

## Project Summary

Robotics is currently at the forefront of technologies with recognized potential for impacting quality of human life. In response to the large need for personalized one-on-one care for the growing populations of elderly individuals and those with special cognitive and social needs throughout life, great strides must be made in the domain of human-robot interaction (HRI) in order to bring robotics into such application domains in human everyday life.

This interdisciplinary proposal identifies a specific set of HRI research questions in *socially assistive robotics*, the study of robotic systems capable of providing help through social rather than physical interaction. The research focus is on two key issues: (1) the role of the robot's physical embodiment in the interaction; and 2) the use of expressive embodied communication and user modeling toward personalized time-extended assistive interaction. A specific consideration is given to interactions under the challenges of socio-communicative heterogeneity and deficits. A novel assistive HRI architecture is proposed based on multimodal perception, embodied expression and communication, and on-line user modeling. The architecture is implemented both on physical socially assistive robots and a simulated agent, allowing for carefully designed hypothesis-testing experiments over a range of embodiments. To give a realistic context to the proposed research, the experimental testing and evaluation will be performed with human subjects, children drawn from a typical population and a population with Autism Spectrum Disorders (ASD), a family of disorders that have already been identified as amenable to technological, and in particular robotic, intervention and therapy.

**Intellectual merit:** A novel assistive HRI architecture is developed, implemented in three different types of real-world socially assistive systems, and tested on a large human subjects pool consisting of both ASD and typical populations. Pilot data with ASD users provides motivation for this work. A key contribution of the research lies in the unified and tightly integrated end-to-end approach that jointly studies embodiment and multimodal expressive communication, grounded in data from hypothesis-driven experiments, and the development and use of novel signal processing and user modeling methods for HRI design. With the support of the large and unique corpus of data that will be collected and analyzed, the expected scientific impact will go well beyond novel insights toward a better understanding of the fundamentals of HRI and its relevance for diverse user populations and for socialization of children with ASD.

**Broader impact:** The proposed research, by its very nature, aims to impact the large and growing population affected by Autism Spectrum Disorders. In addition to the basic research, two complementary educational outreach programs will be implemented to broaden the impact of the work: (1) a novel K-12 outreach and teacher training program specifically aimed at special education through the use of robotics for teaching STEM topics; and (2) undergraduate research training and pipelined role-modeling from pre-university to undergraduate to graduate students. The education programs dovetail with the research plan, resulting in integrated activities involving all participants in the research team.