Exploring Social Skills Training Possibilities in an Open-ended Virtual Reality Application for Adolescents with Autism Spectrum Disorder

Andreas Junker
Aalborg University Copenhagen
Multisensory Experience Lab
ajunke16@student.aau.dk

Lasse Embøl
Aalborg University Copenhagen
Multisensory Experience Lab
lsaren16@student.aau.dk

Carl Hutters
Aalborg University
Multisensory Experience Lab
chutte16@student.aau.dk

Ali Adjorlu
Aalborg University Copenhagen
Multisensory Experience Lab
adj@create.aau.dk

Daniel Reipur
Aalborg University Copenhagen
Multisensory Experience Lab
dreipu16@student.aau.dk

Rolf Nordahl
Aalborg University Copenhagen
Multisensory Experience Lab
rn@create.aau.dk

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Abstract
This paper presents a multi-user Virtual Reality (VR) application designed to perform Social Skills Training (SST) of adolescents with Autism Spectrum Disorder (ASD). A virtual classroom is designed to look similar to the real-world classroom of a school for adolescents with mental disabilities. Up to 20 users can log-in to the virtual environment using any of the common consumer VR Head-Mounted Displays (HMDs) such as HTC Vive, Windows Mixed Reality Headsets, or Oculus Rift. While controlling an avatar, the users can practice a variety of social activities such as verbal communication (over voice chat), non-verbal communication (by controlling their avatar), playing board games, drawing on a whiteboard, and playing video clips on a screen in the virtual environment. Four adolescents diagnosed with ASD participated in an explorative evaluation of the VR SST intervention. Results indicate that the VR SST intervention has the potential of being used as a tool to teach social skills to adolescents diagnosed with ASD.

Author Keywords
Social VR; Social Skills Training; Autism Spectrum Disorder

CCS Concepts
•Applied computing → **Collaborative learning; Interactive learning environments; Distance learning; •Human-centered computing** → Human computer interaction (HCI);

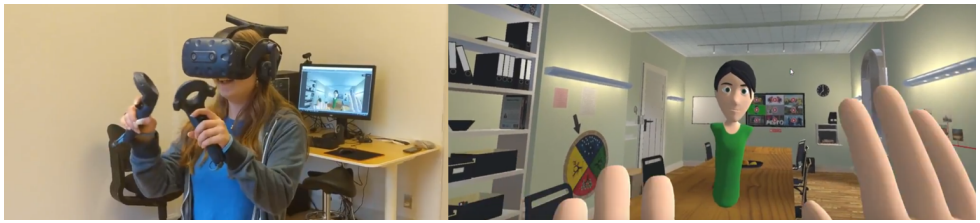

Figure 1: An adolescent with ASD engaged in the social VR application

Introduction

Individuals with Autism Spectrum Disorder (ASD) have profound deficits engaging in and maintaining social interaction throughout life. Their well-being also decreases due to failure to manage and build friendships and professional relations. This can hurt their self-confidence and perhaps even leave them unable to be a productive member of society [2]. Due to neurological underdevelopment, adolescents with ASD will experience lifelong struggles with profound deficits in the acquisition and use of adaptive social, emotional, and daily living skills. Difficulties show when processing sensory input and understanding of social cues [5]. Role-playing is seen as an effective way of helping to generalize learned social skills, especially role-playing via digital media [7, 8]. Virtual Reality enables the possibility to place the users inside relevant virtual environments, within which roleplaying of the desired social skills can take place. VR is advantageous over traditional intervention media such as non-immersive 2D screens in terms of ecological validity. Ecological validity refers to the degree of similarity between the intervention and the real world, as well as its effectiveness in improving real-world behavior [3, 9]. Ecological validity between environments is especially important to individuals with ASD, as they do not readily generalize and maintain skills, and knowledge from one context is hardly transferred to another [6]. If the VE allows for similar interactions and thus similar behavior as in real life, assumptions can be made that what is learned in the VE can have a higher possibility of being generalized. Another advantage of using VR for SST is that it is a computer-based learning intervention. Numerous studies see increased interest, increased motivation, and better behavior by individuals with ASD when utilizing computer-based learning compared to using human-mediated interventions [4, 1]. Therefore, this paper introduces a multi-user VR application designed to roleplay a variety of social skills.

The Social VR Intervention

Based on input from teachers and students from a school for adolescents with mental disabilities, a user-centered approach helped develop a social VR SST training intervention. One of the main requests of the teachers was to create a virtual environment looking similar to their students' current play-room, within which most of the social interactions in the school take place. The virtual play-room and the real play-room can be seen in figure 2. Additionally, the teachers and students requested the ability to be able to perform the same social activities as those performed in the real play-room. Therefore, in the virtual play-room, a number of social activities were implemented based on sim-

Figure 2: Comparisons between the virtual and the real life classroom

ilar activities taking place in the real-world play-room. One of these activities is the ability to draw on a virtual whiteboard with six different grabbable colored markers, and erase the drawings with a virtual eraser. Auditory feedback of marker drawing is played while drawing on the whiteboard. A television is placed in the virtual environment, allowing the users to watch several pre-loaded family-friendly videos together. Additionally, there is an interactive Tic-Tac-Toe game in the virtual classroom, as well as a bowl of fruit that can be grabbed and moved towards the mouth of the users, which will result in the fruit disappearing, followed by 'eating' sounds. Almost all of the smaller objects such as books, folders, small boxes, and the like are grabbable. The users can move around in the virtual environment either by walking or by using controller-based locomotion. Before joining the virtual room, each user can choose one out of four avatars designed for this intervention.

Evaluation

An explorative study is conducted to assess the potential of the developed VR intervention to train social skills. Four students diagnosed with ASD participated in the study (two males, two females). A total of two social VR training sessions were conducted, each lasting around 20 minutes. During each session, two students logged in to the virtual environment from the school. A researcher experienced in working with adolescents diagnosed with ASD logged in to the same environment from a laboratory at the university. Once they all put on the VR HMDs, they could see and talk to each other. The researcher would then introduce the students to the environment and the different possible activities in the environment. The researcher did not introduce

himself as a researcher but acted as if he also was a student. The researcher would then invite the participants to either play Tic-Tac-Toe, watch a video clip on the virtual TV screen, or draw on the whiteboard. The students' behavior were recorded via screen-recordings. Additionally, the students were filmed while interacting with the social VR intervention. A short video presentation of the project can be seen here. In general, the students performed several social activities such as playing Tic-Tac-Toe, talked together, threw objects to each other, helping each other reach objects, listened to music, danced together, and drew on the whiteboard together.

Discussion and Conclusion

By engaging in several aspects of interpersonal communication, the prototype affirmed that participants could act socially in an unstructured, spontaneous manner, albeit with some help from the researcher present in the VE.

Preliminary interviews found that several individuals had difficulties approaching other individuals and initiate social interaction. The same struggles were seen in the prototype, but the researcher was able to handle the situation, using the strategy of being socially engaging and praising social behavior. The researcher would suggest social acts to a participant before inviting the other participant to join. That successfully encouraged participation from those who were struggling to engage in social events. Here, the participants would be engaging socially, and the researcher would get their attention. This functionality could benefit from expanding upon the complexity of the hands implemented in the system, so users would be able to perform more complex hand gestures than just grabbing, e.g. pointing or using sign language. An important skill was practiced in the game of Tic-Tac-Toe, as participants would practice taking turns and experience losing or winning the game while socially engaging with their opponent. Some participants also drew objects on the whiteboard and showed them to the others, where the other participant and the researcher commented and praised the drawing, indicating social behaviour. Finally, grabbable objects were thrown to each other, and was seen as a social interaction, since coordination had to happen between two participants to both throw and catch objects. Here, the VRE could provide an action not intended during the design phase, but the participants and the researcher saw a new opportunity for social interaction.

In general, the social VR intervention showed potential in being a tool to rehearse social skills on children diagnosed with ASD. The application is currently being used at the school. Therefore, in the future, teachers and students interacting with the application will be interviewed with the purpose of understanding how to design future iterations. Additionally, future studies will investigate whether the students' social skills are being improved in the real world.

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