Intelligent Environment in Virtual Reality for Facilitating Social Behavior in Youth with Autism Spectrum Conditions

Introduction

Statement of problem: Young persons with autism spectrum conditions (ASC) commonly experience difficulties in everyday social situations. A person with ASC may desire to engage in social situations, but the ability to read people, to understand implicit social rules, or to filter out excessive sensory impressions are challenging. This may lead to anxiety and stress.

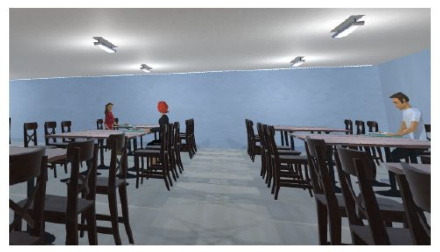
Description of the technology: A digital social training simulation is developed. This is a Virtual Reality (VR) environment integrated with human-aware algorithms that, based on the individual's specific challenges, dynamically manipulates the virtual environment to provide a personalized training scenario. The intelligent system observes the youth's responses in order to understand his/her behaviour and encourage social (inter)actions.

Practical applications: A virtual school cafeteria is modelled. Inside the cafeteria, there are sounds of people eating and talking, and the space is populated by avatars representing people. While the individual explores the virtual environment, the intelligent system adapts the difficulty by adjusting, e.g., light intensity, sound level, and amount of people.

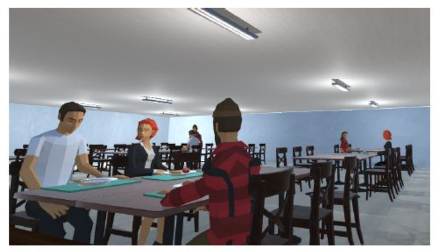
Findings to date: Theory of planned behavior (TPB), a theory to explain human behavior, is identified as a suitable cognitive framework. Through interviews with autism experts, knowledge about social behavior in ASC is incorporated as a symbolic knowledge-base in the system. Early findings from the evaluation of the prototype presents design principles for the digital aid, and suggests a measure of improved social behavior by monitoring the advancement of environment adaptations and depth of exploration in the virtual environment between sessions.

(a) Guide to pick a plate.

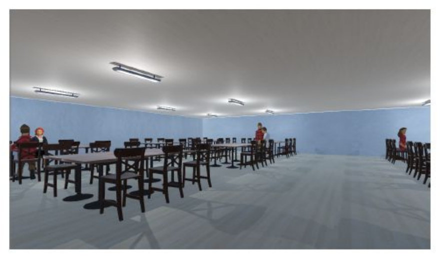
(b) Guide to find a table.



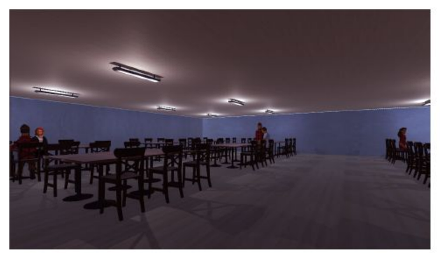
(a) Low amount of people.



(b) High amount of people.

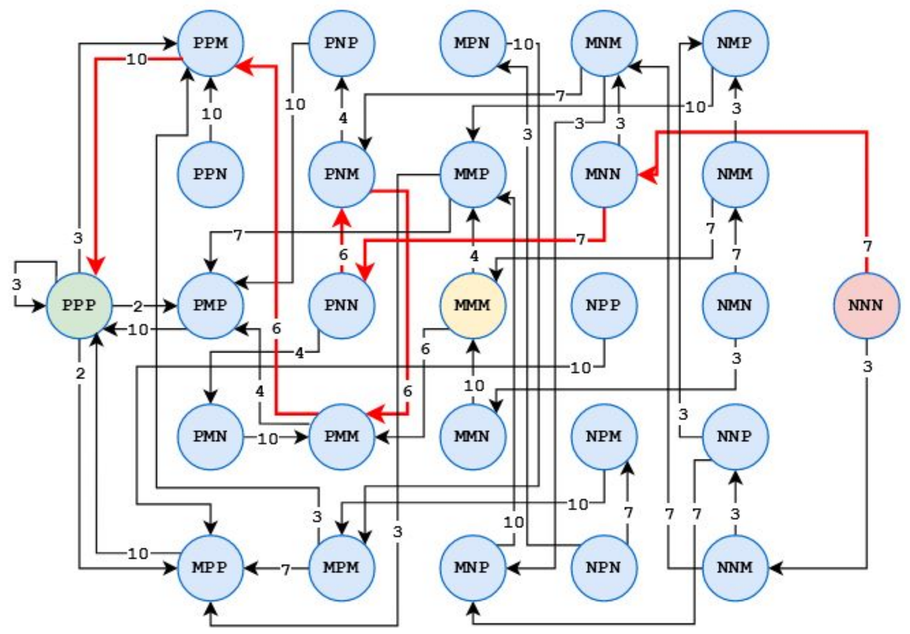


(a) Bright lights.



(b) Dimmed lights.

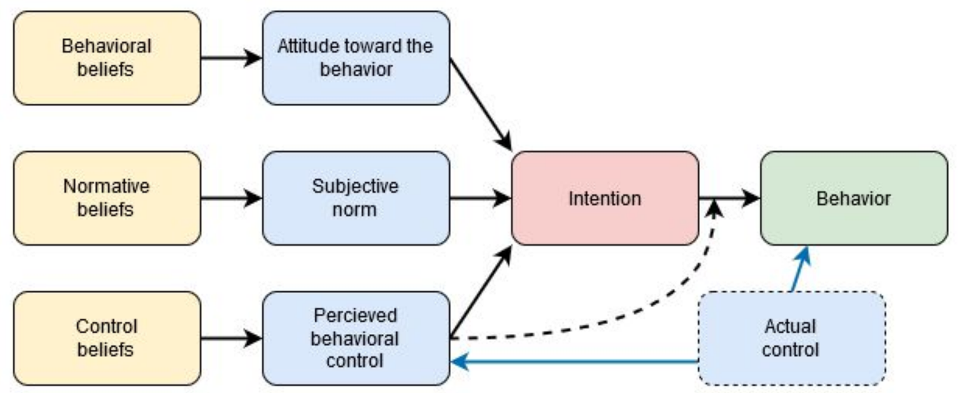
Motivation decision-graph



Variables: Expectations | Subjective Norm | Perceived Behavioral Control.
Values: Negative (N), Medium (M), Positive (P).

The system is designed to assist the child in the right moment, with the right kind of environment adaptations. The motivation decision-graph is comprised of 27 mental states. Each state comprised of three variables: 1) the individual's expectations, 2) motivation in regard to norms and 3) perceived behavioral control, each variable valuated as negative, medium or positive for each state. The system specifies the direction of motivation in a moment by following suggestions from autism experts. These specifications are adapted for each individual.

The Theory of planned behavior



Theoretical base: Theory of planned behavior is a cognitive theory for explaining an individual's intention to engage in a behavior at a specific time and place. The general idea is that the individual's beliefs about a behavior have causal effects on the individual's attitudes, subjective norms, and perceived behavioral control in the behavior, which in turn promotes or inhibits engagement in the behavior.

Incorporated expert knowledge: Following the experts' suggestions, the behavior of the interactive intelligent system is developed with the aim to assist the individual to overcome stress and anxiety in social settings. The rational intelligent agent plans adaptations of the environment to increase motivation, making expectations more clear and the surrounding more predictable.

Real environments: The proposed interactive intelligent system can also be applied in environments that are not virtual. Most modern mobile devices have built-in sensors that measure motion and various environmental conditions, as well as physiological readings of the individual. Contextual data provide the system a representation of the real environment and the individual. In this way, some aspects can be approached similarly in a real, versus virtual, environment. If implemented for Augmented reality (AR), it opens up more possibilities in the way the real world can be adapted by the system. For example, the system could dynamically add guides, or other visual or audial filters, in the real environment to assist the child in a training session.

Authors

Andreas Brännström [1]
andreasb@cs.umu.se

Juan-Carlos Nieves-Sanchez [1]
jcnieves@cs.umu.se

Timotheus Kampik [1]
kampik@cs.umu.se

Erik Domellöf [2]
erik.domellof@umu.se

Limin Gu [3]
limin.gu@umu.se

Monica Liljeström [3]
monica.liljestrom@umu.se

UMEÅ UNIVERSITY

SE-901 87, Umeå, Sweden
[1]Department of Computing Science, [2]Department of Psychology, [3]Department of Education