Assessing Collaboration between Autistic Players — An Engagement Metric

Deborah Sturm
Dept. of Computer Science
College of Staten Island
Deborah.Sturm@csi.cuny.edu

Kristen Gillespie-Lynch
Dept. of Psychology
College of Staten Island
Kristen.Gillespie-Lynch@csi.cuny.edu

Michael Kholodovsky
Dept. of Computer Science
College of Staten Island
Michael.Kholodovsky@cix.csi.cuny.edu

ABSTRACT

We developed an engagement metric that is embedded in a two-player Kinect game. The game is designed to help autistic people interact and collaborate with each other and others. Each level has two phases - initially the players work on a task independently. In order to complete the task they must collaborate and agree. We added a component to assess the level of in-game cooperation. Using face tracking we developed a metric to automatically quantify collaboration based on the amount of time each player individually and together engage with one another. This can replace the time-consuming hand-coded evaluations. We also designed collaborative reward games including one that encourages players to interact with each other.

CCS Concepts

•**Human-centered computing** → *Collaborative and social computing;*

Keywords

Autism; Collaborative Games; Cooperation; Engagement

1. INTRODUCTION

Among the criteria for diagnosing Autism Syndrome Disorder are difficulties socializing and collaborating with others [1]. Autistic individuals often report that they communicate more effectively through computer-mediated communications than with in-person interactions and immersive computer-mediated interventions are more effective at promoting generalizable social skills than less dynamic interventions [3]. Many Autism studies examine attention patterns for diagnostic and predictive purposes [7].Several collaborative apps and games have been developed for players on the autism spectrum. Some use tabletops while others employ tablets ([2], [8],[5]). These games strengthen several social skills including turn taking compromise, empathy and joint attention. In order to help autistic people transfer skills to the real world, Whyte et al. suggest that computer- mediated games include multiple players along with blended computer and in-person interactions[9].

ASSETS '17 October 29-November 1, 2017, Baltimore, MD, USA

ACM ISBN 978-1-4503-4926-0/17/10.

DOI: https://doi.org/10.1145/3132525.3134795

Figure 1: Collaborative phase for anger level

2. CONNECTING THROUGH KINECT

Our collaborative game is immersive and dynamic [4]. The game is designed to support generalizable social skills by providing players with a hybrid intervention where they simultaneously engage with a peer or sibling digitally and in-person and by teaching participants how to interpret complex emotions using varied cues Standing next to each other, player complete collaborative emotion matching puzzles by moving images using Kinect technology with hand gestures. The game has two phases in each level; an independent phase where the players move their own pieces and a collaborative phase where they have to agree on the next move. Our storyline involves a boy who is initially bullied by a group of children but later stands up to the group and is ultimately included. In Figure 1 the scene shows the character confronting the bullies and the players need to agree on his emotion during the collaborative phase.

2.1 Engagement Metric

Khoshelham and Elberink [6] report on the accuracy of the Kinect sensor data and conclude that the sensor data is noisy especially when the players are far from the Kinect. We used more robust face point cloud values along with the skeleton values to compute player orientation. In order to quantify the level of engagement, we developed an engagement metric to measure player interaction. The player can look towards the other player by turning their head alone or their body with their head or both. To capture the body movement, we subtract the distance between the z component of the shoulder vertices. We then add this to the head distance (unless the head is facing forward while the body is rotated). Given

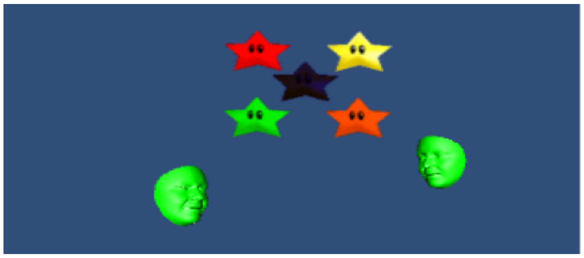

Figure 2: Engagement Reward Game

a player index, the Turn function, T, returns the distance from the sensor: $T(P) = (+/-)(dist(LM_{chin}, Sensor) + SO$, where LM_{chin} is the vertex for the chin landmark from the facial point cloud, and SO is the shoulder offset. The engagement metric for the player on the left is: $E_{PL} = \frac{\sum_{i=0}^{n} TR(PL)_i}{n}$ and on the right: $E_{PR} = \frac{\sum_{i=0}^{n} TL(PR)_i}{n}$ Finally the combined engagement metric is the average the players' metrics: $E = \frac{E_{PL}+E_{PR}}{2}$.

At the end of each level the players agree on a reward. In one reward game meant to encourage interaction between the players, we display the face mesh that we use for tracking the players faces. When the players move their heads the face mask changes to blue. If they look towards each other at the same time, the masks both turn green, a sound effect plays and an animations plays (see figure 2). Players, both typically developing and those on the spectrum have reacted very positively to this game and enjoy controlling the mask with their head movement.

3. PRELIMINARY OBSERVATIONS

In order to validate our metric, we first conducted controlled experiments with timed engagements and confirmed that these matched the generated metric. We then videoed and hand-coded 4 sessions with two players with each session coded by 3 raters. We found that the coders' scores were not consistent - showing that hand-coding can be subjective. Moreover it was difficult to measure short glances that are less than one second. In a longer study, we tested one level of the game with 14 players, recording their engagement levels for the first and second half of the level. Except for one pair, we verified that there was minimal interaction during the independent task, increased engagement during the collaborative portion and the highest level of engagement after the joint task was completed. This seemed to reflect their combined sense of accomplishment. Since each session is approximately one half hour long it can take three hand coders a total of 9 hours to process 6 sessions to record their evaluations of how engaged the players were during game-play. Our current approach with the automatic engagement metric objectively quantifies this in real time.

4. DISCUSSION AND FUTURE WORK

The engagement metric quantifies aspects of player social interaction and can be used to verify or substitute for hand coding game-play. The engagement metric module is independent of our collaborative game and can therefore be added to any Unity-based Kinect game or project. The collaborative reward games are separate scenes and can also be used in other two-player Unity games. In order to encourage even more player interaction, we plan to add a pause moment before they choose the correct emotion for the scene. The players will hopefully interact and discuss what to do next and then proceed. Not all engagement uses eye contact; people also collaborate during a shared task by speaking. We observed that some players cooperated while talking without significant turning. We hope to extend the engagement metric to include player speech. We can do this using speaker diarisation to partition any speech into segments according to player identity. We also intend to improve the metric by weighting the contributions according to time so that short glances have lower weights in the metric.

5. ACKNOWLEDGMENTS

This project has been supported by an interdisciplinary research grant awarded to the first two authors.

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