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# Intervention with a humanoid robot avatar for individuals with social anxiety disorders comorbid with autism spectrum disorders

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ABSTRACT

For some individuals with social anxiety disorders (SAD) comorbid with autism spectrum disorders (ASD), it is difficult to speak in front of others. Herein, we report the case of a patient with SAD comorbid with ASD who could not speak in front of others until she used a humanoid robot as her avatar. During the intervention, her personality changed from shy to outgoing, which is explained by the Proteus effect. These case findings suggest that interventions with a robot avatar might improve the motivation for individuals with SAD comorbid with ASD who cannot speak in front of others to communicate.

## 1. Background

Social anxiety disorder (SAD) commonly co-occurs with autism spectrum disorder (ASD) (Spain et al., 2018). It is difficult for some people to speak in front of others (Muris and Ollendick, 2021), which is linked to social restrictions.

Previous studies have demonstrated that individuals with ASD are motivated to use robotics (Kumazaki et al., 2017, 2019, 2020). These individuals have been found to have a preference for robotics (Kumazaki et al., 2020), and those with particular visual strengths may be especially adept at engaging with digital modalities. Given these findings, it is natural that individuals with ASD are interested in operating robots. In fact, previous studies revealed that they have a higher degree of task engagement when they communicate with others through teleoperating a humanoid robot avatar (Kumazaki et al., 2017, 2019).

In general, for patients with comorbid SAD and ASD, directly speaking to others tends to make the individual self-conscious and is likely to make him or her nervous. It is expected that using the humanoid robot as an avatar when communicating with others would meaningfully increase their motivation, decrease their self-consciousness and nervousness, and provide the opportunity to speak to someone who cannot speak in front of others. Here, we report the case of a patient with comorbid SAD and ASD who could not speak in front of others for many years and used a humanoid robot as an avatar. The patient provided informed consent, and the study design was approved by the appropriate ethics review boards.

## 2. Case presentation

The patient (A) was a 22-year-old woman with ASD, had no delay in achieving motor milestones of development. There was no history of significant physical illness. She would not approach or make eye contact with any guests at home, and in her infancy, she would cry if her mother ever forced him to interact with anyone who was not familiar to her. As a child, she would not play with other children or initiate interactions with them. In kindergarten, she would not interact with teachers or classmates; she would sit alone, and she would not play with other children or show any interest in making friends. She had severe anxiety, and at 6 years of age was unable to utter a word to teachers or classmates. Her IQ (average of perceptual reasoning and processing speed of WAIS-IV) was 85. Her total score on the Childhood Autism Rating Scale (Kurita et al., 1989) was 39, indicating severe ASD. The diagnosis of ASD

*Abbreviations:* SAD, Social anxiety disorder; ASD, Autism spectrum disorders.

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was confirmed using the criteria in the DSM-5 and standardized criteria taken from the Diagnostic Interview for Social and Communication Disorders (DISCO) (Leekam et al., 2002), which has been reported to have good psychometric properties (Wing et al., 2002).

She was also diagnosed with SAD according to the DSM-5 criteria, confirmed with Structured Clinical Interview for DSM Disorders Psychosis Module (Gorgens, 2011). However, she was not diagnosed with selective mutism because she did not have an established capacity to speak in any social situations. For example, even though she could speak at home, she could only talk one-sidedly to her family, and could not communicate interactively.

Despite extensive treatment, including cognitive behavioral treatment, she had been unable to speak to anyone outside of her home for many years. She was adept at engaging with digital modalities and had a preference for interacting with advanced technology. Considering her interest in advanced technology, we decided to use a humanoid robot for intervention.

We used the "CommU" (Vstone Co. Ltd; Fig. 1) (Kumazaki et al., 2020) robot, which can shift its gaze and blink, and demonstrate varied facial expressions. In the previous setting, the therapist input words into the computer, which was read aloud by CommU. Although the therapist prepared an environment in which A could talk to CommU while no one was watching, she could not speak because she feared that someone might be listening. However, she showed strong interest in CommU and the therapist's operation. She thought that CommU had a very expressive face and was good at communicating, which was confirmed by her statement to her mother and the observations of her therapist.

Since A had a strong ability to operate a PC, we suggested that she operate the robot as an avatar, and encouraged her to communicate with the therapist through CommU. Fig. 2 illustrates the experimental room setup. Fig. 3 provides an example that the participant operates the robot as her avatar and communicates with the therapist. (The persons in Fig. 3 provided written informed consent to publish this image.) Very quickly, A began to enjoy chatting about her daily life and future plans through CommU. When A operated the robot, her personality changed from shy to outgoing, which was also confirmed by her statement to her mother. While operating CommU, she concentrated on operating the PC, which helped her avoid eye contact with her interlocutors.

We provided an opportunity for A to participate in 20 intervention sessions, each lasting approximately 30 min, once every two weeks. When communicating in writing, it took approximately three minutes to respond and she could write only a few words. However, when using CommU, she could respond in approximately five seconds, use well-organized sentences, and enjoy a conversation with a good rhythm. She stated that the interlocutor's reaction to her speech (i.e., the utterance by CommU) was not as bad as she expected, which contributed to reducing her anxiety about others and increasing her confidence in speaking.

A began to spend time at school sitting in the middle of the classroom, and she brought up her own experiences by using CommU. In the last session, she was confident that she could overcome her communication issues, which was confirmed by her statement to her mother and observation by her therapist, and spoke greetings to her teacher and classmates via her own mouth after an interval of 16 years.

**Fig. 1.** CommU.

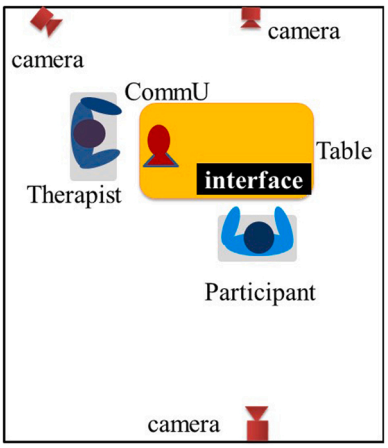


**Fig. 2.** Experimental room setting.

**Fig. 3.** An example that the participant operates the robot as her avatar and communicates with the therapist.

## 3. Discussion

For patient with comorbid SAD and ASD who cannot speak in front of others, intervention with a teleoperated robot as an avatar is very beneficial because the patient can avoid eye contact by focusing on the operation of the PC while still speaking and reacting to others through CommU while in their presence. Above all, the findings suggest that this intervention with a robot might help patient with comorbid SAD and ASD understand that an interlocutor's reaction to their speech is not as negative as expected, which is linked to reducing social anxiety and increasing confidence in speech.

Individuals with ASD are known to avoid eye contact and pay limited attention to an interlocutor's eye area (Noris et al., 2011). One motivation for this pattern of avoidance is that the patients are afraid of being seen by the interlocutor. Despite not wishing to be seen, however, some patients may be interested in staying in the presence of others and communicating with them. In the present case study, operating the robot may have met the patient's needs, allowing her to avoid eye contact with others, employ a PC, remain in the presence of others and communicate with them.

The Proteus effect is the tendency of individuals to be affected by their digital representations such as avatars (Yee and Bailenson, 2007). During the intervention, A's personality changed from shy to outgoing. A judged CommU to have a very expressive face and be good at communicating, which may have contributed to changes in her personality during the experiment, making her more sociable.

These case findings suggest that intervention with a humanoid avatar

may change these traits and improve the motivation to communicate via speech. However, it should be noted that A is skilled at typing; this intervention may be limited or ineffective in patients who are slow typists. Future studies should include a single-case experimental design with information regarding key outcome variables and other relevant variables gathered regularly over time.

## Conflict of Interest

There is no conflict of interest disclosed by any of the study members.

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