

Background:

Researchers are increasingly exploring virtual reality environments as potential intervention platforms for children with autism spectrum disorder (ASD). To date much of this work has focused on interaction with preprogrammed and/or confederate avatars in hopes that such interactions may foster higher level social communication skills. Such systems are often limited by the programming burden of realizing fluid social communication paradigms and/or restraints in the flexibility of employing confederate partners. Another paradigm with potential use in ASD intervention may be distributed Collaborative Virtual Environments (CVEs). CVEs may represent safe, flexible environments for children with autism to communicate and interact with one another and/or peers. Further, controlled tasks may be designed within the environments that may ultimately enhance interaction skills, with potential for generalization, without relying on preprogrammed or facilitated interaction.

Objectives:

In the current work we present a novel CVE environment with the potential capability of promoting communication between children with autism and their peers. This CVE utilizes a flexible conversation environment, instead of a limited and predefined conversation environment, across a series of collaborative task where the interaction is governed by contingent cooperative behavior of the participants.

Methods:

Our CVE was developed with Unity3D game engine (<http://unity3d.com/>). A series of seven block pattern games were designed in a shared virtual environment, which can be accessed by two users from different locations through internet. The connection between two agents was realized using network socket. The distributed users communicate by voice in real time in the CVE. The interaction was governed by implicit rules that required cooperation and communication in order to achieve success (e.g., turn taking of varied intervals, tasks where participant had to simultaneously move the mouse to achieve success, and tasks where participants required their partners to identify colors of blocks not visible to them to achieve success). Quite simply tasks were designed such that participants would have to communicate with their partners in order to achieve success.

Results:

The Unity-based CVE system has been developed with seven different collaborative tasks. We were able to achieve real-time voice interaction and registration of cooperative movement within task. We conducted initial pilot and interview/feedback sessions with 3 adult participants. All participants indicated that the contingent activities both (1) required them to think about collaborative strategies for communicating with their partner and (2) that they enjoyed completing the puzzles. Participants also indicated a degree of frustration with the system noting that the tasks seemed to require very precise coordination of activities that was hard to achieve.

Conclusions:

Initial pilot feasibility results supported the potential value of CVE in fostering collaboration and communication skills for participants. Our CVE may offer a way to explore and train the collaboration skills of children with autism beyond the limits of traditional VR paradigms. Opportunity of feedback from verbal and nonverbal (eye gaze) information may represent a future enhancement of this paradigm.