# SOCIAL ROBOTICS AND VIRTUAL ENVIRONMENTS TO PREPARE ADOLESCENTS WITH ASD FOR EMPLOYMENT

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Unemployment rates among individuals with ASD are often linked to difficulties in verbal and nonverbal communication, needed in job interviews and workplace interactions. Emerging interventions using VR systems and robot-mediated training offer promising solutions by creating safe, structured, and adaptable environments for skill development. This paper presents an ongoing project focused on evaluating the effectiveness of social robots and virtual worlds in improving social skills in children and adolescents with ASD, with particular emphasis on preparing young adults for employment. By combining immersive, interactive experiences with targeted skill-building, robotics and VR provide innovative approaches to enhance social functioning and employment readiness for people with ASD.

## INTRODUCTION

Adolescence marks a critical developmental period for individuals with Autism Spectrum Disorder (ASD), during which the characteristics associated with their condition may evolve (Schall & McDonough, 2010). While some adolescents exhibit improvements in communication skills, persistent challenges in social communication often extend into adulthood (Seltzer et al., 2004). These difficulties can significantly impact the ability to manage the social dynamics of workplaces, households, and communities.

Effective social skills and the ability to adapt to diverse social situations are fundamental for achieving successful employment and broader life outcomes (Schall et al., 2012). For individuals with ASD, self-determination plays an important role in identifying personal strengths, preferences, and interests, enabling them to explore career paths aligned with their capabilities. This process requires a combination of knowledge acquisition, skill demonstration, and opportunity recognition to be empowered and exercise freedom and choice in meaningful ways (Morán et al., 2021). Established practices, including internships, volunteering, and vocational programs, have proven effective in fostering these competencies (Hillier et al., 2007; Nieto et al., 2015; Alfieri et al., 2024).

Emerging technologies, such as social robotics and virtual environments, hold

significant promise as innovative tools to further prepare these individuals for the transition to employment. The paper explores the potential of these technologies to address the needs of adolescents with ASD and present a program that use such tools to prepare them for a future employment interview, promoting social and communication skills.

## 1. EMPLOYABILITY IN ASD

Employment outcomes for individuals with ASD are still limited, with unemployment rates estimated to range between 50% and 75% (Hendricks, 2010; Liptak et al., 2011; Volkmar et al., 2009). Despite these daunting statistics, some individuals with ASD can achieve employment and independence when supported by personalized, goal-focused curricula and intensive, structured instruction. However, critical barriers persist, particularly during the job interview process, which has been identified by stakeholders, such as those in the Autism Speaks community, as a major obstacle for adolescents and adults with ASD (Autism Speaks, 2012).

The communication difficulties characteristic of ASD can disrupt conversational reciprocity and flow, compounding difficulties in interview settings (Morgan et al., 2014). Also, nonverbal communication behaviors – such as limited eye contact, atypical facial expressions, and inconsistent gestures – are particularly impactful, often contributing to poor interview performance (Strickland et al., 2013; Kandalaft et al., 2012).

To address these issues, previous interventions have focused on building essential social and cognitive skills. Programs that provide explicit instruction in emotion recognition and social cognition have shown promise in improving individuals' abilities to understand and attribute mental states to themselves and others (Golan & Baron-Cohen, 2006; Kandalaft et al., 2013; Ozonoff & Miller, 1995; Turner-Brown et al., 2008). Effective social skills trainings include elements such as explicit teaching, modeling, role-play, performance feedback, and the systematic transfer of skills to novel situations to ensure generalization (Lopata et al., 2010).

## 2. THE USE OF TECHNOLOGY IN EMPLOYMENT PROGRAMS FOR ASD

Technology is mainly used in programs to promote skills for employment in ASD to offer safe and controlled environments – both real and virtual – where users can practice and integrate social cues to improve their skills (Kandalaft et al., 2013). A systematic review by Walsh et al. (2017) highlights the effectiveness of technology in enabling individuals with ASD to experiment with new behaviors, demonstrating strong outcomes in the maintenance and generalization of acquired skills across various contexts.

Recent advancements in technology, particularly internet-based training and virtual reality, have shown promise in enhancing employment-related skills for individuals with ASD. Previous studies highlighted the partial effectiveness of such tools in improving job interview skills. Strickland et al. (2013) demonstrated that participants with ASD who completed an internet-accessed training program

exhibited significant improvements in verbal communication compared to a control group. Similarly, Burke et al. (2018) employed a Virtual Interactive Training Agent system, revealing that individuals with ASD could develop critical skills such as identifying personal strengths, self-promotion, self-advocacy, and effectively responding to situational questions. Despite these encouraging outcomes, both studies noted a lack of progress in the realm of nonverbal communication, suggesting an area where further innovation and refinement of these technologies is needed.

To address this limitation, Kumazaki et al. (2019) introduced a role-play-based guidance system featuring an android robot. This system, designed to closely replicate the appearance and movements of a human, provides a platform for individuals with ASD to practice job interview scenarios. By combining advanced robotics with role-play methodology, the system offered a comprehensive approach to improving both verbal and nonverbal communication skills.

Recently, Shahverdi et al. (2023) evaluated the effectiveness of robot-mediated training for job interviews for young adults with ASD. The intervention, conducted over six weeks, utilized a Furhat social robot (Al Moubayed et al., 2013) in simulated job interview scenarios, focusing on enhancing nonverbal communication and interaction skills. The study assessed four key nonverbal behavioral challenges commonly observed in individuals with ASD: maintaining eye contact, minimizing excessive body movements, reducing atypical vocalizations, and maintaining proper orientation toward the interviewer. The results revealed diverse outcomes, with some participants who demonstrated consistent improvement, while others showed fluctuating progress. This variability underscores the importance of tailoring interventions to individual needs, supported by objective and quantitative analysis to optimize training efficacy.

Both VR and robotics create safe, controlled environments where users can practice workplace scenarios and develop essential skills without the stress or risks associated with real-world interactions. VR enables highly realistic simulations of job settings, allowing individuals to explore tasks and challenges that mirror real-life experiences, while robotics, particularly humanoid robots, provide opportunities to practice social interactions and communication. The adaptability of these tools ensures that training can be personalized to the individual's needs, offering repetitive practice, immediate feedback, and gradual skill-building at a pace suited to the learner (Cersosimo & Pennazio, 2024). Furthermore, their interactive and immersive nature enhances engagement and motivation, making the training process more effective (Charron et al., 2017).

## 3. OUR PROJECT

Starting from the considerations illustrated in the previous paragraphs, an ongoing research project at the DISFOR Department of the University of Genoa and started in September 2023 is described. The two-year project, funded by the "Fondazione Italia per l'Autismo" (FIA – Onlus), is based on an innovative framework that merges the use of social robots and VR in order to develop the social, communicative and

conversational skills of adolescents with ASD. In this framework, the communication channel opened by the robot as a social mediator allows access, through the subsequent use of virtual worlds, to higher levels of abstraction, complexity and generalization, ultimately leading to the application of the learned skills in a socially engaging context. This framework, tested in previous studies (Pennazio et al., 2020) has demonstrated its effectiveness in the development of communicative and social skills, including emotion recognition and the analysis of eye contact, attention and imitation. By honing these skills, adolescents with ASD can gain confidence and better navigate social scenarios, ultimately contributing to their success in various aspects of life, including employment opportunities.

The project has three objectives: (a) improve social skills, (b) stimulate communication skills (c) promote conversational skills needed to support a job interview in a structured and interactive way.

The project plans to involve in the initial phase 6 children with ASD aged between 15 and 19 who attend PHILOS, a specialized pedagogical Academy with cutting-edge techniques for the enabling and rehabilitative care of people with ASD and their families, active for many years in the Genoa area.

In order to calibrate the educational intervention around the needs, desires and real possibility of participation of the children, a User Centred Design approach will be followed. Through this approach, the needs and desires of the user will be given a lot of attention in every step of the design process in order to maximize the usability of the intervention itself. The recipients of the project (teachers and pupils/students with ASD and their families) will therefore be actively involved, when possible, as they will be able to offer suggestions, ideas but also stories, narratives, as well as feedback to the proposals put forward by the researchers. These suggestions will be useful for defining the work sessions to be implemented, the activities, the appearance and methods of interaction with the robot, the type of application to virtual worlds and the methods of evaluating the quality and effectiveness of learning paths mediated by robotic systems and virtual worlds.

The study will therefore follow both a top-down approach in which the research team will suggest to therapists and educators activities to implement on the robot and in virtual worlds appropriate to the age and development of the children, and an approach aimed at understanding the recipients themselves, their ambitions and needs. Through a phase of comparison and co-design between the partners (DISFOR researchers, PHILOS professionals, and researchers from the DIBRIS Engineering Department) the educational activities will first be designed by defining the methodologies and strategies to be used (tutoring, small group work, free work), the role of the robot and the virtual world and then implemented on the devices through the creation of interfaces necessary to modify the perception and the degree of sensory stimulation produced (customization of the robot and the virtual environment) and define the environmental scenarios within which the activity will be carried out.

The robot that will be used in the project is Pepper, configured for vocal and visual

interactions. Initially, the choice was made to use the Nao robot, but Pepper's physical and structural characteristics were later found to be more suitable for the age of the people involved. The virtual environment that will be used to replicate the activities proposed in the interaction phase in person with the robot is still being selected, with the aim of allowing a generalization of the skills learned through the simulation of different environments. The choice is however directed towards the use of protected environments such as Edmondo. A final phase aims to propose the same activities in the participants' school environment. In this context, the learning path will begin with just one classmate and will continue involving two, then three, then four classmates. The work, in rotation, will involve all the classmates. The experimenter and the class teachers will always be present.

Since the interaction with the robot is based on social stories, created by Carol Gray (2021) with the aim of improving social skills in individuals with ASD, these will be used in an adapted way in association with the robot. For example, the participants will be presented with stories about how to behave during a job interview and in the work environment.

For each work session, a work script will be created that will be implemented on the robot in which instructions will be given to the robot not only on what it will have to say but also on the feedback it will have to provide through movements and language.

Before the start of the experiment, a test will be administered by the psychologists active at PHILOS to evaluate the communication and conversational skills possessed by the children. This test will be repeated at the end of the experiment. Monitoring tools will also be used (observation grids prepared by the researchers) to observe the various experimental sessions.

In this online supplementary document (link) it is possible to find a description of the first phase of work, the one mediated by the robot, with the articulation of the experimental sessions implemented in the robot by the researchers and then applied with the adolescents by the professionals of PHILOS and the researchers of the University.

## 4. CONCLUSIONS

The use of social robots as innovative tools to support the acquisition of communication and conversational skills in adolescents with ASD has been shown to have a significant impact in supporting their social and emotional development. As highlighted in the paper, interaction with social robots offers the possibility of structuring a controllable and predictable environment, where children can practice without the pressure of traditional human interactions. This approach not only improves their communication skills, but also offers an important opportunity to prepare for real-life situations, such as job interviews.

However, to maximize the effectiveness of such interventions, it is essential to continue with research and innovation. It is essential to program robots that can adapt to different learning styles and specific needs of individual users. Personalization

allows to address more effectively the variations in the behavioral profile and communication preferences of adolescents with ASD. Also essential is the collaboration between experts from various disciplinary fields: robotics (engineers), psychologists, pedagogists and therapists who can contribute to further enrich the development of application formats suitable for social robots. Such synergies could lead to innovative intervention models, able to address the various communication and social challenges that children with ASD face. The goal of research in this area, including that of the presented study, should explore not only the use of robots in therapeutic or school settings, but also their application in real work contexts. Experimenting with training programs that integrate social robots and opportunities for internships or supported jobs could create an effective bridge between education and professional integration.

Furthermore, it is crucial to implement evaluation systems to monitor the effectiveness of social robot-based interventions. Regular feedback from educators, therapists, and families can provide valuable information to optimize programs and improve the learning experiences of people with ASD.

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