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# Is Developmental Robotics a Solution for Socially Assistive Robotics?

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## DIALOG COLUMN

### Is Developmental Robotics a Solution for Socially Assistive Robotics?

The Human-Robot Interaction (HRI) field for assistive applications focuses on how to provide long-term/lifelong social interaction for vulnerable populations (e.g., children with autism, post-stroke patients, and individuals suffering of cognitive impairments) [1]. Due to the sensitive nature of their interactions with humans, socially assistive robots need a thorough and targeted training, similar to that received by nurses/trainers/therapists, before they are released in the wild. They also need to continuously and incrementally learn and adapt their behavior to the user's profile (i.e., personality, preferences, and disability) and to the environmental changes in order to deliver a personalized, engaging, and motivating social interaction and useful feedback to their "users".

Different perceptual modalities and cognitive and behavioral capabilities need to be explored so that a robot can develop through continuous interaction with, learning of, and adaptation in the social environment. The robot's decisional abilities require taking into account context, user's profile and disability level while performing its tasks [1]. It has to take initiative to establish and conduct a fruitful therapeutical session with humans, and change its interaction styles depending on context and scenarios [2], [3]. The point raised by Rohlffing and Wrede regarding the necessity of a long-term memory to facilitate knowledge assimilation and consolidation is one that I also share. I would go even further and argue that sharing learned concepts between robots and make some of that knowledge innate to the next generation is extremely valuable. Moreover, socially assistive robotics is about helping vulnerable users in specific tasks where the robot's behavior evolve with time to better serve the user. In this context, I believe traditional machine learning approaches are more adequate than developmental robotics.

The multimodal sensing capabilities that are required to move and act for long periods of time in continuously changing, human-centered environments have highlighted the importance of the autonomous mental development of robots. Moreover, developing robots capable of expressing intentionality and spontaneity in social interaction is another problem, where the developmental process is more appropriate [4]. Nevertheless, in the assistive context, one difficulty encountered in lifelong learning robots is to measure what the robot has learned and its evolution in time. A qualitative and quantitative answer to this question could provide the possibility for the human to act on and to influence the robot decisional processes and vice versa.

Rohlffing and Wrede discuss also the importance of incorporating some high-level abstract representation of tasks and object affordances in the system. This implies to have or to construct some semantic representation and/or ontological schema. Most of the existing works in robotics have tried to learn the affordances [5] and very little have addressed the key problem of inferring affordance parameters from multimodal perceptual measurements [6]. This is of high importance and more research

should be pursued in this direction.

To conclude this short response, recent works in socially assistive robotics show the importance of long-term interaction in having a personalized adaptive behavior based on the experience achieved and the interaction episodes [7], [3]. In this context, developmental robotics, still in its infancy, can perhaps bring some new solutions to assistive robotics and therefore an interdisciplinary collaboration that creates the marriage between these two fields is required.

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#### REFERENCES

- [1] A. Tapus, C. Tapus, and M. J. Matarić, "User-robot personality matching and robot behavior adaptation for post-stroke rehabilitation therapy," *Intelligent Service Robotics*, vol. 1, no. 2, pp. 169–183, April 2008.
  - [2] A. Tapus and M. J. Matarić, "Socially assistive robotic music therapist for maintaining attention of older adults with cognitive impairments," in *Proceedings of AAAI Fall Symposium AI in Eldercare: New Solutions to Old Problem*, Washington D.C., USA, Nov. 2008.
  - [3] A. Tapus, C. Tapus, and M. J. Matarić, "Long term learning and online robot behavior adaptation for individuals with physical and cognitive impairments," in *In Field and Service Robotics, Results of the 7th International Conference*, A. Kelly, K. Iagnemma, and A. Howard, Eds. Series: Springer Tracts in Advanced Robotics, 2010, vol. 62, pp. 389–401.
  - [4] A. Baranes and P.-Y. Oudeyer, "R-iac: Robust intrinsically motivated exploration and active learning," *IEEE Transactions on Autonomous Mental Development*, vol. 1, no. 3, pp. 155–169, 2009.
  - [5] E. Rome, J. Hertzberg, G. Dorffner, and P. Doherty, "06231 executive summary towards affordance-based robot control," in *ser. Dagstuhl Seminar Proceedings, E. Rome, P. Doherty, G. Dorffner, and J. Hertzberg, Eds., no. 06231. Dagstuhl, Germany: Internationales Begegnungs- und Forschungszentrum für Informatik (IBFI)*, Dagstuhl, Germany, 2006.
  - [6] T. Hermans, J. M. Rehg, and A. Bobick, "Affordance prediction via learned object attributes," in *IEEE International Conference on Robotics and Automation (ICRA): Workshop on Semantic Perception, Mapping, and Exploration*, Shanghai, China, 2011.
  - [7] Y. Demiris, "Knowing when to assist: Developmental issues in lifelong assistive robotics," in *Proceedings of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, Minneapolis, MN, 2009, pp. 3357–3360.
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