but results showed that usage time ranged from 20 minutes to more than five hours a day by each participant. A semi-structured interview was conducted with parents of the ASD individual after 6-8 weeks of app usage. Data analysis of the post-intervention interview, which consisted of an inductive thematic approach, showed three themes describing the usability of the app: engagement, transferred skills and behaviors, and improving the app. Researchers describe an early engagement with the app, and that the app helped develop skills in other areas than the ones intended, which created a domino effect in the development of skills in these individuals (Wilkinson et al., 2018).

Parents described the app as a good starting point, but stated that it that it needed improvement in the future. Parents outlined that their children had improved confidence, turn-

taking abilities, and increased participation in communication, in multiple contexts. It is important to note though, that families of children who were younger (3 years old,) and families of those who were older (11 years old,) outlined the app as having no impact. The authors outlined age as a possible confound to the study in that some participants may have been too young to understand the purpose of the study (Wilkinson et al., 2018).

Current literature outlines the increasing popularity of technologies such as the I-pod touch and I-pad, in improving communication skills in ASD populations in ASD populations. Mancil, Lorah, and Whitby (2016,) aimed to add to existing literature by evaluating the use of the I-pod touch in the generalizability of communication skills on a playground setting, with a comparison made to traditional devices such as the Dynavox. An application called "Go Talk" was used on an I-pod touch, with a total of three ASD participants, two male and one female, ranging in age from 4-5 years. There were also three peers of the ASD individuals chosen randomly for involvement in this study. They provided a way to compare the social interaction skills of ASD individuals to typically developing peers. All student involvement for this study took place at the children's school, with ASD individual sessions taking place on Tuesdays and Thursdays for a total of 11 sessions, and on Mondays, Tuesdays, and Wednesdays for 12 peer comparison sessions. (Mancil, Lorah, & Whitby, 2016).

An alternating treatment design was introduced to evaluate the effectiveness of each strategy (the I-pad app, and the traditional device, Dynavox.) During the first four sessions, baseline data was collected, where interactions were noted on a playground setting, before introducing the I-pad app or Dynavox, which followed with treatment sessions for communication on the playground (the I-pad app, and Dynavox.) Here, the participants were given the I-pad app and Dynavox, in different sessions, and social interactions were then

observed in a playground setting. The final few sessions were used to practice maintenance using the device that had the highest level of social interactions during comparisons. Sessions were then coded and calculated by tallying of occurrences of the target behavior during the sessions (Mancil, Lorah, and Whitby, 2016).

Target behaviors for the three participants were outlined during observations and teacher interviews. Target behaviors consisted of duration of peer social interaction on a playground setting. This included the duration of time that the peer talked or engaged with the participant. A functional analysis was completed to identify the function of each subject's behavior. A manipulation of consequences such as escape from demands, contingent attention, and contingent tangible items to determine the function of the behaviors. To identify the primary function, the effects of contingent reinforcement was compared to other conditions. A tangible function was therefore identified for each participant (Mancil, Lorah, & Whitby, 2016).

Authors concluded that there is an increasing trend for I-pod conditions for social interaction, compared to baseline, and compared to traditional interventions such as Dynavox which was used in this study. This research therefore showed that I-pod conditions can and have showed to increase social interaction in individuals before and after they completed the I-pod related intervention, and also increase social interaction more, when it is compared to traditional intervention methods. Though limitations include a lack of data collection by peer initiation, a small sample size and the inclusion of only computerized selection-based communication methods, this study indicated that the I-pod touch increases the level of social interactions of those with ASD when compared to traditional interventions (Mancil, Lorah, & Whitby, 2016).

The goal of research by Hourcade, Bullock-Rest, & Hansen (2012) was to engage children with ASD in various social activities to build confidence in self-expression, and to build

their skills in understanding emotions. They worked with 16 elementary school children and 10 middle school children in the United States who were on the Autism spectrum. They completed a total of 13, two-hour sessions at each site, which included both classroom and non-classroom settings (Hourcade, Bullock-Rest, & Hansen, 2012).

Authors learned that technology can help us learn more about those with ASD, how we can help them build their skills, and that technology may provide an incentive to improve social interactions, along with providing a safe place where these individuals can both be themselves and work on their skills. It is important to note that authors acknowledge the variability between individuals with ASD, but their interest in computers and other technology seems to be consistent. Authors observed that activities that the individuals participated in, led to a positive effect on social outcomes (Hourcade, Bullock-Rest, & Hansen, 2012).

Wojciechowski & Al-Musawi (2017) discussed an I-pad application called "Let's Play" that allowed parents to choose a limited number of objects for children to focus on in their learning, and define objects or concepts that their children needed to work on. Children then used the application by touching a cartoon image or photo, the name of the object that was displayed was then said aloud. This helped children with ASD increase their vocabulary and improve pronounciation, which in turn, improved social communication (Wojciechowski & Al-Musawi, 2016). (Wojciechowski & Al-Musawi, 2017).

Two participants were included in examining the effectiveness of this application. The study lasted more than 12 weeks with technological devices such as a smart watch and smart phone being used to access the application. Researchers concluded that the process of learning new words was more expedited using this intervention type, when it was compared to other interventions. Both participants seemed to increase communication with others as a result of

learning new vocabulary in this application. When the experiment was over, parents stated that they were satisfied overall with the effects of the application, and will continue to use it in the future (Wojciechowski & Al-Musawi, 2017).

Virtual Reality Interventions

Research has shown that individuals with ASD can transfer the information that they learn in a virtual environment to the real world, and has also shown that using virtual reality may help facilitate connecting to other individuals' identities and experiences (Ke et al., 2015). Ke and Im (2013) outline previous studies that analyzed the impact of virtual environments on social understanding in individuals with ASD. One study found that exposure to virtual reality environments provided significant improvements in individuals explanations about their decisions regarding social judgements. Other studies found that the exposure to virtual agents of reality such as applications or video games showed improvements in language skills after exposure to the intervention. A research group in Taiwan investigated the impact of virtual learning on reciprocal social interactions. Significant improvements were seen in several areas of social interaction skills (Ke & Im, 2013).

Research has also explored the implementation of virtual reality as a tool for teaching individuals with ASD, which is why current authors Ke and Im (2013) decided to investigate this topic. They wanted to discover the impacts of virtual reality-based interventions on social interaction and communication performance in those with ASD. They also wanted to look at what parts of those interventions led to an increase in the social interaction and communication skills in those with ASD. The study consisted of four children in grades 4-5 who had a formal diagnosis of ASD. Participants were given three tasks: recognizing body gestures & facial expressions, responding and maintaining interactions in a school cafeteria, and initiation and

maintaining interactions at a virtual birthday party. Only when the participant reached 80% accuracy in the task did they move on to the next one (Ke and Im, 2013).

Results concluded that participants demonstrated an accuracy rate of 95% in body gesture and facial expression. Participants also showed increased social interaction skills such as eye contact in contexts other than the intervention as well (Ke & Im, 2013).

Ke & Moon (2018) outline the usage of gaming activities in virtual reality programs as being important as well. They believe that these interventions can cause individuals with ASD to significantly improve in several social skills. Ke & Moon (2018) constructed a virtual world that included many real-world settings such as home, school, restaurants, and many more. This virtual world offered competition game play, inquiry, or response/action, role playing situations, and also architecture games. Eight 10 to 14-year-old individuals with a formal diagnosis of ASD, which included one girl and seven boys, were included in this study. Participants social interaction involvement was measured before the intervention, and again as a result of the intervention. Only when the first child gained confidence and stability over sessions, did the second child get to start the intervention and so on. When measuring behaviors, researchers looked for how individuals responded to peer interactions and if they initiated them, if they showed an understanding of other's opinions or thoughts, the ability to explain their own perspective, and the ability to change perspectives depending on the current task at hand (Ke & Moon, 2018).

Results showed that participants demonstrated an increased performance in the tasks measured after the intervention was implemented. Specifically, there was significant improvement in the social interaction skills of the individuals. It is important to note that

researchers discussed that the various games within the virtual reality improved differing skills. For example, a chess game promoted increased skills in understanding other's perspectives, while a sports game did not improve these skills, and instead, improved other areas. What is particularly positive about this virtual reality game is that it provided a variety of games, which in turn, helped improve a variety of skills. This is especially important as this game can therefore be adapted to fit each individual person and their needs. Researchers do note though that often the participants became fixated on one aspect of the game that they were participating in, which was unfortunately not the skill that was being targeted for the activity. Overall, this intervention was successful in improving the social skills of those diagnosed with ASD (Ke & Moon, 2018).

Desktop Computer Interventions

Researchers are now advocating for a collaborative usage of computer-based interventions to improve the social skills in individuals with ASD even more. Collaboration was defined as having the following three principles: mutual responsiveness, joint activity, and mutual support (Wade et al., 2017).

In response to the small amount of research with computer-based interventions on ASD populations, Wade et al., (2017) developed a pilot study called DOSE (Dyad-Operated Social Engagement), a game system which helps develop and improve collaborative social interaction skills for those with ASD. It was hypothesized that the system would be appealing to both an ASD and a typically developing population (Wade et al., 2017).

Twenty-four participants, aged 8-17 years were included in this study in which two comparisons were made. Participants were paired either as an ASD-TD (typical developing) combination, or a TD-TD combination. Participants with ASD were recruited from a university registry of individuals that were formally diagnosed with ASD by a clinical psychologist.

Researchers screened for possible ASD characteristics in the TD population by asking parents to complete a "Social Communication Questionnaire." Before the study began, informed consent was given by all participants (or parents,) and compensation of 25$ US was given to each participant (Wade et al., 2017).

Four game play modes were developed which consisted of a single player mode to practice the game, a two-player competition for players to compete against an artificial intelligent, a two-player game for participant players to compete against each other, and another two-participant-player collaboration game where players had to work together (Wade et al., 2017). The study consisted of pairs of players that had to perform these four tasks. There were sections of game-play that were labelled as practice, pretest, training, and post-test. What is important to mention about each task and section is that the pairs of participants had to work together to complete them; without collaboration, the tasks were not completed (Wade et al., 2017).

Individual performance results indicated equal performance in all of the tasks in the game play modes. Participants also showed an increase in individual skills from pre-test to post-test, although the result was not statistically significant. There was, however, a statistically significant increase in the number of words spoken by individual participants from pre-test to post-test. Results also showed that there was a significant increase in words per minute spoken by the participants, which therefore had a positive impact on contribution disparity. Researchers concluded that DOSE had a positive impact on certain aspects of collaborative and individual skill performance in those with ASD (Wade et al., 2017).

Limitations include a possible ceiling effect due to gameplay performance remaining constant from pre-test to post-test. A small number of participants limits the statistical power of

the analysis and generalization as well. Though there were many positive impacts outlined for this pilot study, researchers conclude that the results should be taken with caution and that there are no known long-term outcomes for this intervention as it is not a highly researched topic area (Wade et al., 2017).

A study conducted by Vellonen, Karna & Virnes (2012) consisted of four children with ASD in Finland who attended a school designed for children with special needs. Two participants were boys, and two were girls; they were between the ages of 8 and 12. The project included one-hour weekly group sessions within their school. The focus of their research was to investigate four technology-based work stations using a desktop computer. The four work stations consisted of: building with bricks, symbol matching, game playing, and storytelling. Building with bricks required participants to build a LEGO construction from a model on the computer application. Symbol matching required participants to do one of many tasks such as match sounds to symbols, and match pictures to emotions. Game play consisted of children selecting two or three short games on an Xbox 360 device. The final work station, storytelling, required participants to create a story by using a picture-based computer application by dragging pieces of a story into place on a timeline (Vellonen, Karna, & Virnes, 2012).

Findings suggested that the children with ASD used a large variety of communication means in the learning environment. Researchers discussed that the number of vocal expressions by each participant at the work stations was very high compared to the usage of sign-like gestures such as those used in sign language. This means that the improvements seen in participants by researchers showed leadership and were immediately shown. One interesting finding noted by researchers was that the children were able to use multiple ways of

communication at one time which provided excellent exposure for these children to work on various ways of communicating with others (Vellonen, Karna, & Virnes, 2012).

A study by Hopkins et al,. (2011) investigated "FaceSay," a computer based social skills intervention. The primary aim of this study was to learn the impact of this intervention on children's emotion and facial recognition skills. The study also looked at the impact of the intervention on social behaviors in the natural environment of participants. A total of 49 children participated in the study, which included 44 boys and 5 girls, with two groups: one receiving the intervention, and one not receiving the intervention. The Kaufman Brief Intelligence Test, and the Childhood Autism Rating Scale were used to obtain cognitive functioning abilities and to confirm the ASD diagnosis. Both photographs and schematic drawings were used to measure children's ability to recognize emotional expressions before and after training, and also the Benton Facial Recognition Test, and the Social Skills Rating System was delivered to participants to measure facial recognition skills. Sessions were limited to twice a week, for six weeks, with a total of no more than 12 sessions (Hopkins et al., 2011).

Three games were included in FaceSay: Amazing Gazing, which was designed to teach children eye gazing skills, Band Aid Clinic, which aimed to teach facial processing and recognition, and Follow the Leader, which taught children to attend to eye movements to improve facial recognition skills. Results outlined that there was a significant difference in total emotion recognition skills using both photographs and stimuli, and also an overall positive change in facial recognition skills of those who received the training compared to those who did not. Finally, those who received the training for the intervention also improved significantly in their social interaction skills in natural environments (Hopkins et al., 2011).

Length of treatment was outlined as a possible limitation of this intervention as authors were unsure how and if the length of treatment impacted the effectiveness of the intervention. Also, this study did not compare this type of intervention to other traditional models of intervention, which can lead results to be questioned. Results therefore provide support for the effectiveness of using computer-based interactive simulation program as a vehicle for enhancing observed and reported social skills (Hopkins et al., 2011).

As mentioned previously, ASD is a disorder that exists on a spectrum, with a wide variety and diversification of individuals. Technology interventions have the ability to be altered to meet the needs of all individuals, and the deficits that they face. These interventions offer a form of individuality to ASD individuals, that previous intervention methods simply did not offer. This is why researchers such as Ploog, et al., (2013) argue computer-assisted technologies to be the best mediums to provide significant positive improvements in the social interaction skills of those with ASD (Ploog et al., 2013).

Ploog et al., (2013) completed a literature review that consisted of many findings. The included studies focused on the use of computer-assisted technologies for language deficits in the ASD population. One of these used an audio and visual display to encourage children to speak, which reportedly increased participants speech by over 75%. Others outlined the use of computer-delivered instructions through visual feedback as superior to traditional play as a way to improve vocal imitation. Ploog et al., (2013) also introduced other studies that used computer-assisted technologies to help improve skills such as communication ability, vocalization, motivation for learning, phonological awareness, social understanding, and emotion recognition, most of which included positive improvements due to the inclusion of computer-assisted conditions. Researchers also mention that for overall effectiveness, it may be worthwhile to

investigate the inclusion of a human run intervention combined with the usage of technology (Ploog et al., 2013). Wright, D'Astous, Wright, & Diener (2012) focused their research on the visual-spatial strengths of those with ASD as a way to build social interaction skills through shared, computer activities. This team of researchers used Google Sketch as part of their intervention. The research focused on three areas: social skills, verbal and non-verbal communication, and stereotyped behaviors. They chose to focus on grandparents, as they contend that grandparents are becoming increasingly involved in the care of their grandchildren with ASD (Wright et al., 2012).

Workshops with teachers and parents examined the use of Sketch Up as a way to facilitate social engagement in individuals with ASD. Sketch up in particular was chosen for this study because of the visual-spatial skills that it requires for usage, which is typically a strength of individuals with ASD. Seven boys participated in the workshops, which were all between the ages of 8-17, with six of them having a diagnosis of ASD. Six grandparents participated in the (2) focus groups and represented four of the seven families included in the study. The first focus group was held the week after the workshop ended, and the second took place three months later. Each group session lasted roughly 90 minutes and consisted of an examination through interview of the interactions between grandparents and grandchildren, the grandparents' feelings about the child's involvement in Sketch Up, and also the grandparents' use of computer technology.

Two themes were developed through this study: reframed expectations and building communications through shared interests. These themes demonstrate that grandparents were able to reframe their thinking and expectations for their grandchildren, and were able to understand the benefits of computer technology for their grandchildren. Grandparents outlined that "by focusing on their grandchild's computer strengths, it opened up possibilities for their

grandchild's future." They also mentioned that they felt the computer workshops gave an opportunity to their grandchildren to communicate with others with similar interests and abilities. They felt that their grandchildren had genuine enthusiasm for the program, which provided them with a sense of confidence in their grandchildren, something they had never felt before. It is important to note that grandparents felt that their grandchildren developed genuine friendships with other individuals who participated in the study (Wright et al., 2012).

Several limitations must be mentioned though, which include that there was a small number of participants. Researchers also mention that it is possible they are missing quite important data from children whose grandparents were not involved in the study. This study was also limited because of it only including the perspectives of the grandparents and not the children themselves. Even though there were limitations in this study, it is concluded that because of this intervention, grandparents envisioned a brighter future for their grandchildren, and they realized the increasingly popular potential of computer-assisted technologies for their grandchildren with ASD (Wright et al., 2012).

Robot Interventions

The introduction of robots as a way to increase social interaction skills in those with ASD, particularly with peers, has become increasingly popular in more recent literature. One company that has explored these ideas is Aldebaran Robotics. This company aimed to examine whether the robot increased social interaction compared to a human partner. A series of four single-subject design experiments were introduced to investigate if children with ASD showed increased social engagement while interacting with a robot, compared to a human partner in an imitation task. Through observation, less stereotyped behavior was observed in individuals with ASD with a robot, compared to a human partner. The authors indicated that the robot did in fact

increase social interaction skills in individuals with ASD compared to when they interacted with a human (Bharatharaj, Huang, Krageloh, Elara, & Al-Jumaily, 2018).

Other companies have also created several different robots to study these ideas as well. A human like robot named Zeno was developed by Hanson robotics, with an aim to provide a more realistic robot than others. Kinsetic and Synchronization in Personal Assistant Robots introduced a child-sized humanoid robot with minimal expressive features for a purpose of studying human-robot interaction. Artificial Intelligence Robot was also introduced, and is a dog-like robot designed by Sony. Effects of improving social engagement and an ability to detect or respond to a physical or social environment were investigated with this robot. When this robot was used in studies, researchers indicated that children spoke and interacted more with this type of robot in comparison to another mechanical toy. CuDDler, a polar bear like companion is also discussed as being an assistive and educational tool for children with ASD. Improvements in learning and social communication were investigated here, with researchers reporting improvements in these areas for 90% of participants involved (Bharatharaj et al., 2018).

Researchers Bharatharaj et al., (2018) designed a "parrot" like robot to improve learning and social interaction of those with ASD. They called their robot the "KiliRo," which is built to look exactly like a parrot and includes cameras, speakers, microphones, and much more to assist in the communication between participants and the robot. Bharatharaj et al., (2018) used 10 children with ASD, between 7-11 years of age from a special school in Chennai, India. Information was received from a professional psychologist and the Childhood Autism Spectrum test to confirm diagnosis. The study took place at the school, over a three-day period, with a total of nine sessions. There were three conditions to this study: one at baseline without human and robot interaction, another with human interaction, and finally, one with robot interaction. During

the baseline, ten behaviors were monitored, which included when the participant looked at the person/robot, when they had verbal communication with the person/robot, or when they touched the person/robot. During sessions, the participant, the robot, and/or a human were placed in a small room together (Bharatharaj et al., 2018).

Most participants showed increased interactions during sessions with the robot compared to sessions with a human. Though there were limitations such as a small sample size, and that the study was not long term, researchers feel confident in their results as being generalizable to other ASD populations, but would like to validate this by investigating these ideas in other areas of the world (Bharatharaj et al., 2018).

Video Game Use for Intervention

Playing video games is a very common practice with over 50% of U.S. households reporting the existence of videogame players in their household, with an average of two "gamers" in each household. Though video gaming is often seen as a solo activity, the Entertainment Software Association found that more than 60% of gamers report playing with others. Children with ASD tend to spend a lot of their time with various screen-based media's such as television, or computers, which have been outlined as the most popular "free time" activities for individuals with ASD (Chung, Vanderbilt, & Soares, 2015).

A small study conducted through parent reports by Mazurek & Wenstrup (2013) examined the nature of television, video game, and social media use in children with ASD, compared to typically developing siblings. As mentioned above, parents completed measures through parental reports on their children's screen-based activities. Results found that children with ASD spent about 62% more time watching television or playing video games than all other screen-based activities combined. Results also outlined that children with ASD spend an average

of 2.0 hours per weekday, and 3.1 hours per weekend day playing video games, which was seen as significantly more time than their typically developing siblings, with an average of about one more hour per day of video game activity for both males and females (Mazurek & Wenstrup, 2013).

Adolescents diagnosed with ASD are also likely to prioritize videogaming as a recreational activity, and often describe it as a social activity. Developments in the entertainment industry have led to there being improvements and advancements in the interfaces offered for video gaming. Gaming systems offer gaming that involves body motion rather than simply button control and are known as "active videogames" (AVGs). Because of this, improvements in daily living, executive functioning, and social interaction skills have been seen. However, these results should be considered with caution as there is a small amount of research currently in this area (Chung, Vanderbilt, & Soares, 2015).

Sundberg (2018) conducted a survey which looked at the video gaming behaviors such as how much time individuals spend playing video games, and various questions regarding friendships, and feelings of loneliness while playing, with a comparison of ASD individuals, to non-ASD individuals. Results concluded that individuals with ASD play significantly more video games than those without ASD. Results also indicated that participants with ASD who play video games, have more friendships than those who do not play. Results concluded that those who play less than an hour a day, experience less loneliness than others, but not less than those who do not play video games, or those who play more than 5 hours a day. This result could be described by a balance of both online and real-life friendships in these individuals, and also those who play more than 5 hours a day may have limited real-life interactions and find it easier

to make closer relationships online. It is important to note that no connections were found between online gaming and friendships for those without ASD (Sundberg, 2018).

Limitations of this study include the cross-sectional nature. Due to this, researchers cannot be sure if more friendships lead to online gaming, or online gaming leads to more friendships. Second, researchers did not ask for any proof of diagnosis to those with ASD. This could lead to individuals that are not actually diagnosed with ASD being involved in this study. Third, the results of this study cannot be generalized to a larger group of individuals diagnosed with ASD. Because the participants of this study were recruited via an online platform, (Facebook and e-mail,) it is possible that the individuals who use these online platforms are more likely to play online games than those who do not use these platforms. A low number of non-gaming ASD participants also contributes to the limitations of this study (Sundberg, 2018).

Chung, Vanderbilt, & Soares (2015) conducted a study to investigate the "differences in communication, positive affect, and aggression in children while playing AVG's versus traditional video games with a sibling." Joint positive affect was defined as "verbal expressions of enjoyment or laughter... generated by both siblings within a two-second interval. Reciprocal conversation was defined as any utterance and response between the target child and sibling that was not separated by more than 3 seconds. Aggression was defined as verbal and physical hostility…" Their hypothesis was that the AVG's would increase social behaviors such as reciprocity, and decrease aggression (Chung, Vanderbilt, and Soares, 2015).

The video games used in the study were "*Lego Star Wars, Disney Universe*," and an "augmented reality" game. Participants were recruited via a convenience sample, had been diagnosed with ASD, and were all between 6 and 12 years of age. A total of three individuals were subjects in this study. All sessions took place in the participants home while a parent or

guardian observed. Parents completed a pre-study questionnaire on the videogaming habits of their child, as well as a social communication questionnaire. After the study, parents also filled out a post-experience survey. The target child chose their preferred videogame at the beginning of the study and was included in 12 gaming sessions, each no longer than a half hour, with a limit of three sessions per week (Chung, Vanderbilt, & Soares, 2015).

Results concluded that the intervention slightly increased joint positive affect, decreased reciprocal communication, and suggested a plateau in aggression in one participant, while contributing to a decrease in reciprocal communication and no change in aggression and positive affect in another, as well as decreases in positive affect and reciprocal communication with aggression unchanged in another. Parents however, for all three participants noted that the games were enjoyable and social experiences for their children. They also felt that the video games resulted in equal or more social behaviors from their children, when compared to sedentary gaming. Authors concluded that videogaming did not result in sustained improvements on social behavior, though they note that they have been shown to be a promising avenue for therapy in individuals with ASD to improve socialization. Limitations included the sample size of three, which limits generalizability, the usage of short-term outcomes, and inconsistent categorization of behavioral profiles (Chung, Vanderbilt, and Soares, 2015). Although these findings support that the kinetic technology play condition was more effective in eliciting positive social interactions between ASD individuals and typically developing peers when compared to other conditions such as recess and facilitated play, no significance difference was found between these conditions (Hiltz, 2017).

Hiltz (2017) completed a study which looked at differences in play behaviors shown by children with ASD when played with typically developing peers. Pairs of students, consisting of

one ASD individual and one typically developing peer aged 7-11, participated in three play settings: school recess (which was used as a baseline condition), kinetic technology using an Xbox video game console, and facilitated play led by adults. The purpose of the study was to see how the three play conditions differed in their elicitation of positive social interactions for students with ASD and typically developing peers. Through both a pilot study, and official data collection, several measures were taken. Independent variables of affection to peer (both verbally and non-verbally), responsiveness to help from peer, compromise with peer, and non-verbal behaviors were changed or controlled in this study, while the dependent variable of positive social interaction was measured. A five-question survey was also given to participants to discover which play condition they each preferred (Hiltz, 2017).

Researcher observed pairs of participants engaged in play for 12 weeks across three conditions, which found that kinetic technology play elicited the most positive social interactions for all participants, with an average of 21-78% positive social interactions during this condition. The other conditions, recess play, and facilitated play, both showed existence of positive social interaction, but, for all participants, this percentage was much lower than for the kinetic play condition. Although these findings support that the kinetic technology play condition was more effective in eliciting positive social interactions between ASD individuals and typically developing peers when compared to other conditions such as recess and facilitated play, no significant difference was found between these conditions (Hiltz, 2017).

A study carried out by Gallup & Serianni (2017) examined the relationship between socialization and the virtual environment. Researchers wanted to understand the "social interactions of young adults with ASD as they occur, and the friendships developed within the virtual environment." Data was collected during interviews and observations of five participants

with Autism that were between the ages of 18-24. Results identified that participants described emotions 145 times throughout the interviews, 20% of which included emotional recognition and reciprocity. Before becoming an online gamer, all participants outlined a feeling of frustration when it came to social interactions. Now, as regular users of online gaming, they describe themselves as being happy and excited when they participate in online battles (Gallup & Serianni, 2017).

Gallup & Serianni, (2017) concluded that virtual gaming connections can be a "powerful conduit to increase socialization, friendships, emotional awareness and reciprocation." What is most important though, is that the participants described socialization as enjoyable and necessary after the study. All participants have since improved on their social interaction skills both inside and outside the virtual environment. Limitations of this study though, must be taken into consideration and include a limited sample. But, as stated above, this field of research is new and cannot be generalized, but will continue to grow in the future (Gallup & Serianni, 2017).

As mentioned above, as more and more people continue to gain access to the internet, society also sees an increase in the usage of video games and computer games. Several studies have looked at the positive impacts of online gaming such as developing a social network, decreased feelings of loneliness, and increased bonding with others. Multi-player online role-playing games such as "*World of Warcraft*" have been reported to enhance real-life interactions. Another component that has been mentioned before as well is that these online gaming platforms take away the anxiety and loneliness that is experienced in the real-world. The authors do acknowledge though, that there can be a negative side to video games in the violence that can be portrayed in various games. Therefore, researchers emphasize the importance of careful consideration and identification of appropriate games for individuals, in order for them to

influence positive results on building social interaction and communication skills (Sundberg, 2018).

Reasons for Current Study

Currently, no research looks to understand if or outlines how ASD individuals engage in a virtual environment differently, when compared to a real-life setting. The purpose of the current study is to attempt to understand if the social deficits that exist in the real-world for individuals diagnosed with Autism Spectrum Disorder, carry over into virtual reality settings.

Most of the existing research concerning Autism Spectrum Disorder individuals has looked at technology-based interventions such as I-pad applications, virtual reality, robots, and video-gaming, and how they can or cannot help improve the social interaction and social communication skills of those with ASD (Chung, Vanderbilt, & Soares, 2015). Technology interventions are said to provide a predictable, safe environment for those with ASD. Within these, they are able to work on skills that they struggle with, without having the added anxiety of a social situation (Mazurek, 2013). In group interventions, individuals have the opportunity to interact with others, and so, the intervention acts as an intervention within itself. Researchers have also discussed individual interventions as being effective, but arguments are made that for the particular skill of social interaction and communication, group interventions may be the better choice (Tachibana, 2018).

Though there have been studies where participants have been introduced to the use of video games both as an individual and group intervention, little research exists which explores whether any significant differences exist between videogaming social behaviors of ASD and non-ASD groups. The proposed study intends to add to current literature by exploring whether

differences exist in relation to social interaction, cooperative acts, and verbal/chat interactions during game play between ASD individuals and typically developing peers.

The current study is important in that it hopes to address the gaps of existing literature so that knowledge can continue to grow, and we can better understand ASD individuals in a variety of settings and situations in order to help these individuals move forward and build the skills that they struggle with in methods that work best for them.

Methods

Participants

Non-ASD participants were recruited from a first year, introductory psychology course at the University of Prince Edward Island (UPEI,) with the ASD students being recruited through accessibility services at UPEI and the Stars for Life Foundation of PEI. All participants were offered a bonus point in their introductory psychology course, or a five-dollar gift card to Amazon or Tim Hortons in exchange for their participation in the research study. The total number of participants was 13, with five participants in the ASD group, and eight participants in the non-ASD group. There were eleven males and two females in the study. Recruitment of the Autism Spectrum Disorder group was quite difficult for the researcher. Due to the deficits that come along with being diagnosed with ASD, the social nature of the study must be considered a hinderance here. The specific qualifications of participants for the study, such as being above the age of 18, and having played *Fortnite* previously, in combination with the study taking place in a small community, also contributed to this small sample size. Due to the very small sample size, with only participants in the ASD group, the researcher was unable to complete the intended analysis, and instead had to do a comparison of means and standard deviations with the collected

data. This small sample size is important to discuss as it is consistent with all existing literature in that ASD groups tend to be of a small sample size when involved in research.

Materials

Data was collected through the use of a brief questionnaire and 40 minutes of video game play on a desktop computer. Demographic questions were constructed to collect data on participants age, education, living situation, gender, marital status, employment status, and ethnicity. Engagement in and history of video game play was assessed using questions that included information about their experiences with "the game *Fortnite*, how often they played the game, when they played, and if they preferred to play alone or with other individuals via an online platform."

An Autism screening tool included in the questionnaire included questions related to the DSM diagnostic criteria from the DSM for Autism Spectrum Disorder. Responses to these questions were on a likert scale that ranged from 1 (strongly disagree,) to 5 (strongly agree,) and included statements such as "it does not upset me when my daily routine is disrupted, I do not find it difficult to understand other people's emotions, I find social situations easy, I am fascinated by numbers, patterns, or license plates, and I find it difficult to play games with children that involve pretending" (Autism Canada, 2018). As mentioned above, the purpose of this screening was to take extra precaution to be sure that there were no ASD individuals in the non-ASD group. It is also important to note that in the invitation to participants through introductory psychology courses, an exclusion-criteria of having ASD was included. This assisted in the task of having no individuals with ASD in the non-ASD group. The total length of the questionnaire was 21 questions.

Procedure

After the current study was approved by the University of Prince Edward Island (UPEI) research ethics board, (See Appendix I,) the researcher contacted accessibility services and asked for their assistance in recruitment of ASD individuals for the study (see appendix F.) An "invitation to participate" was then sent to Accessibility services at UPEI for them to distribute to possible participants (see appendix A.) The researcher also sent an email notification and an "invitation to participate" to introductory psychology professors for distribution to students (see appendix G.) After starting data collection, an amendment through the ethics board was sought and approved (see appendix J,) which allowed the primary investigator to recruit ASD participants through the Autism Society and Stars for Life Foundation as well. A letter was then sent to Stars for Life and the Autism Society to ask for their assistance in recruitment (see appendix E.) An invitation to participate (appendix A,) was then distributed to the applicable persons.

Interested participants contacted the researcher to set up a time to complete the research. Upon arrival at the research space, each participant first signed a consent form (see appendix B) and completed a brief questionnaire, which contained demographic questions, questions regarding video game usage, and autism screening questions (see appendix D.) Each participant was read the same script (see Appendix H) during their participation in the study. After completing the questionnaire, participants started game play. During game play, participants were observed via webcam and screen capture technology, and several variables were measured, which will be outlined below. During data collection, each participant used the same desktop computer to play the game, in the same research space.

During data collection, participants were divided into two groups, those who had been diagnosed with Autism Spectrum Disorder, and those who had not, with a purpose of comparing the two on several variables. After game play, each participant was given a full debriefing (see appendix C.) Total completion time for each participant was one hour, with 40 minutes of game play time, and 20 minutes for signing consent, completing the questionnaire, and to provide a full debriefing after study participation.

Variables

During video game play, several variables were measured, the first of which was the number of cooperative acts completed while playing the game. This was defined as how many times during game play a participant attempted to or completed an action that had a common, mutual, or other benefit to other individuals involved. The second variable measured in this study was reciprocal communication. This was defined as how many times a participant answered another player in return while playing the game, whether it be through word, or action, such as a laugh. The third variable, non-reciprocal communication, was defined by how many times a participant does not answer another player in return, when there was the option to while playing the game. Before starting game play, each participant was also asked to adjust the volume and brightness of the computer to their liking, these are the fourth and fifth variables that were measured. Volume was defined as the level of sound (audio,) out of 100 that that participant put on the computer while playing the game. Brightness was defined as the level of light (out of 100,) that the participant put on the computer while playing the game. Variable number six was aggressive acts, which was defined by how many times a participant displayed verbal aggression (the use of vulgar/inappropriate language towards the game or other players in a state of anger,) or physical aggression (destruction of property, inflicting self-punishment through physical acts,

or reactions such as fist founding, or throwing objects) while playing the game. Variable number seven, distraction, was defined by how many times the participant looked away from gaming materials such as the computer screen and keyboard during game play time. Variable number eight, Game Stop, was defined by how long after the researcher told the participant that game play was over, did the participant shut down the game. Variable number nine, delay of social interaction, was defined by how many times a delay of three seconds or longer occurred before social interaction initiated between the participant and another player in the game. Social interaction was defined by communicating with other players in the game when given the option to. The tenth variable, expressions of happiness or excitement, was defined by how many times the participant expressed happiness and excitement through word, (both appropriate and inappropriate word choices, used in a state of happiness or excitement,) expressions, body language, or physical actions such as smiling, or laughing while playing the game.

Other variables identified during game play that were not included in the initial list constructed by the researcher before data collection but were identified during data analysis included frustration or annoyance, which was defined as signs of irritation, displeasure, or exasperation. Also identified was expressions of fatigue, which was defined as the participant yawning. Altering of posture was recognized during game play as well, which was defined as standing up to change placement on the chair, or standing taller in the chair as well. The variables discovery and disappointment were also identified. Discovery was defined as expressions of surprise, uncovering an article or learning something for the first time in the game, and disappointment was defined as a state of sadness caused by not fulfilling one's expectations of the game, such as getting eliminated from the game. The variable of confusion was identified during data collection as well, which was defined as portraying a lack of

understanding or uncertainty. Finally, the variable of Room Lighting was identified during data collection, which was defined as having the lights in the room turned on or off during game play.

Data Analysis

Data analysis was performed using IBM's (2016) SPSS Statistics (Version 23). Many descriptive statistics were concluded in the analysis such as the mean age of participants, among other demographics, and the frequencies of demographic variables by each level of the variable, such as for completed education, there was high school, undergraduate and graduate levels. Means and standard deviations of each measured variable, such as the number of cooperative acts were also collected, with a comparison made between the ASD and non-ASD group. Due to having only five ASD participants, and eight non-ASD participants, the research only allowed for the examination of possible trends in the collected data via descriptive statistics, which should be treated with a high amount caution and consideration. Due to the theory behind inferential, correlational, and non-parametric tests, as well as the small sample size, this type of analysis was not appropriate for the data.

Results

Descriptive Statistics

As outlined in table two below, there was a total of 13 participants in the current study, five in the ASD group, and eight in the non-ASD group. The average age of participants in the ASD group was M= 31 years (SD=5.9) with the average age of participants in the non-ASD group being M= 21 years (SD=2.6). When asked how much time per week they spent playing *Fortnite*, the average for the ASD group was M= 3.2 hours (SD=3.3) per week, with an average of M= 5.1 hours (SD=6.7) in the non-ASD group. Upon breaking this down, into weekday and weekend day play time, on a week day, the ASD group played an average of M= 1.6 hours

(SD=1.6) of video games per day, and the non-ASD group playing M= 1.3 hours (SD= 0.8) per day. On a weekend day, the ASD group played an average of M= 1.6 hours (SD=1.6) per day, with the non-ASD group playing an average of M= 2.1 (SD=1.6) per day.

Table 2
Participants, Age, and Game Play Time

	Participants	Age	Time Playing per week (total)	Time playing per weekday	Time playing per weekend day
ASD	5	M=31 (SD=5.9)	M=3.2 (SD=3.35)	M=1.6 (SD=1.6)	M=1.6 (SD=1.6)
Non-ASD	8	M=20.9 (SD=2.6)	M=5.1 (SD=6.7)	M=1.3 (SD=0.8)	M=2.1 (SD=1.6)

Tables three to eight below, outline the various demographics that were gathered during data collection.

Table 3
Gender

	Male	Female
ASD	5	0
Non-ASD	6	2

Table 4
Education

	High School	Undergraduate	Graduate
ASD	3	1	1
Non-ASD	8	0	0

Table 5
Marital Status

	Single	In a Relationship	Engaged	Married	Divorced/Separated
ASD	3	0	1	1	0
Non-ASD	8	0	0	0	0

Table 6
Ethnicity

	Caucasian	African American/Of Colour	South Asian	South Korean
ASD	5	0	0	0
Non-ASD	4	2	1	1

Table 7
Employment Status

	Employed	Unemployed
ASD	5	0
Non-ASD	5	3

Table 8
Living Situation

	Apartment	Home with Parents	House
ASD	4	1	0
Non-ASD	4	3	1

In terms of video game usage, which is outlined in tables nine and ten below, for the non-ASD group, two participants have been playing *Fortnite* for less than six months, one participant has been playing for 6-11 months, two started playing a year ago, and three have been playing for over a year. Only one of these individuals prefers to play *Fortnite* by themselves, with four having a preference of playing with others. Three participants of this group noted that they prefer to play by themselves, but also with others. For participants in the ASD group, only one participant has been playing for less than six months, two participants have been playing *Fortnite* for 6-11 months, and two for more than a year. In terms of how they prefer to play, one individual preferred to play with others, three preferred to play by themselves, with only one preferring to play by themselves and others.

Table 9
When did you start playing Fortnite?

	Less than 6 Months Ago	6-11 Months Ago	A year ago	More than a year ago
ASD	1	2	0	2
Non-ASD	2	1	2	3

Table 10
Video Game Play Preference

	By Myself	With Others	By Myself & With Others
ASD	3	1	1
Non-ASD	1	4	3

In table 11 below, you can see the results of the Autism Screening tool used in the questionnaire. Each participant was given nine statements and asked to rate how they identified with each statement on a likert scale that consisted of 1(strongly disagree) to 5(strongly agree). Results are outlined as a mean and standard deviation for each participant group.

Table 11
Autism Screening Tool

Question	ASD Group	Non-ASD Group
It does not upset me if my daily routine is disturbed.	M=2.2 (SD=0.45)	M=2.8 (1.0)
I am good at social chitchat.	M=3.2 (SD=1.3)	M=4.1 (SD=0.35)
I find it easy to play games that involve pretending.	M=3.2 (2.0)	M=3.6 (SD=1.4)
I do not find it difficult to understand other people's emotions.	M=2.4 (SD=1.1)	M=4.1 (0.8)
I prefer to do things with others rather than on my own.	M=2.8 (SD=1.8)	M=3.8 (SD=1.0)
I frequently get so strongly absorbed in one thing that I lose sight of other things.	M=4.6 (SD=0.55)	M=2.5 (SD=0.8)
I find social situations easy.	M=3.0 (SD=1.9)	M=4.1 (SD=0.6)

I am fascinated by numbers, patterns, or license plates.	M=2.6 (SD=1.8)	M=2.9 (SD=1.1)
I find it easy to make friends.	M=3.0 (SD=1.9)	M=1.8 (SD=0.5)

As you can see in table number 12 below, the variable of number of cooperative acts had a mean of M=16.4 (SD=4.0) for the ASD group, while in the non-ASD group it was M=12.8 (SD=5.3). The number of reciprocal communications for the ASD group was M=6.2 (SD=13.9,) while it was M=2.6 (SD=5.3) for the non-ASD group. The number of non-reciprocal communications was M= 17.4 (SD=9.9) in the ASD group, with M=20 (SD=20.4) in the non-ASD group. The variable of volume had a mean of M=28.0(SD=22.9) with the non-ASD having a mean of M=48 (SD=25.7). The variable of brightness for the ASD group had a mean of M=76.6 (SD=34.6), and a mean of M= 71 (SD=23) in the non-ASD group. The number of distractions had a mean of M=3.8(SD=4.8) for the ASD group, with the non-ASD group having a mean of M=6(SD=4.7).

Table 12
Variable Results

Variable	ASD Group	Non-ASD Group
# of Cooperative Acts	M=16.4 (SD=4.0)	M=12.8 (SD=5.3)
# of Reciprocal Communications	M=6.2 (SD=13.8)	M=2.6 (SD=5.3)
# of Non-Reciprocal Communications	M=17.4 (SD=9.9)	M=20.0 (SD=20.4)
Volume	M=28 (SD=22.9)	M=48.0 (SD=25.7)
Brightness	M=76.6 (SD=34.6)	M=71.1 (SD=22.7)
# of Aggressive Acts	M=0 (SD=0)	M=0.6 (SD=1.2)
# of Distractions	M=3.8 (SD=4.8)	M=6.0 (SD=4.7)

Game Stop Time	M=0 (SD=0)	M=0.1 (SD=0.4)
Delay of Social Interaction	M=0 (SD=0)	M=0.0 (SD=0)
# of Happy/Excited Acts	M=5.4 (SD=4.5)	M=6.9 (SD=5.3)
# of Frustrated/Annoyed Acts	M=5.4 (SD=6.2)	M=2.0 (SD=6.9)
# of times Fatigue is displayed	M=0.4 (SD=0.55)	M=1.5 (SD=1.6)
# of Posture Changes	M=1.0 (SD=1.0)	M=1.5 (SD=1.2)
# of Moments of Discovery	M=.40 (SD=0.9)	M=0.5 (SD=1.0)
# of Moments of Disappointment	M=.20 (SD=0.45)	M=1.8 (SD=2.0)
# of Moments of Confusion	M=0.60 (SD=0.9)	M=0.5 (SD=1.1)
Room Lighting	M=1.00 (SD=0)	M=0.9 (SD=0.35)

Discussion

The results of this study show a possible trend that ASD individuals play video games a little more than half the time that non-ASD individuals play. When the results are broken down into weekday and weekend day, the results for the ASD group on a weekday are similar to a study completed by Mazurek & Wenstrup (2013.) They found that children with ASD spend about 2 hours per weekday, and 3 hours per weekend day playing video games, which was significantly more than their typically developing siblings. Though the overall amount of time in hours is similar for weekdays, the difference is double when looking at weekend days between groups. The catch though, is that in this previous study completed by Mazurek and Wenstrup (2013,) the ASD group played significantly more video games than their typically developing siblings. This pattern is simply not seen in the current study. As mentioned above, the opposite is

seen in the current study, as the ASD group plays *Fortnite* a little more than half the amount of time that the non-ASD group plays.

The current results also do not follow the research of Sundberg (2018) who found that individuals with ASD play significantly more video games than those without ASD. This could be for multiple reasons, the first being that in the current study, the sample size of ASD individuals was small at five participants. Secondly, previous research outlines the counted amount as 'total video game playing time,' whereas the current study asks specifically about the amount of time spent playing the video game *Fortnite*. Amounts for the ASD group might have been higher if participants were asked about total video game usage, rather than *Fortnite* usage. This could have also led the non-ASD video game usage to go up as well.

When looking at the results of video game play preference, it is noted that only one participant in the non-ASD group preferred to play by themselves, with three ASD participants preferring to play by themselves. The results also showed that only one ASD individual preferred to play with others, with four non-ASD participants preferring to play with others. When comparing group differences, these results showed that overall, the ASD group preferred to play by themselves, while the non-ASD group preferred to play with others. What is important to notice here though, is that there were eight participants in the non-ASD group, and only five in the ASD group. An uneven number of participants can lead to skewed results and conclusions. These results suggest that the deficits in social communication and interaction of those with ASD, carry over into the virtual world in that they preferred to play by themselves than with others.

Upon examining the results of the variables cooperative acts and reciprocal communications, the researcher is able to say that the ASD group completed more cooperative

acts, and more reciprocal communications than the non-ASD group. It is important to note though, that even though the ASD group did complete more cooperative acts than the non-ASD group, results were relatively similar. On the variable of reciprocal communication, results are similar as well, but, they do show more than double communications for the ASD group compared to the non-ASD group. What is important to note about the results of this study though, is that the ASD group completed less non-reciprocal communications than the non-ASD group. This was not expected by the researcher, due to social interaction and communication being a main deficit for those diagnosed with ASD. Due to these results, and their heavy reliance on social communication behavior, a possible trend and carry over in the social behaviors from a real-world to a virtual world cannot be concluded for Autism Spectrum Disorder on these variables. This means that the ideas of social communication and interaction appear to be different when looking at a real world versus virtual world environment. This pattern may have been present in the current research due to the preference and skill that ASD individuals have for technology interventions and in describing technology as a social activity. It is also important to mention that technology mediums provide a platform for ASD individuals to interact socially, without having to deal with other social constraints (for an individual diagnosed with ASD) such as body language.

On the variable of volume, the differences that were found between groups was expected by the researcher. The average volume for the non-ASD group was almost double that of the ASD group. The variable of brightness showed a different trend. These results showed that the ASD group preferred to have the brightness of the game, an average of 5.5 points higher than the non-ASD group. The results of volume were expected and unsurprising to the researcher due to the sensory sensitivities of those diagnosed with ASD. The results of the brightness were

surprising to the researcher, as it was predicted that it would be a similar pattern between volume and brightness due to their similarity in sensory activity. In terms of brightness, this again, may point to a possibility of the virtual world being different than the real world for those diagnosed with ASD. It is important to note though, that the opposite could be said about the differences and carry over of volume.

The variable of distraction showed results that were not surprising to the researcher. Because ASD individuals typically have strong, fixated, and restricted interests (American Psychiatric Association, 2013), the researcher predicted that the ASD group would have less distraction than the non-ASD group, which turned out to be true. Results showed that the ASD group had two thirds the amount of distraction compared to the non-ASD group. Again, this could be because of the fixated interests and concentration of those with ASD, or could simply come from their love of the game and wanting to do well. Overall though, there was not a huge amount of distraction present in the data.

With the variable of frustrated and annoyed acts, the ASD group had a mean of more than double the non-ASD group. The researcher suspects that this might be due to the emotional sensitivity that individuals with ASD sometimes present. This may have allowed for the ASD participants to become frustrated or annoyed with the game more easily than the non-ASD group. It is important to note that even though the ASD group showed more than double on this variable, there was still a relatively small amount of frustration and annoyance present within the data.

On the variables of confusion, disappointment, discovery, posture changes, fatigue, delay of social interaction, game stop time, and aggressive acts, the ASD group had a mean of one or

less. It is important to mention these variables as for each of these variables, the non-ASD group had means that were generally within one numerical value.

Having zero delay of social interaction for the ASD and non-ASD group is an interesting result. What this seems to say is that with both groups they either communicated or not. It was either an immediate decision to communication or an immediate decision to not communicate; there was no hesitation or confusion. This was both surprising and not surprising to the researcher. It was surprising because the researcher felt that due to the social deficits that individuals with ASD face, some may have still communicated, but simply have been delayed, depending on where each participant is on the spectrum of Autism. This was not surprising as well, again, due to the social deficits that ASD individuals face. Social communication is difficult for those diagnosed with ASD, and depending on where each individual falls on the Autism spectrum, they may or may not simply refuse to communicate.

Limitations

The current study had a number of shortcomings which must be discussed. It is the goal of the researcher to have the limitations addressed and improved upon in future studies. The first limitation of the current study involves the sample. The total sample size (N=13), with five participants in the ASD group, and eight participants in the non-ASD group was a limitation of this study. These small numbers limit the external validity and generalizability of the results to a wider population. Also, having uneven participant numbers between the two groups involved in this study is another limitation. In relation to this limitation, it is important to note a theme noticed in current literature. This theme outlines that in the small amount of current literature in this area, the sample sizes are quite small, as it is only an emerging area of research. That being

said, this study is the first of its kind in literature, limitations will exist. It is the goal and hope of the researcher to acknowledge these, and improve upon them in the future.

Upon starting data collection for this study, the researcher had intentions of completing an experimental exploration of the included variables between groups by carrying out a statistical analysis via a MACOVA through SPSS. Due to the very small sample size, with only five participants in the ASD group, the researcher was unable to complete this analysis, and instead completed a comparison of means and standard deviations with the collected data. Future studies should focus more on earlier recruitment, and the possible inclusion of adolescent participants in addition to adults. The researcher may also like to include a wider area in terms of geography for recruitment. Future studies should attempt to implement the following two changes: a larger sample, and even participation groups.

A second limitation of this study was that the Autism Screening Tool used in the questionnaire of this study, was not an official diagnostic device. The purpose of the inclusion of this tool was to have a method in place to double check the non-ASD group in the study, to make sure that there were no participants who were diagnosed with ASD, or who had Autism like characteristics within this group. The questions included in this tool were taken from an online resource through the organization *Autism Canada*. Given an unlimited budget, and a longer timeline for completion, the researcher would like to include an official testing portion to the study through a licenced clinical psychologist. This would be a more reliable method to ensure that there were no ASD individuals in the non-ASD group.

A third limitation of this study is that only one individual rated or coded the data, and assigned those codes to an action. This study, therefore, did not have inter-rater reliability. Possible implications for this limitation on the research is that incorrect counting or labelling of

variables during data analysis took place, which could have led to skewed or inaccurate results. In future research, having multiple individuals take part in this process would be ideal, as this would produce more of a consensus or agreement in assignments that were given to the data. This can also be related to the Autism screening tool that was used in data collection. Because this device was not an official diagnostic tool, there could be limitations seen in its validity and conclusions made. This presents an issue regarding a lack of standardized tools needed to perform research in this field. Gaining access to more of these tools in future research would eliminate many limitations faced.

Conclusion

As Autism Spectrum Disorder becomes increasingly prevalent in the population, it is important to acknowledge the need for literature and resources in this area. A small amount of current literature describes technology-based interventions that can help improve the social interaction and communication skills of those with ASD (Mazurek, 2013). Researchers touch on group and individual interventions, and technology interventions such as I-pad applications, computer interventions, and video gaming (Chung, Vanderbilt, & Soares, 2015,) but, currently, no literature looks to understand the social behaviors present during video gaming, with a comparison of ASD and non-ASD individuals.

The current study intended to introduce literature in this area in order to better understand individuals diagnosed with ASD, and to understand if the social behaviors of ASD individuals in a real-world environment, carries over into a virtual world environment, such as video gaming. In carrying out this intention, the researcher designed a study with five ASD individuals and eight non-ASD individuals, which collected demographic information, as well as measured various social behaviors that take place during video game play.

Results of the current study included a conclusion that ASD individuals play video games a little more than half the time that non-ASD individuals play. Results also point to a possible conclusion that some deficits that ASD individuals face in the real world, do not carry over into the virtual environment, such as completing more cooperative acts, more reciprocal communications, and less non-reciprocal communications than non-ASD individuals. Distinguishable differences in volume, with ASD individuals preferring a lower volume, and a higher brightness than those without ASD were concluded as well.

Though this study came with limitations, including a small number of participants, this was a pilot study, and was the first time that these comparisons were made on these variables in current research. There were several important conclusions made in this study, which the researcher hopes are the first of many, in order to continue to build the research in this area.

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Appendix A
Invitation to Participate
A Study Examining Game Play Characteristics in *Fortnite*

You are invited to participate in a study that explores game play characteristics in *Fortnite*. The criteria to participate in the study is that you have some experience playing the video game *Fortnite*, are above the age of 18, and have a diagnosis of an Autism Spectrum Disorder. This research is being conducted by Mikaela Flood, as her honours thesis research project in psychology. The research is being supervised by Dr. Jason Doiron and has been approved by the UPEI Research Ethics Board.

Participation in this research will require one hour of your time. If you choose to participate you will set up an appointment to come to the research space located on the UPEI campus: memorial hall, room 108.

At the appointment, you will first provide informed consent and complete a brief questionnaire that includes demographic items and items about your video gaming and non-video gaming behavior. Following completion of the questionnaire you will be engaged in a total of 40 minutes of *Fortnite* game play. Your game play will be captured using standard screen capture technology. A standard webcam will also capture your facial expressions during game play. After 40 minutes of game play you will be provided with a full debriefing that will include information about how to learn more about the results of the research study. As a participant in this research project, you will be provided with a five-dollar Amazon gift card, a five-dollar Tim Hortons gift card, or the option to receive a bonus mark in an introductory psychology class.

All responses and data will be kept anonymous. All questionnaire data, screen capture data, and webcam data will be stored in a secure manner (stored in a locked cabinet, on a personal memory stick that requires a password to access the information) and will be viewed only by the researcher (Mikaela Flood) and supervisor (Dr. Jason Doiron). Your identity will not be shared; your participation is completely confidential.

After participation in the study, if a participant wishes to withdraw from the study he/she may do so until two weeks after data collection without penalty or reproach.

Please be advised that by agreeing to participate in this study, you are agreeing to a release of personal information, (your diagnosis.)

If you would like to participate in this research project, or have any questions, please contact me (Mikaela) at mflood@upei.ca.

Appendix B

Informed Consent

A Study Examining Game Play Characteristics in *Fortnite*

You are being asked to take part in a research study on game play characteristics in *Fortnite*. This research study is being conducted by Mikaela Flood to fulfil the requirements of her honours degree in psychology. The research is being supervised by Dr. Jason Doiron, UPEI Department of Psychology.

Participation in this research will require one hour of your time and include the completion of a brief questionnaire that includes demographic items and items about your video gaming and non-video gaming behavior. After you complete the questionnaire, you will play *Fortnite* for 40 minutes. Your game play will be captured using standard screen capture technology, and your facial expressions will be recorded via a webcam. After 40 minutes of game play you will be provided with a full debriefing that will include information about how to learn more about the results of the research study. As a participant in this research project you will be provided with a five-dollar Amazon gift card, a five-dollar Tim Hortons gift card or a bonus mark in an introductory psychology class.

The data collected for this study will be anonymous. Numbers will be assigned to participants so that participant names do not appear with data. Participant confidentiality will be protected. All data will be stored under lock and key (questionnaire) and in password protected computer files (screen capture). Only the researcher (Mikaela Flood) and supervisor (Dr. Jason Doiron) will have access to the data.

Your involvement in the current study is voluntary. After participation in the study, if a participant wishes to withdraw from the study he/she may do so until two weeks after data collection without penalty or reproach.

For my participation in the study, I would like to receive a (please check one of the following):

□ Amazon gift card

□Tim-Hortons gift card

□Bonus mark for an introductory psychology class

Contact Information to Receive Gift Cards (only fill this out if you are requesting a gift card as compensation): _____

I have read and understand this information and have had the opportunity to ask questions. I understand that I am free to withdraw within two weeks of data collection, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____

Investigator's signature _____ Date _____

If you have questions about the study you may contact the investigator (Mikaela Flood, mflood@upei.ca) or supervisor (Dr. Jason Doiron, jpdoiron@upei.ca). The research has been approved by the University of Prince Edward Island Research Ethics Board (REB) which can be reached at 902-620-5104 or reb@upei.ca.

Appendix C
Game Play Characteristics in Fortnite

Thank you for your participation in my research study which I am conducting as part of my honors degree in psychology.

As you may know, Fortnite is currently one of the most popular video games and is increasingly becoming the focus of research. The purpose of the present study is to more fully understand the within-game playing characteristics of Fortnite players, with a comparison of those who have been diagnosed with Autism Spectrum Disorder, and those without Autism Spectrum Disorder. Various within-game characteristics were recorded (such as number of cooperative acts, number of social interactions present during game play, eye contact with the screen, and facial expressions of aggression and happiness, from the screen capture and webcam footage. These within-game characteristics will be analyzed along with the questionnaire data. This analysis will help us to understand whether there is any relationship between game play characteristics and various demographics between those who have been diagnosed with ASD and those who have not.

If you wish to receive an e-copy of the full research summary, please provide your preferred contact information on the second page of this document. You may also send me (Mikaela) an e-mail requesting the summary. You will find my e-mail address below.

If you wish to withdraw from this study, you may do so until two weeks from data collection (today) without penalty or reproach.

Do you have any questions?

I hope you enjoyed your experience today. If you have any questions at a later time please feel free to contact me (principal investigator, Mikaela,) at mflood@upei.ca.

Thank you again for your participation.

Preferred Method of Contact for Research Summary:

_____

Appendix D
Questionnaire

Please answer the following questions by writing your answer in the blank provided.

Demographics

1. What is your age? _____
2. What is your highest completed level of education? _____
3. What is your current living situation? _____
4. What is your gender? _____
5. What is your marital status? _____
6. What is your employment status? _____
7. To which ethnicity do you identify? _____

Video Game Usage

8. When did you start playing Fortnite? _____
9. How much time per week do you spend playing Fortnite? _____
10. On an average week day, how much time do you spend playing Fortnite? _____
11. On an average weekend day, how much time do you spend playing Fortnite? _____
12. Do you prefer to play/ do you tend to play video games by yourself or with others (in person, or via an online platform)?

*Please see the next page for the final part of the questionnaire.

Other: Please answer the following questions by circling the number that best fits your answer.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1.It does not upset me if my daily routine is disturbed.	1	2	3	4	5
2.I am good at social chitchat.	1	2	3	4	5
3.I find it very easy to play games with	1	2	3	4	5

children that involve pretending.					
4.I do not find it difficult to understand other people's emotions.	1	2	3	4	5
5.I prefer to do things with others rather than on my own.	1	2	3	4	5
6.I frequently get so strongly absorbed in one thing that I lose sight of other things.	1	2	3	4	5
7.I find social situations easy.	1	2	3	4	5
8.I am fascinated by numbers, patterns, or license plates.	1	2	3	4	5
9.I find it hard to make friends.	1	2	3	4	5

Appendix E

Dear _____,

My name is Mikaela Flood, and I am completing an honours in psychology presently at the University of Prince Edward Island under the supervision of Dr. Jason Doiron. I am contacting you as my research is looking to analyze the social behaviors of individuals with Autism Spectrum Disorder (ASD) during video game play, and was hoping that you would be able to assist me in my recruitment process.

I am looking to recruit participants that have been diagnosed with ASD, and was hoping that you could forward an "invitation to participate" to all individuals diagnosed with Autism Spectrum Disorder that are involved with the Autism Society of PEI or the Stars for Life Foundation. The "invitation to participate" includes some information about the study and specifically notes that participation would mean disclosing their status as a person with ASD. Of course, we intend to keep this information confidential, but it is important that potential participants know that the researcher (myself) will know that they have been diagnosed with ASD.

Thank you for considering this request. If you are able to help, I will send the "invitation to participate" document along to you as I start my recruitment process in the near future. Please note that the research has been approved by the UPEI Research Ethics Board.

Thank you and I look forward to your response,

Mikaela Flood

Appendix F

Dear _____,

My name is Mikaela Flood, and I am completing an honours in psychology presently at the University of Prince Edward Island under the supervision of Dr. Jason Doiron. I am contacting you as my research is looking to analyze the social behaviors of individuals with Autism Spectrum Disorder (ASD) during video game play, and was hoping that you would be able to assist me in my recruitment process.

I am looking to recruit participants that have been diagnosed with ASD, and was hoping that you could forward an "invitation to participate" to all students with ASD that are registered with student accessibility services. The "invitation to participate" includes some information about the study and specifically notes that participation would mean disclosing their status as a person with ASD. Of course, we intend to keep this information confidential, but it is important that potential participants know that the researcher (myself) will know that they have been diagnosed with ASD.

Thank you for considering this request. If you are able to help, I will send the "invitation to participate" document along to you as I start my recruitment process in the near future. Please note that the research has been approved by the UPEI Research Ethics Board.

Thank you and I look forward to your response,

Mikaela Flood

Appendix G

You are invited to participate in a study that explores game play characteristics in Fortnite. The criteria to participate in the study is that you have experience playing the video game Fortnite, and are above the age of 18. Exclusion criteria for the study includes having a diagnosis of an Autism Spectrum Disorder. If you have an Autism Spectrum Disorder you are not able to participate in this study.

This research is being conducted by Mikaela Flood, as her honours thesis research project in psychology. The research is being supervised by Dr. Jason Doiron and has been approved by the UPEI Research Ethics Board.

Participation in this research will require one hour of your time. If you choose to participate you will set up an appointment to come to the on-campus research space.

At the appointment, you will first provide informed consent and complete a brief questionnaire that includes demographic items and items about your video gaming and non-video gaming behavior. Following completion of the questionnaire you will be engaged in a total of 40 minutes of Fortnite game play. Your game play will be captured using standard screen capture technology. A standard webcam will also capture your facial expressions during game play as well. After 40 minutes of game play you will be provided with a full debriefing that will include information about how to learn more about the results of the research study. As a participant in this research project, you will be provided with a five-dollar Amazon gift card, a five-dollar Tim Hortons gift card, or the option to receive a bonus mark in an introductory psychology class.

All responses and data will be kept anonymous. All questionnaire data, screen capture data, and webcam data will be stored in a secure manner (stored in a locked cabinet, on a personal memory stick that requires a password to access the information) and will be viewed only by the researcher (Mikaela Flood) and supervisor (Dr. Jason Doiron). Your identity will not be shared; your participation is completely confidential.

After participation in the study, if a participant wishes to withdraw from the study he/she may do so until two weeks after data collection without penalty or reproach.

If you would like to participate in this research project, or have any questions, please contact me (Mikaela) at mflood@upei.ca.

Appendix H

Hello and welcome to my research space, my name is Mikaela.
Before we get started, there are just a few things to go over.

Please read the following consent form over, and if you agree, sign where it states "participants signature." Also, please make sure you indicate which type of compensation you would like to receive for your participation in this study. You will have to sign two copies of the consent form, as one copy stays with you, and I keep one as well. If you choose a gift card, please leave your e-mail so that I can contact you to distribute the compensation. This will take place as soon as data collection is complete.

Thank you. Before beginning the game play, I would ask you to please fill out this brief questionnaire that contains demographic questions, questions regarding your video game usage, and a few general questions displayed on a likert scale. Please let me know when you are finished.

Great, so let's head into the next room and I will get you set up for game play. Before you begin game play, I would ask you to set the volume and brightness of the computer to your own liking. This can be done by using these two buttons for the brightness, and clicking on this here to increase the volume. Here, you have a set of headphones that is set up with a microphone that you are free to use while playing as well. You will play for 40 minutes; I will set a timer on my phone, and I will come and get you when the time is up. If you have any issues, I will be in the next room. You may start your game play now.

Ok, time is up now. Please shut off the game.

Please come and sit so that I may go over a few things with you. (Debriefing document was read over to each participant.) *Please see the debriefing document, Appendix C.

Would you like to receive the full research study upon completion?
What form of compensation would you like to receive?
Do you have any other questions?

Thank you again for participating in my research. Have a great day.

Appendix I

To: Mikaela Flood Psychology

Protocol Number: REB Ref # 6008018
Title: Autism Spectrum Disorder and Video Gaming: An Experimental Exploration of Within-game

Social Behaviors
Date Approved: February 11 2019 End Date: February 10 2020

This research proposal has been reviewed and approved by the UPEI Research Ethics Board. Please be advised that the Research Ethics Board currently operates according to the Tri-Council Policy Statement 2: Ethical Conduct for Research Involving Humans (2014) and applicable laws and regulations.

It is your responsibility to ensure that the Annual Renewal and Amendment Form for Approved Studies is forwarded to Research Services prior to the renewal date. The information provided in this form must be current to the time of submission and submitted to Research Services not less than 30 days prior to the anniversary of your approval date. The Renewal/Amendment form can be downloaded from the Research Services website.

The Research Ethics Board advises that IF YOU DO NOT return the completed Ethics Renewal form prior to the date of renewal:

•Your ethics approval permit will lapse;

- You will be required to stop research activity immediately;
- You will not be permitted to restart the study until you reapply for and receive approval to undertake the study again.
- Lapse in ethics approval may result in the interruption or termination of funding.

Any proposed changes to the study must also be submitted on the same form to the UPEI Research Ethics Board for approval.

Notwithstanding the approval of the REB, the primary responsibility for the ethical conduct of the investigation remains with you.

Sincerely,

Misty Rossiter, Ph.D.
Chair, UPEI Research Ethics Board

Appendix J

To: Mikaela Flood Psychology

amendment) End Date: February 10 2020

Protocol Number: REB Ref # 6008018
Title: Autism Spectrum Disorder and Video Gaming: An Experimental Exploration of Within-game

Social Behaviors
Date Approved: April 2 2019

The amendment to this research proposal has been reviewed and approved by the UPEI Research Ethics Board (REB). Please be advised that the REB currently operates according to the Tri-Council Policy Statement 2: Ethical Conduct for Research Involving Humans (2014) and applicable laws and regulations.

It is your responsibility to ensure that the Annual Renewal and Amendment Form for Approved Studies is forwarded to Research Services prior to the renewal date. The information provided in this form must be current to the time of submission and submitted to Research Services not less than 30 days prior to the anniversary of your approval date. The Renewal/Amendment form can be downloaded from the Research Services website.

The Research Ethics Board advises that IF YOU DO NOT return the completed Ethics Renewal form prior to the date of renewal:

• Your ethics approval permit will lapse;

- You will be required to stop research activity immediately;
- You will not be permitted to restart the study until you reapply for and receive approval to undertake the study again.
- Lapse in ethics approval may result in the interruption or termination of funding.

Any proposed changes to the study must also be submitted on the same form to the UPEI Research Ethics Board for approval.

Notwithstanding the approval of the REB, the primary responsibility for the ethical conduct of the investigation remains with you.

Sincerely,

M. Rossiter Misty Rossiter, Ph.D.
Chair, UPEI Research Ethics Board