Autism and Communication Through Virtual Means

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I: INTRODUCTION:

Autism Spectrum Disorder, or ASD, is a neurodevelopmental disorder that begins to manifest in early childhood and persists throughout adulthood. It is a spectrum disorder, encompassing various functionalities of autism (high- versus low-functioning autism) and Asperger syndrome. Individuals with ASD commonly exhibit repetitive behaviors, restricted interests, and low social interaction. They generally are delayed or impaired in their verbal and nonverbal communication skills during development, which can lead to social avoidance behaviors as time goes on. This can include avoiding attending school and other typical social events or situations for their age (Kuusikko et al, 2008). These behaviors can become real problems as academic performance is affected as well as any other exposure the child would have had to normal social situations. Data from the Autism society has shown that these symptoms only worsen as the child ages. 35% of young adults with autism do not go on to pursue higher education or receive jobs after graduating high school, and even if they do, it costs thousands of dollars more to educate them per year than typically developing students.

ASD, whether it's becoming increasingly prevalent or is just being diagnosed more, is nonetheless an ever-growing concern in the psychological community. Especially in adults with ASD, there is a lot of push to help them lead more independent lives. However, the social inhibitors present in most ASD adults make them anxious in social situations, such as the need to respond at the right time and the interpretation of facial cues or body language. In an age where virtual communication has entered the norm, what are the possible benefits of using that kind of structured environment to facilitate communication in adults with ASD? If it proves significantly effective, virtual communication could be the future of helping people with ASD in their

interpersonal relationships as well as in expressing themselves without the pressure of face-to-face or even over-the-phone interactions.

A good deal of research has been done studying the effectiveness of computer-mediated communication in individuals with ASD, but with mixed results. Burke, Kraut, & Williams (2010) found that even through textual online communication, autistic individuals still found it hard to form new relationships, reporting similar problems that they had in face-to-face interactions such as detecting humor, sarcasm, and other common social cues and conventions. A good deal of these miscommunications have to do with misrecognition or misinterpretation of facial cues for emotion recognition. Harms, Martin, & Wallace (2010) describe the atypical processing of visual stimuli to contribute to problems with emotion recognition, asserting that the ability to link emotions with facial cues is "essential for social interaction". There are many complex and subtle changes in facial expressions, especially negative ones, that can make a huge difference in what emotion is being expressed, and they often happen so quickly that autistic individuals don't have time to process it. Studies have found that individuals with ASD process faces differently than controls in respect to eye-focus and gaze in eye-tracking experiments. Pioggia et al (2005) described some of the differences stemming from people with autism processing specific aspects of the face individually as opposed to the face as a whole. Mazurek et al (2011) found supporting results in their study which showed autistic individuals as having significantly low engagement in online communication in general because of the conversational deficiencies that cause their initial social anxieties. However, research has still found that text-based communication is still the preferred method of expression for many individuals with ASD, as Davidson (2008) described. The pressure of face-to-face interactions proved oftentimes to be

too much for autistic individuals, with simple things such as laughing overwhelming and upsetting them.

Pioggia et al (2005) combatted these deficits with the introduction of an android they created called FACE (Facial Automation for Conveying Emotions). This robot projected basic emotions (controlled by the observer) onto a silicone face and was presented to two children, one with ASD and one without. They were encouraged to interact with the robot and their physiological reactions were recorded in relation to how they perceived the facial expressions they were presented with. Both children were able to identify the robot as a person and distinguish different facial expressions. Their results showed that children with autism can be led and encouraged to interact with this believably human-like android in order to practice identifying facial expressions, social interactions, facial mimicry, etc. Introducing this kind of treatment early in life can be extremely helpful in the journey toward a more typical development in children with autism.

In the age of the internet and with the rise of the avatar, I want to see if there is a way to combine the structured and low-pressure environment that text-based communication provides with the more physical additions of the avatar to aid in communication. Avatars are able to represent common facial expressions and features in a more dissociative and simple way, which could help facilitate a conversation that is closer to a face-to-face interaction without the pressures of conversation flow and nonverbal cues. As technology advances, the similarities to the intricacies of human facial expressions grows all the time, with facial tracking becoming more accurate and quicker to respond to and record the subtle changes in facial movements in real time (Bailenson, Merget, & Schroeder, 2006). Increasing the realism of facial expressions in avatars through real-time facial tracking can help facilitate more normal social interaction while

maintaining the relative distance and anonymity of an online environment. Davidson (2008) found that in the virtual world of Second Life, a specific island exists as a community for people with Autism, helping them find a community of similar others that McKenna et al (2002) describes as one of the main attractions of online communities. This state of online presence that is somewhere between pure textual communication and actual face-to-face interaction is where I believe lies the key to helping autistic individuals form more social relationships and ones that are deeper and longer lasting. This experiment has the potential to help adults with ASD to function more effectively not only in their online relationships, but also in their offline relationships by training them to recognize patterns of emotion and expression through simulated facial expressions and clear expressional cues in their textual communications.

II: PROPOSED STUDY

In my study, I want to see how the use of avatars can help people with ASD form relationships with new people, with autism and without. The goal is that with controlled and regulated nonverbal cues and tonal cues, autistic individuals will be able to engage in a conversation and eventually a relationship with another person more easily than through other mediums. This experiment aims to see a decrease in the social anxiety symptoms that autistic individuals normally report, and an increase in the participants feeling that they are understood and are understanding others better through this method of communication. I hypothesize that the structured environment and simplified facial and verbal cues will lead to a decrease in social anxiety and increases in ease of self-expression and facial emotion recognition.

i: PARTICPANTS

This experiment will draw results from a group of 300 individuals, 150 with ASD and 150 without. These people will be gathered from the general community as well as the

Champaign-Urbana Autism Network, which could put me in touch with many of local people living with ASD. The inclusion of a group of people without autism is intended to provide a control group for measurement as well as provide a contrast in individuals with whom the ASD participants will be interacting. I am more interested to see if there are improvements reported especially in interactions between the two groups as opposed to within them, as that is where most of the trouble arises in face-to-face communication. The community will be open for all participants to explore and customize to their desire and comfort, similar to the environment in Second Life. Participants will be encouraged to engage in conversation and activities with anyone they want, but they will not know any of the other people and their avatars will not be distinguished by what group they are in.

ii: DESIGN

I would create an isolated community for my study, where participants can create their own avatars and in turn interact with other avatars in the community. Verbal communication would all be text-based, coming from a live chat box that participants can use to converse with other people. To indicate sarcasm or humor, users can choose to modify the text in their chat box by using colors to indicate different nonverbal cues or emotions that don't translate well through text. Similar to the use of emojis to indicate happiness, sadness, anger, etc., participants will be able to change the color of the text to express certain emotions. However, in addition to basic emotions of happiness (yellow) sadness (blue) and anger (red), participants can also change the color to green to indicate sarcasm. Perceiving sarcasm is hard for most people in general, and even harder through text, so this modification should help with its communication and minimize misinterpretation. In addition to textual modification, users can choose to add facial expressions to their avatar in reaction to their conversation. They can choose among basic, common emotions

— happy, sad, surprised, laughing, confused, angry, or disgusted. These expressions would look basically the same on all the avatars, and would therefore be easily recognizable and distinguishable to the viewer. The expression would remain on the avatar's face for 2-3 seconds, which is longer than in normal face-to-face interactions, but would give the participant time to interpret and distinguish the emotion without the pressure of having to react right away. Participants will report the facial expressions they see as well as the ease with which they identified them. The program will also keep a log of the participants' conversations and track how many times they utilized the various text modifications. The program will be accessible online as an application similar to Second Life, so the participants will have the ability and convenience of being able to use the program at home. The experiment will take place over the course of three months, and participants will be encouraged to engage with the program every day, but will only be required to go on five days out of the week for at least an hour each time. They will be asked to keep a record of how often and how long they engaged with the program for measurement reasons.

iii: MEASURES

Before and after the experiment, the participants will be asked to complete the same tests in order to measure any changes that occur. The first test I will administer will be the Liebowitz Social Anxiety Scale (LSAS) as a self-report measure of their anxiety. The test is normally administered by a clinician rather than self-reported, but it has been shown that there are no significant differences between the two methods of taking the test. There are 24 questions on the scale that measure the fear and avoidance factors of various situations. 13 of these questions refer to performance situations, and the remaining 11 focus on social interaction (Fresco et al, 2001). The participants will take the whole test, but I will only focus on the results that pertain to social

interaction. These questions measure a participant's anxiety in things like "meeting strangers", "calling someone you don't know very well", and "expressing a disagreement or disapproval to people you don't know very well". The control results will be used as a baseline for differences in social anxiety between those with and without autism, and then the results will be compared before and after the experiment to see if there are any changes. I hypothesize that the reported levels of social anxiety in those with autism will decrease after using the program.

The second measure I will administer before and after the experiment is similar to measures they used in a study done by Harms et al (2010). This test will measure emotion recognition accuracy and reaction time. The participants will be shown 20 different pictures of people showing various facial expressions, comprising all of the basic expressions – happiness, sadness, anger, surprise, disgust, laughter, and confusion – in a random order. The participant will then be asked to choose among those emotions to identify which one is being expressed in the picture. The presentation of the picture will be linked to seven buttons, each indicating a different emotion. As soon as the picture is presented, a timer will start and will stop once the participant has pressed the button of the emotion they think is being expressed. The time between presentation and selection will then be recorded, as well as the percent accuracy of the selections at the end of the test. I hypothesize that after participating in the experiment and having had practice with and exposure to the various basic facial expressions in a structured and exaggerated way, reaction times will decrease and percent accuracy will increase.

The third measure I will administer is a self-report questionnaire about their feelings of being understood and understanding textual social cues specifically. They will rate how much they feel they can understand and pick up on different emotions (including sarcasm) in conversation, as well as how they felt they were understood by the other person in attempts at

emotional discourse and sarcasm. These questions will also be asked before and after the experiment to see if the program's text modification feature had any effect in training the participants to be able to identify different tonal differences in text and then be able to transfer them into face-to-face conversation.

iv: DISCUSSION, STRENGTHS/LIMITATIONS

These methods are not fully developed and therefore still have limitations that need to be addressed, but there are also ways that it is on the right track. One pro is that this takes place in a controlled environment where all the results can be measured in the same way and by the same measures, as opposed to observing different online mediums that already exist where participants have not been controlled or gathered into a community and too many outside variables exist. However, a con to this same environment is that it is hard to generalize these behaviors because the participants are being compelled to interact with others in a way that they may not have sought out on their own. Especially in relation to Mazurek et al (2011) where it was found that autistic individuals are more likely to engage in activities like watching television that require less exertion and social effort, motivating people to engage in these kinds of online communities on their own may prove difficult. A pro of this specific simulation that does not exist in other mediums is the insertion of facial expressions. By choosing how the avatar will react with the safety of a delay from the computer and the dissociation of the avatar, autistic individuals may find it easier to express the normal emotions and reactions in conversation without being overwhelmed by timeliness and flow. Even with these methods for establishing a relationship, at present this model does not include any way to measure longevity of relationships besides that of moving the relationship into other forms of communication like email, Facebook, or other chat mediums. The participants would have to have a way to continue to engage in this specifically

created community at home via an actual website. Even then, there is no way outside of the initial study to compel these individuals to continue to participate and the population of study could diminish significantly over the time needed to analyze the longevity and depth of relationships formed in the study. There is no motivation, too, for participants to continue to sue the program after the experiment has ended. The relatively short time period that the experiment takes place in may not be long enough to have lasting results. The fact, too, that the experiment takes place in an online community poses potential problems for generalizability and transferability to offline conversations. The structured environment of the online community could help participants in interactions *in online communities*, but may not necessarily be transferrable to normal face-to-face interactions and offline social situations. Further study and follow-ups (maybe 6 months) would have to be done after this experiment to see if the program actually helped in offline social situations as opposed to simply online communication.

Studies of facial emotion recognition in children with autism show that using a more simplistic and exaggerated representation of facial expressions through the medium of an android can significantly help in their processing development. This study, focused on adults, can be easily converted to an environment made for children for educational purposes. It can be used to train children in the recognition and mimicry of facial expressions in simulated conversation. The use of the avatar to simulate purposeful facial expressions in a way that is not quite real-life can be a great tool in teaching children with autism how to recognize these emotions in people, which can then translate into their offline relationships as they grow and develop. This experiment therefore not only has stakes for the relationships of already developed adults, but that of children as well.

Annotated Bibliography:

Bailenson, J. N., Yee, N., Merget, D., & Schroeder, R. (2006). The Effect of Behavioral Realism and Form Realism of Real-Time Avatar Faces on Verbal Disclosure, Nonverbal Disclosure, Emotion Recognition, and Copresence in Dyadic Interaction. *Presence: Teleoperators and Virtual Environments, 15*(4), 359-372.

This study is interesting because it looks at the effects of varying levels of realism in technologically-mediated interactions between people. They use voice-only, emotibox, and videoconference methods to measure the dyadic developments and self-disclosure between participants. The emotibox was particularly interesting, as they developed it to track facial expressions in real time and transmit them to the other person as shapes and colors that they would be expected to interpret without any kind of training. They found that the voice-only participants were more likely to self-disclose and to reveal more personal information than with the emotibox and videoconference options, consistent with theories of anonymity and the dyadic boundary. Since my experiment works to increase the realism of facial expressions and emotion recognition in autistic individuals, it will be interesting to compare with this study that is somewhat contradictory in that it demonstrates the effectiveness of a lack of facial cues in forming more meaningful relationships through self-disclosure.

Burke, M., Kraut, R., & Williams, D. (2010). Social use of computer-mediated communication by adults on the autism spectrum. *Proceedings of the 2010 ACM Conference on Computer Supported Cooperative Work - CSCW '10.*

In this study, researchers were interested in seeing the benefits of CMC (computer-mediated communication) on people with ASD. They hoped that the removal of the physical aspect of conversation and the structured, yet idea planning-friendly environment would help their subjects

form and/or maintain interpersonal relationships. Interestingly, they found mixed results. Generally, the subjects found themselves more at ease in initiating conversation and expressing themselves in a timely fashion through virtual communication. For those who already had some sort of friend base, this was beneficial for maintaining or even expanding those relationships. On the other hand, textual communication doesn't convey facial cues, sarcasm, or humor as well, causing difficulties. In addition, those who were attempting to form new relationships (i.e. relationships not initially formed face-to-face) found much difficulty in maintaining those relationships. This came from issues of trust and picking up on social conventions that they still couldn't escape in the virtual world. This article will be useful in helping demonstrate the steps being taken towards facilitating communication among individuals with ASD, but also that there is still room to grow and adjust, especially in terms of maintaining some of the cues that are lost through many virtual mediums.

Davidson, J. (2008). Autistic culture online: Virtual communication and cultural expression on the spectrum. *Social & Cultural Geography, 9(7),* 791-806.

In her study of communication among those with ASD, Joyce Davidson analyzed many autobiographical accounts of individuals on the spectrum, feeling that it would be most effective to learn from their own words, especially in the print form where they feel most comfortable. She was very interested in the difference between the "language games" of normal interactions as opposed to those with ASD, who are often alarmed and overwhelmed by what most people would consider to be easy to interpret or follow, even when expressing positive emotions like smiling or laughing. She found that preference for textual communication supported these reactions and ASD individuals' need for structure and rules. She also studies autistics' engagement in online communities with each other, helping them to find similar others and come

together in a way they normally couldn't do. This particular finding will be especially useful in comparing with other research I've found on motivations for engaging in online communities and seeing how it relates to the context of autistic communities.

Facts and Statistics - Autism Society. (n.d.). Retrieved December 07, 2016, from http://www.autism-society.org/what-is/facts-and-statistics/

This list of statistics from the Autism Society give important information on the prevalence of autism throughout the nation and the world, drawing from various studies and data collected by the CDC. These statistics help in explaining the importance of studying and working to treat autism, because they show how many people are diagnosed and how that number has been increasing over time. It details the financial costs of taking care of someone with autism and shows that a large percentage of individuals with autism don't advance to higher learning or even participating in the labor force. In order for them to be able to participate in society to a similar degree as the general population, we need to continue research for new treatments and developmental therapies for those with autism.

Fresco, D. M., Coles, M. E., Heimberg, R. G., Liebowitz, M. R., Hami, S., Stein, M. B., & Goetz, D. (2001). The Liebowitz Social Anxiety Scale: A comparison of the psychometric properties of self-report and clinician-administered formats. *Psychological Medicine, 31*(06).

This was a study done to determine if there were any differences between the clinician-administered version of the Liebowitz Social Anxiety Scale (LSAS-CA) and its use as a self-report measure (LSAS-SR). This will be useful in giving me background on the scale, how it works, and what it measures. The study showed that there was little significant difference between the self-report measures and the clinician-administered results, so this gives me

confidence that I can ask my participants to self-report their social anxiety symptoms on this scale before and after the experiment in order to measure any changes.

Harms, M. B., Martin, A., & Wallace, G. L. (2010). Facial Emotion Recognition in Autism Spectrum Disorders: A Review of Behavioral and Neuroimaging Studies. *Neurospsychol Rev*.

This journal will be extremely helpful in gearing my experiment towards some of the specific problems that autistic individuals have in social interactions. The study discusses emotion recognition by facial expressions in individuals with ASD as opposed to control groups. Eye-tracking and neuroimaging studies found that autistic individuals process faces at a different pace, in a different order, and just in a different way in general than controls. Neuroimaging results showed a general decrease in activation in certain brain areas that detect emotion in faces for adults with ASD as opposed to neurotypical participants. From a development standpoint, adults with ASD were inhibited somehow in their development of FER techniques and are thus slower to detect certain subtleties of emotion and expression that only come with practice. They found that it seems to act in a cycle of lack of processing development leading to decreased social interactions, which, in turn, gives the individual less practice in learning to process facial expressions which leads to, again, a lack of social interactions. This literature will help me aim the design of my avatars to be largely focused on clear expression of emotion through facial expressions, giving the participants practice in identifying the specific emotions attached to them.

Kuusikko, S., Pollock-Wurman, R., Jussila, K., Carter, A. S., Mattila, M., Ebeling, H., . . . Moilanen, I. (2008). Social Anxiety in High-functioning Children and Adolescents with Autism and Asperger Syndrome. *Journal of Autism and Developmental Disorders, 38(9),* 1697-1709.

This research studied and compared the types and degrees of social anxiety symptoms in children with High-Functioning Autism and Asperger Syndrome to normally developing children. They looked at how those symptoms may influence their development and how time, in turn, affects those symptoms. They found, as may be expected, that children with HFA/AS reported much higher levels of social anxiety symptoms such as behavioral inhibition, social discomfort, and fear of public performance. They also found that these children had a much different path of development than normally-developing children, as their social anxiety symptoms were reported to worsen as they grew older. Typically-developing children, on the other hand, reported a decrease in their symptoms as they grew older. This study will be useful in relating to other research I have found that analyzes various motivations for turning to online mediums for socialization, partially stemming from social anxiety. It will be interesting to see if these motivations manifest themselves in the same ways/patterns in autistic individuals as in a control population.

Liebowitz Social Anxiety Scale (LSAS). (n.d.). Retrieved December 07, 2016, from https://psychology-tools.com/liebowitz-social-anxiety-scale/

This link goes hand-in-hand with the study done on the LSAS by Fresco et al. That study only detailed the general results pertaining to performance anxiety and social interaction anxiety as a whole. This link to the actual assessment gives me a detailed look at all of the actual questions that are asked on the scale, giving me a better view of which questions I would analyze for results before and after my experiment.

Mazurek, M. O., Shattuck, P. T., Wagner, M., & Cooper, B. P. (2011). Prevalence and Correlates of Screen-Based Media Use Among Youths with Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders, 42(8*), 1757-1767.

This study focused on the rates of screen-based media (computers, television, video games) among autistic children. Interestingly, they found that while most of the ASD children they studied reported that they spent a significant amount of their free time watching television and playing video games (double that of the other children in the study), a drastically smaller amount of them spent time on email and in chat rooms. Researchers attributed this to the social anxieties that prevent ASD individuals from engaging in social interactions in the offline world as well. It seems that many of the children they studied did not have an offline friend base to communicate with via email or instant messaging, so in turn did not have need for those mediums. It seems that they found similar results to Burke Kraut, and Williams (2010) as far as individuals who already had a friend base. This article will be useful in comparing to newer methods of online relationship formation that ASD individuals can engage in and see if there are any changes for individuals where forming new relationships is made easier through online mediated communication.

McKenna, K. Y., Green, A. S., & Gleason, M. E. (2002). Relationship Formation on the Internet: What's the Big Attraction? *Journal of Social Issues, 58(1),* 9-31.

This article focused on three distinct qualities about internet communication that influence the relationships people form online. The anonymity of the internet easily facilitates the formation of the “dyadic boundary”, establishing mutual trust and disclosure that takes much more time face to face. This also eliminates any usual “gating features” that could inhibit relationship formation. The internet, too, provides a place for “similar others” to find each other and communicate in an open and supportive environment. This study is particularly interesting because it focuses its research on people who report social anxiety and loneliness. They found that people who self report this way are more likely use the internet to express their true selves. I think the results

found in this study will support data from individuals with ASD because they report having similar anxieties in face-to-face social interactions, just to a much higher degree. These results can be useful to compare to ASD individuals' motivations for going online.

Pioggia, G., Igliozzi, R., Ferro, M., Ahluwalia, A., Muratori, F., & Derossi, D. (2005). An Android for Enhancing Social Skills and Emotion Recognition in People With Autism. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 13(4), 507-515.

This study will be especially helpful in the development of my avatar system and the customization of facial expressions. The article describes a study done with an android called FACE, which projects simplistic facial expressions on a silicone robot face. The robot was presented to children with and without autism and their reactions were recorded. The children with ASD responded well to the android, prompting the need for further study on the implications of using this technology to help autistic children's development of facial emotion recognition. This article will be useful in not only helping develop this experiment for social facilitation in adults, but also has potential for applying this kind of technology to children in order to train them in recognition, processing, and facial mimicry earlier in life so they can function even better as adults.