The Effect of Movement Kinematics on Sociability in Autism Spectrum Disorder

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Introduction

Autism spectrum disorder (ASD) is characterized by deficits in communication and social interaction. Such difficulty has been the focus of research studies regarding ASD (Bauminger, 2002; McConnell, 2002; Robins, Dautenhahn, Boekhorst & Billard, 2005), which has allowed for a better understanding of the disorder. However, other relevant aspects of ASD are unknown. One understudied concept is the role that somatic kinematics (movement patterns) play in ASD, particularly with respect to sociability. More specifically, it is not known how atypical movement patterns observed in individuals with ASD affect their social relations with typically developing individuals.

Objective

The objective of this study is to examine if people's sociability judgements of others can be based solely on somatic kinematics.

Hypothesis

Our main hypothesis is that typically developing individuals make sociability judgments of others based on their movement patterns. As a consequence, the atypical movement patterns of individuals with ASD are thought to affect the way in which typically developing individuals form sociability judgements of this group, thereby affecting the way in which ASD individuals form social relations with typically developing people.

Methods

Participants

A total of 30 subjects will participate in this study. 20 will be adults ages 18-60, and 10 will be children ages 10-17. An equal number of typically developing children and adults will serve as a comparison group.

Apparatus

Kinematic data will be collected using a Microsoft Kinect system (See figure 1). The system makes use of depth and motion sensors to output skeletal data as depicted in figure 2. The system was originally created for gaming applications, which made the use of this hardware challenging to use in this experiment. The use of such devices in the field of cognitive neuroscience is relatively new, with very few studies having been conducted using this equipment. Such novelty in the field makes this study particularly unique and innovative.

Figure 1. The Microsoft Kinect system.

Software

The Microsoft Kinect system was originally developed for gaming, but its rising popularity in scientific research has allowed for the development of professional software applications to aid in such activities. Regardless, the amount of applications available is still limited due to the novelty of the system, which made this project challenging due to the programming that had to be accomplished for the development of an application that was suitable for our purposes. A program, which has been called "Body Stream" was written in C# to aid in our research.

Body Stream allows for the tracking of joints of interest, which are the arms (2 links), legs (2links), feet, shoulders, neck/head, torso, and thumbs. The program can track up to 6 people detected by the Kinect system. The removal of the background visuals is still being worked on (see figure 2).

We plan on developing this software further, so that another application can analyze the vector data collected by Body Stream. This vector data represents the position of the joints over time; the analysis of this type of data would allow for a more empirical interpretation of the results of this project.

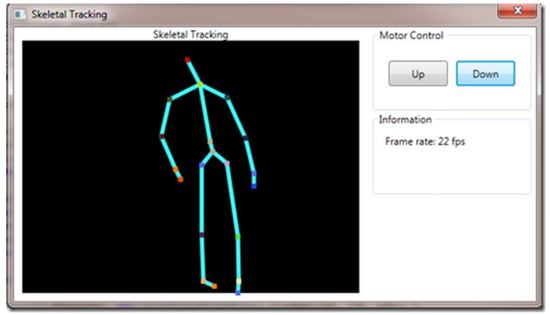

Figure 2. Skeletal tracking data.

Stimuli

The subjects of this study will be exposed to the kinematic data of two other participants (see figure 2). This data will be presented as a short video.

Procedure

Pretest Phase

Participants will be allowed to move freely in front of the Kinect in order to get them familiar and comfortable around the equipment.

Test Phase

a) Movement Task

Participants will be asked to carry out a set of predefined movements in front of the Kinect. Movements will include a handshake, a "come here" gesture, pointing, a high five, and a "hello" or "goodbye" hand wave. These movements will be recorded in the form of kinematic data (see figure 2).

Figure 3. Movement Task.

b) *Perceptual Task*

After the movement phase, participants will be asked to form a social judgment based on the kinematic data of two other subjects, one video from each group of interest. While the participant is viewing the data, a 2- part questionnaire will be administered (see figures 4 and 5).

Questionnaire

Part I

Due to the novelty of this experiment, a measure of sociability based on somatic kinematic data had to be developed. Part one of the questionnaire is meant to assess the level of interest that the participant has in engaging socially with the subject in the video. The sociability judgement will be based solely on kinematic data. Each question is based on a scale of 1 to 5, 1 being in complete disagreement and 5 being in complete agreement. The last two questions particularly aim to asses whether the subject understands that the person in the video is trying to socially interact with them, while the first three asses whether the subject would be willing to engage in a certain action with the individual on the video.

Question	Completely Disagree (1)	Somewhat Disagree (2)	Neither Agree or Disagree (3)	Agree (4)	Strongly Agree (5)
Would you approach this person?					
Would you be okay with having physical contact with this person?					
Would you return the person's gesture?					
Do the person's movements make sense to you?					
Would you say that the other person clearly wants to interact with you?					

Figure 4. Part 1 of the questionnaire.

Part II

Part two of the questionnaire, on the other hand, is meant to asses the level of atypicality observed in the movement patterns of the person in the video. The questions are rated on the same scale as those in part one.

Question	Completely Disagree (1)	Somewhat Disagree (2)	Neither Agree or Disagree (3)	Somewhat Agree (4)	Completely Agree (5)
Do the movements of this person seem jerky or robotic?					
Does it look like the person is moving too fast or too slow?					
Do the movements of this person seem consistent?					

Figure 5. Part 2 of the questionnaire.

Expected Results

We expect to find that typically developing individuals form sociability judgements based on the movement patterns of others. Specifically, we expect that individuals with ASD will score lower on the sociability questionnaire due to their atypical movement patterns.

References

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