Using Autonomous Agents to Educate Children on Autistic Spectrum Disorder about the Impact of Their Behaviour

Introduction

Autism Spectrum Disorders (ASDs) refer to a group of neurodevelopmental disabilities that affect an individual's social interaction, communication, interests and behaviour (Ousley and Cermak, 2014). Sensory processing issues are the most common issues observed in individuals with ASD (American Psychiatric Association, 2013). As many as 90% of ASD individuals may have experienced atypical sensory responses in audition, vision, touch, taste and smell (Leekam et al., 2007). ASD individuals who are hypo-sensitive may fail to notice sensory stimuli which typically developing (TD) people can easily detect, resulting in behavioural outcomes such as having difficulty paying attention. Conversely, those who are hyper-sensitive are likely to experience distress to sensory stimuli (Deng, Rattadilok, Xiong, 2021).

Problem Context

Improved independence and social skills of children with autism (Rattaz, Michelon, Munir, & Baghdadli, 2018) can reduce parental/sibling stress in day-to-day environments (Shivers, McGregor, & Hough, 2019). Efficacy of autonomous agent mediated behavioural interventions are evidenced in research, both with a physical presence i.e., robots (Lytridis et al, 2022) and without i.e., virtual companion (Turgeon, Lanovaz, & Dufour, 2021). Although robots have been used in research as a steppingstone to more human interaction (Alcorn et al, 2019), the additional hardware cost can be a limiting factor for everyday home usage (e.g., outside of the clinical or educational setting (Katsanis, & Moulianitis, 2021)) which could be beneficial for continuous learning of children with autism.

The existing research on the Kaspar robot (Wood et al, 2021) and an automatic detection of sensory distress of children with autism in variable environments using a combination of wearable and static sensors (Deng & Rattadilok, 2020) will be extended to explore their impact on challenging behaviours. Kaspar and a virtual companion (Figure 1) will be used to demonstrate to the child using visual gestures and verbal communication. For example, the robot/agent will touch their ears and verbally communicate to the child about their discomfort in hearing a loud noise.

(a) (b)

Figure 1: Intended Platforms (a) Kaspar, and (b) iOS Virtual Companion.

The aims of this PhD are to:

- Develop behavioural interventions modules for autonomous agents i.e., robot and virtual companion.
- Compare the efficacy of autonomous agent with conventional behavioural intervention techniques.

Person Specifications

The candidate should have an interest in working with people with disabilities.

Supervisory Team

Dr Prapa Rattadilok

Dr Gabriella Lakatos

Professor Farshid Amirabdollahian

Contact

For informal enquiries about this PhD, please contact Dr Prapa Rattadilok p.rattadilok@herts.ac.uk

References

Ousley, O., Cermak, T. (2014). Autism Spectrum Disorder: Defining dimensions and subgroups. Curr. Dev. Disord. Rep., 1, 20–28. https://doi.org/10.1007/s40474-013-0003-1

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders, 5th ed.; American Psychiatric Association: Washington, DC, USA.

Leekam, S.R., Nieto, C., Libby, S.J., Wing, L. Gould, J. (2007). Describing the sensory abnormalities of children and adults with autism. J. Autism Dev. Disord., 37, 894–910. https://doi.org/10.1007/s10803-006-0218-7

Deng, L., Rattadilok, P., Xiong, R. (2021). A Machine Learning-Based Monitoring System for Attention and Stress Detection for Children with Autism Spectrum Disorders. In Proceedings of the 3rd International Conference on Intelligent Medicine and Health, Macau, China, 13-15 August, pp. 23–29. https://doi.org/10.1145/3484377.3484381

Rattaz, C., Michelon, C., Munir, K., & Baghdadli, A. (2018). Challenging behaviours at early adulthood in autism spectrum disorders: topography, risk factors and evolution. Journal of intellectual disability research : JIDR, 62(7), 637–649. https://doi.org/10.1111/jir.12503

Shivers, C. M., McGregor, C., & Hough, A. (2019). Self-reported stress among adolescent siblings of individuals with autism spectrum disorder and Down syndrome. Autism, 23(1), 112–122. https://doi.org/10.1177/1362361317722432

Lytridis, C., Kaburlasos, V. G., Bazinas, C., Papakostas, G. A., Sidiropoulos, G., Nikopoulou, V. A., Holeva, V., Papadopoulou, M., & Evangeliou, A. (2022). Behavioral Data Analysis of Robot-Assisted Autism Spectrum Disorder (ASD) Interventions Based on Lattice Computing Techniques. Sensors (Basel, Switzerland), 22(2), 621. https://doi.org/10.3390/s22020621.

Turgeon, S., Lanovaz, M. J., & Dufour, M.-M. (2021). Effects of an Interactive Web Training to Support Parents in Reducing Challenging Behaviors in Children with Autism. Behavior Modification, 45(5), 769–796. https://doi.org/10.1177/0145445520915671.

Katsanis, I. A., & Moulianitis, V. C. (2021). An Architecture for Safe Child–Robot Interactions in Autism Interventions. Robotics, 10(1), 20. https://doi.org/10.3390/robotics10010020.

Wood, L.J., Zaraki, A., Robins, B., & Dautenhahn, K. (2021). Developing Kaspar: A Humanoid Robot for Children with Autism. Int J of Soc Robotics 13, 491–508. https://doi.org/10.1007/s12369-019-00563-6.

Deng, L., & Rattadilok, P. (2020). The need for and barriers to using assistive technologies among individuals with Autism Spectrum Disorders in China. Assistive technology : the official journal of RESNA, 1–12. Advance online publication. https://doi.org/10.1080/10400435.2020.1757787.