

AUTISM AND CREATIVITY: A SOCIAL ROBOTICS APPLICATION

Gilberto Marzano

Rezekne Academy of Technologies, Latvia
Janusz Korczak pedagogical University in Warsaw, Poland

Simone Zorzi

Azienda Sanitaria Universitaria Friuli Centrale, Italy
Ecoistituto del Friuli Venezia Giulia, Italy

Abstract. *This paper focuses on the relationship of genius with certain forms of autism. It synthesizes some results of two ongoing research activities. The first one concerns the investigation of creativity and the arts in the digital age, while the second an educational experience to support the socialization of people with Autism Spectrum Disorder.*

The educational experience was based on storytelling, drama, and programmable toy robots. Our research emerged that low functioning autistic people may exhibit creative attitudes, but the creativity of educators has a crucial role in stimulating their creativity.

Keywords: *Autism Spectrum Disorder, creativity, drama, educators' creativity, programmable toy robots, storytelling.*

Introduction

The term autism comes from the Greek word *autos*, meaning *self*. It was first used in the expression *autistic thinking* by the Swiss psychiatrist Eugen Bleuler (1911) in relation to schizophrenia to describe the withdrawal of schizophrenic patients into their fantasies (Kuhn & Cahn, 2004).

The first clinical definition of autism appeared in the first half of the 20th century. Grunya Efimovna Sukhareva (1891-1991), a Soviet child psychiatrist, published a detailed description of autistic symptoms in 1925. Her article, written in Russian, was translated into German a year later (Sukhareva, 1926). She initially used the term "schizoid (eccentric) psychopathy" but later replaced it with "autistic (pathological avoidant) psychopathy" to describe the clinical picture of autism. In 1943, Leo Kanner, an American-Austrian psychiatrist, published the first systematic description of early infantile autism (Harris, 2018). In 1944, Hans Asperger (1906-1980) published a definition of autistic psychopathy that was similar to Sukhareva's definition (Asperger, 1991). Asperger identified the many following characteristics of autistic people:

- lack of empathy
- little ability to form friendships
- one-sided conversations

- intense absorption in a particular interest
- clumsy movements

In 1994, the American Psychiatric Association (APA) recognized the diagnosis of Asperger's syndrome in the fourth edition of its Diagnostic and Statistical Manual (DSM). In 2013, APA revised the DSM and in the fifth edition of the DSM deleted Asperger's syndrome in favor of a single category, Autism Spectrum Disorder (ASD).

Difficulties in interaction and social communication are considered one of the core deficits of this disorder (Baron-Cohen, Ashwin, Ashwin, Tavassoli, & Chakrabarti, 2009). Autistic traits are detectable from early childhood and tend to remain throughout the person's existence.

The Center for Disease and Control (CDC) reported that approximately 1 in 44 children in the U.S. is diagnosed with an autism spectrum disorder (ASD), according to 2018 data (Maenner et al., 2021). In Europe, the three-year (2015-2018) program Autism Spectrum Disorders in Europe (ASDEU) scrutinized 631,619 children, with an average estimated prevalence of 12.2 per 1,000 (one in 89) children aged 7-9 years. Overall ASD prevalence estimates varied among European countries, from 4.4 - 19.7 (percentiles 10 and 90) per 1,000 aged 7-9 years.

This paper reports on an ongoing research investigating the relationship between autism and creativity, also, illustrating an educational experience carried out with a group of four young adult boys diagnosed with a low functioning autism.

Before presenting our research outcomes, a short highlight on autism and creativity is helpful.

Autism and creativity

The psychiatrist Michael Fitzgerald is one of the eminent scholar who studied the connection between autism and creativity to ask the question if there is a link between autism and exceptional ability. In the popular book *Autism and creativity: Is there a link between autism in men and exceptional ability?* (Fitzgerald, 2004), he presented the diagnostic issues about autism and the descriptions of autism from 1980 to 1990s, then discusses the psychology of high-functioning autism/Asperger's syndrome according to the literature of that time. He claimed many geniuses exhibit Asperger's traits, e.g., Isaac Newton, Albert Einstein, George Orwell, and Herbert George Wells. Nevertheless, in the past, this idea was not shared by many researchers. It was believed that people with autism could not develop any creativity, except for Asperger people. The severe difficulties in the sphere of communication and socialization of non-high functioning autistic subjects brought many researchers to believe they cannot be creative (Hermelin, 2001).

Recent findings suggest that individuals with ASD are not necessarily impaired in creativity but possess specific creative capabilities (Hetzroni, Agada, & Leikin, 2019; Kasirer, Adi-Japha, & Mashal, 2020; Liu, Shih, & Ma, 2011).

The literature is rich in studies and experiments on the creative ability of children with ASD (Artemova & Ryazhenova, 2020; Epp, 2008; Khodadadi, 2018; Perriello, 2019). Many studies show that creativity is something that can be built upon and enhanced. An autistic child's creative progression relies on a number of factors. These can include the encouragement of teachers and parents to promote creativity, as well as the type of approach taken to arouse creative enhancement (Smith, A., & Madden-Zibman, 2014). The case of a 6-year-old boy diagnosed with autism without mental retardation presented and discussed by Melinda J. Emery illustrates many aspects of art therapy and how it can improve the social skills and creativity of an autistic subject (Emery, 2004). This case also warns on the role of the therapist and the effort necessary to achieve results. From her experience, she concludes that:

- The constancy of parents, teachers, and therapists is necessary to help children with autism.
- Children with autism thrive in an environment where patience, acceptance, understanding, and constancy are fundamental for their growth and development.
- Art therapy for autistic children may serve as a path toward increased awareness of the self, and the sense of self is a cornerstone for relating.

A remarkable study based on sandplay showed that this form of art therapy encourages autistic children to become more creative and imaginative (Lu, Petersen, Lacroix, & Rousseau, 2010).

Art therapy methods have been used to help children with ASD develop a better understanding of appropriate ways to respond in social situations (D'Amico, & Lalonde, 2017; Van Lith, & Beerse, 2019). Art therapy with puppet making and puppetry using the *Expressive Therapies Continuum* (Kagin & Lusebrink, 1978) has been explored to promote emotional empathy in individuals with ASD within the larger goal of addressing socialization (Malhotra, 2019).

Recently, robot interaction has been experimented as a method of enhancing creativity (Wainer, Ferrari, Dautenhahn, & Robins, 2010).

The following paragraphs illustrates and discusses an educational experience performed combining use of programmable toy robots, storytelling, and drama.

Research objective and methodology

The research objective results from the activities of two ongoing research started in 2019:

- Creativity and the arts in the digital age

- Social robotics.

Part of the two researches endeavor converged in a specific investigation strand started in 2020 and concerning the development of educational interventions to improve the communication skills of people with ASD using programmable toy robots (PTRs).

The first step of this investigation (January-December 2020) was a literature analysis on social robotics for autistic people and the development of some explorative practices using PTRs with autistic adolescents (Marzano, Tambato, Zorzi, 2021). The first step emerged the question of autistic people creativity and the possibility to involve them in creative educational interventions.

Based on the first step, a second investigation step has been defined and carried out (January-December 2021). It included two main activities:

- Reviewing scientific literature on autism and creativity.
- Defining and developing an educational intervention based on the integration of PTR with storytelling and drama.

The literature review analyzed the main scientific contributions on autism and creativity (about 47 items, including books, articles and reports) available in various in databases (Scopus, Web of Science, SAGE, ERIC, IEEE, etc.), following a consolidated methodology (Booth, Sutton, & Papaioannou, 2016; Fink, 2019; Jesson, Matheson, & Lacey, 2011).

The educational intervention involved four subjects, aged between 16 and 33 years and diagnosed with a severe level of autism, and two social educators. The educational intervention took place in Italy, at the Disability Service Center of the Central Friuli University Health Authority (March-November 2021). The autism level of the young adults involved in the research was determined through the Childhood Autism Rating Scale (CARS), which provides a score range from 15 to 60 (Chlebowski, Green, Barton, & Fein, 2010; Schopler, Reichler, DeVellis, & Daly, 1980):

- Score 30 is the cutoff rate for a diagnosis of mild autism.
- Scores 30-37 indicate mild to moderate autism.
- Scores 38-60 indicate severe autism.

The adaptive behaviour of the autistic subjects have been measured through the Vineland Adaptive Behavior Scales (VABS) that is a tool that utilizes semi-structured interview and the Adaptive Behavior Composite (ABC) to measure the individual's adaptive functioning (Saulnier & Klaiman, 2018; Sparrow, Cicchetti & Saulnier, 2016). VABS uses qualitative descriptors of “high” (domain and ABC Standard Scores of 130–140), “moderately high” (domain and ABC Standard Scores of 115–129), “adequate” (domain and ABC Standard Scores of 86–114), “moderately low” (domain and ABC Standard Scores of 71–85), and “low (domain and ABC Standard Scores of 20–70).

Table 1 reports the VABS and CARS evaluation of the four autistic involved in the project.

Table 1 The level of autism of the young boys involved in the research (own source)

Subject nickname	Age	Communication Skills	Daily Living Skills	Social Skills and Relationships	Overall Summary	CARS
Ludovico	15	20	28	20	20	39
Alberto	16	20	60	20	20	39
Cristiano	21	20	23	20	20	47
Michele	33	20	20	20	20	37

In the following paragraphs, the results of the investigation are shortly illustrated and discussed, starting with a short overview of autism and creativity resulting from our desk research.

The educational intervention

The low-cost LEGO® BOOST PTR, in the humanoid version of Vernie, was used for the realization of the educational intervention. Vernie is a PTR that can be programmed to perform sequences of interactive tasks, such as moving (forward, backward, right, left, in a circle), speaking, moving arms, moving head. It has a color and distance sensor capable of detecting 6 colors and objects at a 5-10cm distance. Vernie is programmable using an icon-based drag-and-drop coding interface (Benedettelli, 2018; Bundschuh, 2019) through an Android smartphone or a tablet (Fig.1 and 2).

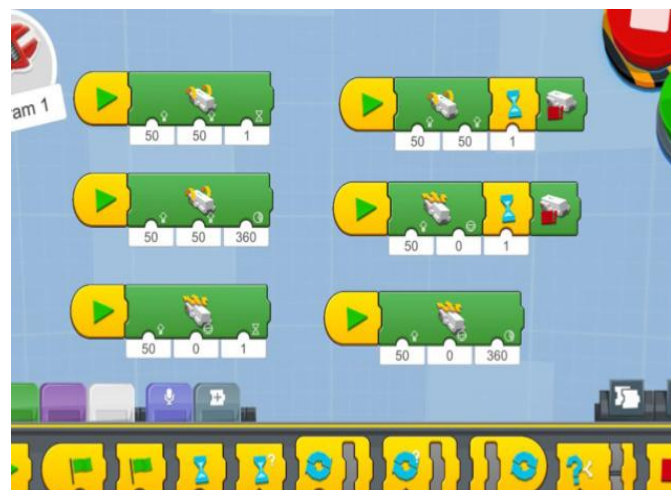
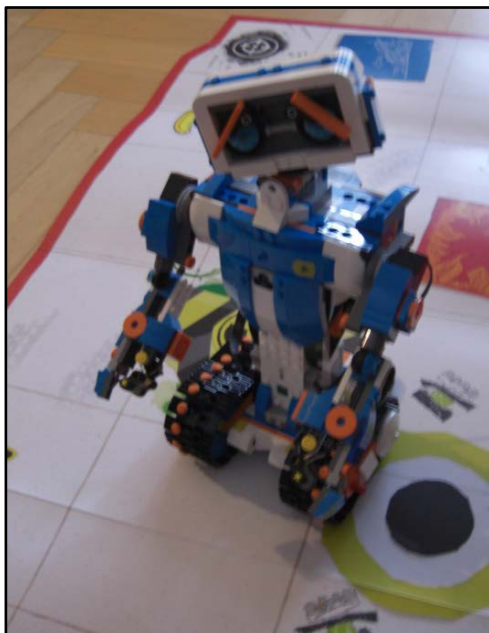


Figure 1 The robot Vernie (own source) Figure 2 Programming blocks (own source)

The educational intervention had foreseen that each autistic subject should have gone to a commercial establishment (supermarket, bar, bakery, newsstand)

to purchase something. Four shops were chosen close to the Disability Service Center, where the autistic subjects were assisted. Then, an educator, previously taught to perform the intervention, defined a social history for each kind of purchase. Verni was programmed to be the protagonist of the four social stories, appropriately performed within a room of the Center. To this end, using Google Maps, four maps were reproduced on 110x60cm sheets with the route to reach the target places on feet. In addition, cardboard reproductions of the shops were made, trying to make them as resembling as possible with their real correspondent (Fig. 3).



Figure 3 *The supermarket and newsstand with their cardboard reproductions (own source)*

The educational intervention has been organized in two Phases:

- Phase I. The educator creates a social story involving an autistic subject. The social story is performed using Vernie, the maps, and the cardboard reproductions. The story was divided into steps corresponding to a robot action previously programmed by the educator. Table 2 shows the steps of a social story.

- Phase II. Once the training with Vernie has been completed, the educator organizes an activity out of the Center. The autistic subject, accompanied by the educator, leaves the Center and goes to the store to buy a product. The autistic subject is asked to apply what was previously learned in Phase I.

Table 2 *Example of social story (own source)*

Step	Actor	Action
1	Vernie	“Good morning, my name is Vernie. What’s your name?”
2	User	“My name is <username>”. [Vernie pauses until the user responds. The educator can help the user to answer]
3	Vernie	“Well <username>! Now I'm going to buy <product name> at the <shop type> shop which is near the Center. See how I do it. ”
4	Vernie	Vernie moves on the map obtained through Google Maps (Figure 4).
5	Educator	The educator can program specific activities that Vernie will have to perform during the road. To this end, the educator can use the color and proximity sensor. For example, Vernie can ask the user "Where am I now?", "The shop is still far away", or "Is there something in front of me?. Do you know what it is? ".
6	Vernie	[Vernie arrives at the shop, stops, and asks the user] "Do you remember what I have to buy ?."
7	User	“You must buy <product name>”. [The educator can help the user to give the answer]
8	Vernie	“Thanks a lot, <username>.”
9	Vernie	“I am in. Now I put the sanitizing gel. ”
10	Vernie	Vernie does where can purchase the product.
11	Vernie	"Please, I would like <quantity> of <product name>."
12	Vernie	[Vernie receives the product] “Thank you. How much do I pay ?. ”
13	Vernie	Vernie pays and leaves the shop.
14	Educator	The educator asks the user to tell what Vernie did. The educators reviews the story several times, asking each step what is happening and what will happen at the next step.

Phase I and Phase II are repeated several times, and each time the educator evaluates the autistic subject's performance using a weighted checklist, based on a five-point Likert scale for each action, such as understanding, communicating, interacting, moving, etc.

The educational intervention emerges two main considerations: the benefits of robot therapy for people with ASD and the importance of creative educators.

Some reflections: the importance of creative educators

Some reflections emerged from our research are synthesized as follows.

To realize the illustrated educational intervention, digital basic competence and knowledge of the behavior of autistic people have been necessary. The two educators involved in the intervention have been taught to appropriately use the Lego Boost Verni robot with the four autistic subjects. The use of storytelling and drama was discussed before starting the intervention with experts and academic researchers. Educators participated in a three-month preliminary phase analyzing the literature on social robotics for autistic people and deepen the idea of combining storytelling and drama with the Verni robot. The reported experience indicated that educational institutions should create the right attitude of future social educators towards digital technology and robot therapy. It should be necessary to improve their professional skills and competence. According to the educational experience highlighted in the previous paragraph, a preliminary competency framework in social robotics for social educators should include:

- Digital technology understanding - encompassing knowledge about the multifarious dimensions of the digital revolution and its impact on social services and SEN.
- Digital-based SEN programs - comprising both theoretical and practical knowledge of online educational models as well as teaching-learning practices that can support the implementation and running of programs for people with special needs, also remotely.
- Sectorial knowledge - including knowledge in specific fields, such as the use of PTRs with children with ASD.

However, it also emerged how the creativity of educators has been relevant to stimulate the creativity of the four autistic subjects involved in the educational intervention. Educators had the idea to use cardboard reproductions to facilitate the identification of the real places and engage the young autistic adults in cardboard design and realization. They participated in the Verni robot construction, the design of the social stories and their dramatization as well as in defining the dialogue with Verni. The creativity of educators encouraged the four autistic subjects to be creative and active in co-design the educational intervention. This result confirmed what literature shows about participatory design in the context of designing technologies that could support autistic people in daily life (Coon & Watson, 2013; Fabri, Andrews, & Pukki, 2016; Maun, Fabri, & Trevorow, 2021; Millen, Edlin-White, & Cobb, 2010). Most research on participatory design for people with ASD focuses on solutions to overcome the difficulties these persons could find to use technology products and applications due to communication impairments, inability to understand social situations and confusion in recognizing other people's feelings.

In the last few years, many applications of participatory design concerned social robotics and autism (Aslam, Dertien, & van Dijk, 2019; Costa, Lehmann, Dautenhahn, Robins, & Soares, 2015; Malinverni, L., Mora-Guiard, J., Padillo, V., Mairena, M., Hervás, A., & Pares, 2014).

According to the evidence coming from the recent studies and experiences, one can conclude that the creativity of educators may have a crucial role in designing new innovative educational interventions and can be precious in the participatory design of technological applications for people with special needs. Of course, educators' creative skills should be grounded on solid knowledge of technologies and special needs education theories and practices.

Conclusion

The continuous processes of digitization and digitalization are profoundly changing contemporary society, affecting private and public organizations as well as public and social services.

Robotics and artificial intelligence can provide valuable solutions to extend and enhance social services, for example, supporting people with various cognitive disturbances or limited opportunities. Moreover, digital competence has become a prerequisite in societal participation.

In this paper, the question of creativity and ASD has been shortly illustrated and discussed, focusing on brilliance and autism. Research showed that many geniuses present some autistic traits since being a genius implies high observation ability and capability to concentrate on a specific topic for a long time.

We also presented an educational experience concerning the combined use of storytelling, drama, and robotics. It is part of a more articulated ongoing research on the use of programmable toy robots and autism. Despite its inherent limitations, this experience encourages the use of robots to improve the communication skills of autistic people. This experience will be exploited to realize an experiment involving a large audience of children with ASD and to design the guidelines for a socialization robot therapy for autistic people. Moreover, our experience has highlighted some crucial aspects concerning the need to professionalize social educators and develop their creativity. Training, coaching, and other support should be provided to social educators and students in social pedagogy in order to develop their skills, focusing mainly on innovative ways in which digital technologies can enhance and transform the assistance of vulnerable and disabled people, as well as helping those with behavioral disorders.

For this purpose, an effort should be necessary to design and experiment with training courses that improve the digital social innovation competence of active social educators and social educator teachers.

Moreover, reflection should be made during their professional training and development on the best way to acquire knowledge of distinct digital

communication behaviors in the various assistive contexts as well as a mastery of the different digital tools that can be employed for supporting assisted people.

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