Editorial

Kim Baraka*, Rebecca Beights, Marta Couto, and Michael Radice

Special issue on robots and autism: Conceptualization, technology, and methodology

https://doi.org/10.1515/pjbr-2021-0022
received April 18, 2021

The idea that robots will play a role in the future of autism spectrum disorder (ASD) therapy has been strengthened by increasing supportive evidence. The predictable and programmable nature of robots can provide individuals with ASD, and especially children, with opportunities to practice social interactions that can be configured to fit each individual's needs. These characteristics place robots in a privileged position to become a bridge between interactions with inanimate objects and interactions with full-fledged social agents, i.e., humans.

For some, using robots for ASD therapy may seem counter-intuitive. How can we improve social skills in naturalistic contexts with a non-natural tool? If children with ASD seem particularly fond of technology, are we not replacing meaningful social interactions with shallow interactions with a machine? Although robots are not inherently natural, they can be put into naturalistic environments and programmed to mimic social interactions, thus providing children with the opportunity to practice such skills in a more controllable fashion. They can also act as mediators by aiding children in establishing social interactions with peers. Generally, the roles and contexts in which robots are being investigated in relation to ASD are growing and diversifying.

1 Context on special issue

This special issue was launched as a follow-up to a web panel discussion on the current state of socially assistive robotics with a focus on ASD. The panel discussion was held on June 27, 2019 and organized by Chartacloud | Robotteca.

The issue aims to gather the latest research addressing long-standing challenges of socially assistive robotics in ASD, from both technological and empirical perspectives. It brings together a selection of interdisciplinary research projects reflecting expertise in a number of fields, including computer science, engineering, behavior analysis, psychology, and education. Each of these professional disciplines offers particular areas of competency and practice that overlap with others when addressing the relevant research challenges, which we describe next.

2 Research challenges

Designing robots that are able to (semi-)autonomously interact with children with diverse behavioral profiles over an extended time span poses a number of technical challenges, many of which are far from being solved. On the perception side, these robots will need to appropriately model and infer affective states, levels of engagement, task performance, and therapeutic needs without heavily relying on therapist intervention. On the cognition side, they will need to have powerful mechanisms for adapting their behavior to account for inter- and intra-individual differences and varying contexts, while ensuring that short-term goals (engagement, enjoyment) and long-term goals (therapeutic outcomes) are met. On the execution side, they will have to possess robust ways to recover from interaction failures, whether automatically or through carefully designed human-in-the-loop interfaces.

From a design perspective, a better understanding of suitable robot characteristics, scenarios, and tasks for intervention and assessment is needed. From a technological perspective, more algorithmic advances in modeling, sensing, decision-making, and adaptation over interactive scenarios may unlock more powerful and flexible solutions. From an empirical perspective, more evidence is required to evaluate deployment, efficacy, and usability of these technologies in different settings and by different

* **Corresponding author: Kim Baraka,** Department of Computer Sciences, Vrije Universiteit Amsterdam, The Netherlands, e-mail: k.baraka@vu.nl
Rebecca Beights: Irabina Autism Services, Melbourne, Australia, e-mail: rebeccab@irabina.com
Marta Couto: Group of AI for People and Society (GAIPS), INESC-ID, Lisbon, Portugal, e-mail: marta.couto@gaips.inesc-id.pt
Michael Radice: Advisory Editor: ChartaCloud | ROBOTTECA, Randolph, NH, USA, e-mail: mike@chartacloud.com

users (caregivers, teachers, and clinicians). Finally, ethical and philosophical considerations when designing and adopting such technologies are also notable areas of research needing further examination.

3 Contributions to the issue

The issue contains four original research papers and one communication, which all address a subset of the aforementioned challenges.

Lakatos et al. [1] investigated the use of socially assistive robots to help with understudied target skills, namely, visual perspective taking and theory of mind. Their work enriches the toolbox of scenarios and target skills that therapists may be able to use to deliver therapy in the future.

Louie et al. [2] utilized methods from applied behavior analysis in the context of a robot-mediated listening comprehension intervention. Their work adds to a body of evidence showing that established ASD therapy methods can be effective when delivered by robots, and that robots can have a measurable impact on interaction quality, including engagement and positive affect.

Taheri et al. [3] highlighted the use of robots in delivering music education as a therapeutic strategy for a sample of children with more limited skills. Targeting this potentially more challenging and complex ASD sample provides clinicians and the scientific community with opportunities for greater evaluation of utility, effectiveness, and social engagement of robots in a sensory and education focused environment.

Burns et al. [4] provided a series of notable recommendations on robot design and intervention for adaptive communication according to their qualitative analysis of interviews with autism professionals. Their research addresses variability in the reported patterns of behavior and sensitivities of individuals with ASD, calling on the researchers and clinicians to consider an expansive range of robot capabilities and features.

Finally, Brivio et al. [5] addressed practical issues in using a robot to assist ASD therapy. The authors share insights and lessons learnt from a 2-year-long deployment of their robot in a care center, and an application that helps non-technical users control the robot, responding to the therapist's needs during the sessions.

All these papers emphasize the complexity of introducing robots in the therapy room and open the door to new questions and possibilities in the realm of socially assistive robotics.

4 Concluding thoughts

As time and research progress, so do science's views and society's views of autism. As we move forward, it becomes essential to involve stakeholders in decision processes. When developing technologies that focus on assisting clinicians and teachers working with individuals with ASD, it is important to clarify what role(s) robots will need to play. Often, robots are deployed in clinical or educational settings with no end-user involvement during development. This may raise concerns or resistance in using the technology, which may be perceived as a replacement rather than a helpful tool. Moving forward, it is crucial that we do not dismiss these concerns and work towards an inclusive approach to technology development in these critical contexts.

As a final note, we would like to thank authors for their submissions, reviewers for their service, and the Paladyn, Journal of Behavioral Robotics (degruyter.com/pjbr) for offering a space to disseminate interdisciplinary research.

References

[1] G. Lakatos, L. J. Wood, D. S. Syrdal, B. Robins, A. Zaraki, and K. Dautenhahn, "Robot-mediated intervention can assist children with ASD to develop visual perspective taking skills," *Paladyn, J. Behav. Robot.*, vol. 12, no. 1, pp. 87–101, 2021, DOI: https://doi.org/10.1515/pjbr-2021-0007.

[2] W.-Y. Geoffrey Louie, J. Korneder, I. Abbas, and C. Pawluk, "A study on an applied behavior analysis based robot-mediated listening comprehension intervention for ASD," *Paladyn, J. Behav. Robot.*, vol. 12, no. 1, pp. 31–46, 2021, DOI: https://doi.org/10.1515/pjbr-2021-0005.

[3] A. Taheri, A. Shariati, R. Heidari, M. Shahab, M. Alemi and A. Meghdari, "Impacts of using a social robot in teaching music to children with low-functioning autism," *Paladyn, J. Behav. Robot.*, vol. 12, no. 1, pp. 256–275, 2021, DOI: https://doi.org/10.1515/pjbr-2021-0018.

[4] R. B. Burns, H. Seifi, H. Lee, and K. J. Kuchenbecker, "Getting in touch with children with autism: specialist guidelines for a touch-perceiving robot," *Paladyn, J. Behav. Robot.*, vol. 12, no. 1, pp. 115–135, 2021, DOI: https://doi.org/10.1515/pjbr-2021-0010.

[5] A. Brivio, K. Rogacheva, M. Lucchelli, and A. Bonarini, "A soft, mobile, autonomous robot for playing with autistic people," *Paladyn, J. Behav. Robot.*, vol. 12, no. 1, pp. 187–198, 2021, DOI: https://doi.org/10.1515/pjbr-2021-0015.