Evaluating and Visualizing Interpersonal Synchrony in Autism Spectrum Condition Using Wearable Accelerometers

Researcher: Allison Woodward
Supervisors: Jamie A. Ward and Antonia Hamilton

Abstract

This project studies the use of wearable accelerometers as a means of measuring interpersonal synchrony in individuals with Autism Spectrum Condition in an interactive theater setting. Building upon previous techniques, the research aims to develop innovative synchronization and visualization methods to effectively highlight key moments of social engagement.

Introduction

Interpersonal synchrony, the dynamic coordination of individuals over time (Delaherche et al., 2012), is a crucial indicator of social engagement. Synchronizing movements with others in social contexts fosters connection, mutual liking, effective communication, and empathy.

People with autism spectrum condition (ASC) tend to exhibit lower synchronization abilities compared to neurotypical individuals (Fitzpatrick et al., 2017), as well as challenges in social interaction and communication skills. Studying synchrony in individuals with ASC can serve as a significant marker of successful social interactions and provide insights into engagement without relying on verbal communication.

Ward and colleagues (2018) developed a method to measure non-verbal social coordination using wrist-worn accelerometers. These wearable sensors were used in collaboration with Flute Theater during a series of interactive theatrical performances. This research extends upon their work to study synchrony in autism in an interactive theater setting.

Aims and Objectives

1. To develop an accurate method of matching up accelerometer movement data with the coordinating video footage

2. To investigate various methods for queueing the interpersonal motion coordination and develop measures for its quantitative assessment

3. To produce a way of visualizing synchrony that can be useful to reveal important moments of interest

Synchronized Acceleration Magnitudes from Actors and Participants
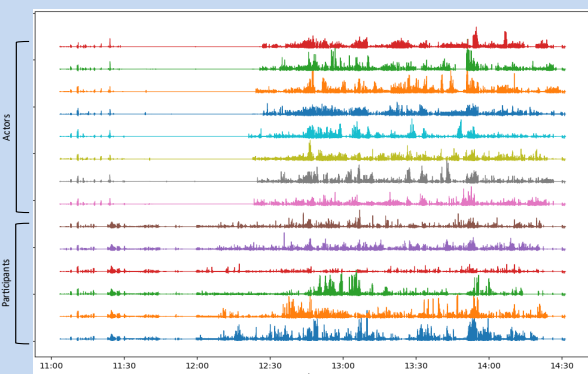
Hypotheses

- It is hypothesized that wearable sensors using time series similarity measures can be used to detect interesting social behaviors in a group of young adults in a theater setting

- It is hypothesized that a visualization based on this approach can be easily interpretable for professionals working in the autism research or intervention fields

Experimental Design

- Data collection occurred over the span of two Flute Theater performances of a rendition of Shakespeare's "A Midsummer Night's Dream," adapted to be interactive (each about two hours long)

- Participants and actors wore rubber wrist bands with Metamotion sensors to record their movements by way of 3-axis acceleration and gyro data at 20 Hz

- In addition to the movement data collected during the performances, participants continued to wear the wrist bands during a 10-20 minute post-performance break in a room outside the theater to engage in free interaction

- Video recordings of performances will be used as an additional measure of interpersonal synchrony and annotated for use alongside the sensor movement data

- Movement data will be analyzed in MATLAB using cross-wavelet coherence analysis to spot key moments of movement synchrony between actors and participants

- MATLAB and/or Python will be used to generate easily interpretable visualizations of key moments of engagement and interpersonal synchrony

Summary

- This research examines interpersonal synchrony in individuals with autism spectrum condition (ASC) using wearable sensors during interactive theatrical performances.

- The study expects to develop techniques for evaluating and visualizing non-verbal social coordination, providing insights into social interactions without verbal communication.

- Cross-wavelet coherence methods will be used to analyze movement data and identify key moments of synchrony.

- Interpretable visualizations will be created with the intent of being useful for professionals in autism research and intervention.

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Ward, J. A., Richardson, D., Orgs, G., Hunter, K., & Hamilton, A. (2018). Sensing interpersonal synchrony between actors and autistic children in theatre using wrist-worn accelerometers. Proceedings of the 2018 ACM International Symposium on Wearable Computers. https://doi.org/10.1145/3267242.3267263