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Could Robots Empatize? A Review on The Employment of Social Robots in Mental Healthcare

Robotlar Empati Yapabilir mi? Sosyal Robotların Ruh Sağlığı Hizmetlerinde Kullanımı Üzerine Bir Derleme

Mücahit Gültekin

Authors Information

Mücahit Gültekin
Assistant Professor, Afyon Kocatepe University, Afyonkarahisar, Türkiye
mucahit.gultekin@aku.edu.tr

ABSTRACT

The advances in artificial intelligence and robotics began to transform business and human relations. The employment of robots in health, education, entertainment and rehabilitation as well as industries introduced the concept of "social robots". Although there is no consensus on the definition of the concept, robots with some degree of autonomy and could conduct meaningful social interactions with humans are considered social robots. Studies have been conducted on the employment of social robots in mental health services. Studies have been conducted on the employment of social robots in mental health services. The effectiveness of social robots in the treatment of anxiety, stress, depression, anger, and eating disorders, especially dementia and autism spectrum disorder, has also been investigated. The question of "can robots empathize" is a significant topic in research that focus on human-robot interactions. Robotic empathy studies were conducted with two dimensions of human empathy for robots and robot empathy for humans and led to various philosophical and ethical discussions. Some argued that robot-human interaction leads to new opportunities in mental health services, while others criticized the use of robots since it could increase human solitude, blur the line between reality and virtuality perceptions and the distinction between ontological categories. The present literature review aimed to discuss the concepts of artificial intelligence, robots, and social robots, provide information about the studies on the employment of social robots in mental healthcare, and address the studies and views based on the question "can social robots empathize?"

Article Information

Keywords
Social Robot, Robot, Artificial Intelligence, Mental Health, Empathy

Anahtar Kelimeler
Sosyal Robot, Robot, Yapay Zekâ, Ruh Sağlığı, Empati

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ÖZET

Günümüzde yapay zekâ ve robotik alanındaki gelişmeler iş ve insan ilişkilerini dönüştürmeye başlamıştır. Robotların sadece endüstriyel alanda değil, sağlık, eğitim, eğlence, rehabilitasyon gibi alanlarda kullanılması "sosyal robot" kavramını gündeme getirmiştir. Kavramın üzerinde uzlaşılan ortak bir tanımı bulunmasa da, bir dereceye kadar özerkliğe sahip, insanlarla anlamlı sosyal etkileşimler kurabilen robotlar sosyal robotlar olarak kabul edilebilir. Bu bağlamda sosyal robotların ruh sağlığı hizmetlerinde kullanımına yönelik çalışmalar da yapılmaktadır. Sosyal robotların demans ve otizm spektrum bozukluğu başta olmak üzere anksiyete, stres, depresyon, öfke, yeme problemleri gibi sorunların terapisinde de etkililiği araştırılmaktadır. "Robotlar empati yapabilir mi?" sorusu ise insan-robot etkileşimine odaklanan araştırmaların önemli bir tartışma konusudur. Robot-insan etkileşiminin ruh sağlığı hizmetleri için yeni fırsatlar yarattığını savunanlar olduğu gibi, insanın yalnızlığını arttıracağı, gerçeklik ve sanallık arasındaki çizgiyi belirsizleştirebileceği, ontolojik kategoriler arasındaki ayrımı bulanıklaştırabileceği gibi eleştiriler de yapılmaktadır. Bu derleme yazıda yapay zekâ, robot, sosyal robot kavramlarını açıklamak; sosyal robotların ruh sağlığı hizmetlerinde kullanımına ilişkin yapılan çalışmalar hakkında bilgi vermek, "sosyal robotlar empati yapabilir mi?" sorusu çerçevesinde yapılan araştırmaları ve öne sürülen görüşleri tartışmak amaçlanmıştır.

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INTRODUCTION

It has been about seventy years since the beginning of contemporary artificial intelligence studies. The article "Computing Machinery and Intelligence" published by Alan Turing in Mind magazine in 1950 is accepted as the first artificial intelligence study (McCorduck, 2004). The concept of artificial intelligence was first introduced in a letter written by McCarty et al. (2006) to the Rockefeller Foundation in 1955. The workshop organized at Dartmouth College in 1956 is accepted as the official beginning of modern artificial intelligence studies (Say, 2018). However, the number of artificial intelligence studies waned and investments decreased in the period christened as the "artificial intelligence winter" during the 1970s (Bostrom, 2018). The studies on artificial intelligence were revived in the 1990s. The interest and investments in artificial intelligence increased after the artificial intelligence called Deep Blue, developed by IBM, defeated the world chess champion Kasparov in 1997 (Fan, 2020). The popularization of the Internet and mobile phones made it easier to access large data, which in turn introduced significant developments in machine learning, a sub-field of artificial intelligence. The developments in machine learning led to more human-like artificial intelligence cognitively and emotionally, and the developments in robotic architecture made it possible to design robots that are more human-like in appearance and movement.

The current developments in artificial intelligence and robotics increased the visibility of robots in business and social arena. According to the International Federation of Robotics (IFR) report, the number of industrial robots employed in factories globally increased by 12% in 2019 compared to 2018 and reached 2.7 million units. Since the same figure was 1.021 million in 2009, it could be suggested that the number of robots has increased about 3 times in the last decade (IFR, 2020a). The IFR report noted a significant increase in the production and sales of both industrial and service robots. The professional service robots market grew by 32% in 2019 when compared to 2018 from $8.5 billion to $11.2 billion. The employment of service robots in medicine increased by 28% in 2019, accounting for 47% of the total service robot turnover. The popularity of service robots in homes and public spaces has also increased. The number of service robots designed for domestic work was 18.6 million in 2019, and increased by 16% to 21.6 million in 2020. This figure is expected to increase to 48.6 million in 2023 (IFR, 2020b). It was reported that the interest in the benefits of artificial intelligence and robotics in health has increased, especially due to the Covid-19 pandemic. It was estimated that the market share of artificial intelligence in healthcare, which was 5 billion dollars in 2020, will increase to 45 billion dollars by 2026 (Lee et al., 2021). Rapid advances in artificial intelligence and robotics required the inclusion of the states in the process, and more than 60 nations have published national artificial intelligence strategy documents (Türkiye Cumhuriyeti Cumhurbaşkanlığı Dijital Dönüşüm Ofisi, 2021).

The employment of robots in areas with intense contact with individuals such as education, maintenance, transportation, rehabilitation and entertainment industries in addition to the manufacturing plants led to the introduction of the concept of "social robot" (Socially Assistive Robot), the robots that could establish meaningful social interactions with individuals (Breazal, 2003; Duffy, 2003; Severinson-Eklundh et al., 2003). The employment of social robots in industries that require social interaction with humans led to discussions in social sciences such as philosophy, law, ethics, and psychology. Issues such as the consciousness of artificial intelligence (Doğan, 2020), criminal responsibility of artificial intelligence (Kangal, 2021), differentiation between good and bad behavior by artificial intelligence (Çelebi & İnal, 2019), and emotional capacity of artificial intelligence (Yonck, 2019) have been discussed. The goal of socialization of the robots led social robotics to design more human-like robots, not only cognitively, but also emotionally and physically. For example, as robots adopted a more human-like features (such as hands, face, eyes), people tended to anthropomorphize robots (DiSalvo et al., 2002). Anthropomorphism, defined as the tendency to attribute human traits to inanimate objects, animals and other beings (Duffy, 2003; Zlotowski et al., 2015), plays a key role in the interaction between humans and social robots. The ability of humans to establish social interaction with the robots on a psychological level depends to some extent on anthropomorphizing the robot. Studies on human-robot interaction reported that humans could anthropomorphize the robots and interact with social robots on a psychological level. Thus, recent studies demonstrated that social robots could be employed in psychological healthcare (Abdi et al., 2018). The use of social robots in care, therapy, education and counseling introduced the question of how much social robots could meet therapeutic requirements such as empathy (Bagheri et al., 2021; James et al., 2018).

The present literature review aimed to discuss the concepts of artificial intelligence, robots, and social robots, previous studies on the employment of social robots in mental healthcare, the empathic potential of the robots, views on these issues, and the possible impact of the developments in social robotics on mental healthcare. In the first section, the concepts of artificial intelligence, robots and social robots are discussed to clarify the differences between these concepts. In the second section, recent studies are presented in three parts to provide certain examples for the employment of social robots in mental healthcare. In the third section, the studies on empathic potential of the social robots and related ethical and philosophical debates were addressed. In the discussion section, the potential impact of social robots on mental healthcare are discussed, and recommendations are presented for future research.

Artificial Intelligence, Robots and Social Robots

Although artificial intelligence, robots and social robots are associated concepts, it is important to distinguish certain differences. Nilsson (2019) described artificial intelligence briefly as the activity of the introduction of intelligence to machines, while Whitby (2005) defined it as a scientific field that studies intelligent behavior in humans, animals and machines and attempts to determine how artificial devices could exhibit the same behavior. Russell and Norvig investigated various definitions in the textbooks. They reported that the definitions, which they analyzed based on two dimensions, could be categorized into 4 groups. Thus, AI was categorized as systems that think like humans, systems that act like humans, systems that think rationally, and systems that act rationally. European Commission (2019, p. 1) defined artificial intelligence as the "systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals." The European Commission High Level Experts Group (2019, p. 6) later expanded this definition: "Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal."

The Concept of Robot

The term robot was first used by Czech writer Karel Capek in the play "Rossum's Universal Robots" in 1920. This term means a slave, forced labor, hard work in Czech language (Nilsson, 2019). The American Robotics Institute defined the concept of robot as "a multifunctional and programmable manipulator designed to move materials, parts and tools, or a special tool that can perform various programmed movements to perform different tasks" (Kyriakopoulos & Loizou, 2015). Robots are basically categorized in two basic groups of fixed and mobile robots; however, they are also classified based on the intended use, functional features, control methods, operational principles, etc. (Ben-Ari & Mondada, 2017; Dobra, 2014; Gürgöze & Türkoğlu, 2019) Based on the intended use, robots are generally classified as industrial and service robots (Shibata, 2004). There are also different types of service robots such as defense, educational, domestic and health robots (Ben-Ari & Mondada, 2017).

The European Commission (2019) clarified the differences between AI and robots. It was emphasized that robots are "physical machines," while artificial intelligence could be included in a robot. It was indicated that the robots with artificial intelligence could be called "embodied artificial intelligence", and certain robotics applications are outside the field of artificial intelligence. Duffy (2003) also reported that the term robot refers to a material manifestation in the physical and social space, and virtual characters and avatar-based interfaces should be excluded. Artificially intelligent robots are not required to interact with humans. Thus, the fact that a robot has artificial intelligence is not sufficient for it to be defined as a social robot.

The Concept of Social Robot

There is no consensus about the definition of the concept of social robot. Sheridan (2020) argued that any robot that interacts with a human could be called a "social robot." However, this would also include surgical robots such as Da Vinci, which are controlled externally and designed to perform certain mechanical tasks, or certain manufacturing robots that collaborate with humans. In fact, these robots are called "co-bots" (Collaborative Robots) to describe their collaboration with humans. Sheridan (2020) stated that the concept of social robot is used in a narrow sense. The purpose of social robots does not entail external mechanical tasks but the humans. Social robots are robots that aim to engage in interactions with humans for emotional or other assistance. Sarrica et al. (2020) conducted a comprehensive study on the definition of social robots in scientific and popular literature. The authors reviewed 143 papers published in the International Journal of Social Robotics and listed the most cited definitions. Thus, a common definition described a social robot as an autonomous agent that could act in a socially adequate manner based on its role in an interaction. Another common definition described social robots as those that conduct meaningful interactions with humans (Breazal, 2003). Yan et al. (2014), on the other hand, included the ability to interact with individuals based on certain social cues and rules as a requirement for the acceptance of a robot as a social robot. Sarrica et al. (2020) determined the three common features across the definitions mentioned in academic and popular literature. These were the features of social robots associated with autonomy, capacity to interact with humans (via the comprehension and utilization of language and emotions), and their ability to work for humans. However, there are differences between the meanings associated with to the concepts of "autonomy", "interaction" and "working for humans" in popular culture and scientific literature. For example, definitions in popular culture tend to assign "absolute autonomy" to social robots, while scientific literature considers social robots as only "functionally autonomous" entities that perform specific tasks. Also, for example, "working for the people" was associated with the physical body in popular culture. However, robots that do not have a physical body could also work for and assist people (Sarrica et al., 2020). Fong et al. (2003) argued that a social robot may not necessarily need a physical body. For instance, a chatbot called Woebot, designed with the cognitive-behavioral model, could help those who suffer from depression (Fitzpatrick et al., 2017). Certain authors described chatbots as a "specific type" of social robots (Westerman et al., 2019) while others categorized social robots as "bodied" and "unbodied"(Dennis, 2022). However, "physical body" has been commonly accepted as a common feature of social robots in the literature (Sarrica et al., 2020). For example, a recent study described "physical body" as a common feature of social robots (Asprino et al., 2022).While we discussed the employment of chatbots in mental healthcare in the present study, we focused on social robots with a physical body.

Sarrica et al. (2020) concluded that there was no consensus on the definition in scientific literature, and it was in the stage of development. However, it could be suggested that the concept of social robot is based on the assumption of "being like a human" not only in cognitive but also in physical and emotional sense. Behind the differences between the definitions lie the potential conflicts due to the attempts to produce human-like social robots (Sarrica et al, 2020). Nyholm (2020) indicated that humans tend to anthropomorphize robots. In social robotics, the robots are designed to be more human-like, reinforcing this trend. Thus, it was reported that social robots should have six basic design features: (1) Ability to communicate using natural language or non-verbal methods (such as light, motion, sound), (2) Ability to express emotional behavior and/or perceive human emotions, (3) A distinctive personality or character, (4) Ability to model the social human traits, (5) Ability to learn and/or develop social skills, (6) Ability to establish and maintain social relationships (Baraka et al., 2019; Fong et al., 2003).

Social robots are classified in three categories based on appearance: inspired by biology (e.g., human or animal form), inspired by artificial and imaginary objects (e.g., cars, table lamps or cartoon characters), and functional social robots, and employed in the fields of healthcare and therapy, education, entertainment, art, search and rescue, at home and workplace, and public services (Baraka et al. 2019). In social robotics, anthropomorphic and zoomorphic robots are quite common, especially among robots inspired by biological forms.

The robotic hardware and software that could interact with individuals not only physically and cognitively but also emotionally led to the idea that robots could be employed in mental healthcare. In recent years, special social robots were developed for educational, healthcare and therapeutical purposes, and the effectiveness of these robots was tested in various scientific studies. Although these studies reported promising results, various limitations of social robots were also emphasized. In the next section, examples for the employment of social robots in mental healthcare are presented based on the literature.

The Employment of Social Robots in Mental Healthcare

In recent years, the interest in the employment of social robots in mental healthcare has increased. Weir (2018) emphasized this in an article titled "The Dawn of Social Robots" published in APA Monitor and argued that social robots could serve as therapists and companions and called for a collaboration between social robotics experts and psychologists. The first issue of the journal "Technology, Mind and Behavior", published by the American Psychological Association (APA) on April 2020 emphasized the central impact of technological advances such as artificial intelligence and robotics on human health, mind and behavior.

The review of the studies on social robot-human interaction demonstrated that the use of social robots was prominent in childcare and care of elderly adults in the treatment of developmental disorders such as autism spectrum disorder (ASD) (Moyle et al., 2013; Vanderborght et al., 2012). However, the investigation of social robots in mental healthcare is still at an early stage. Studies demonstrated that the employment of social robots in mental healthcare would increase gradually. For example, Rabbitt et al. (2015) reported that social robots could be used in several psychological health problems, including adults with mood and anxiety disorders, children with disruptive behavior, and individuals who do not meet clinical criteria. In this section, the studies conducted on the employment of social robots in mental healthcare are summarized in three parts.

Social Robots in the Healthcare and Therapy of the Elderly

There are several social robots such as KASPAR, Pepper, Keapon, NAO, PARO, the effectiveness of which was investigated in mental health disorders, and these robots have been employed for the reduction of the emotion of loneliness, depression and anxiety among the elderly (Cifuentes et al., 2020). In a systematic review that covered a decade of studies (2008-2018), Lambert et al. (2020) reported that 35 social robots were employed. A social robot could be utilized in several areas. For example, NAO could be programmed for assistance in disorders such as autism and dementia, or as a playmate (Robaczewski, 2021).

PARO, the design of which was initiated in 1993 to help dementia patients, is the most frequently used robot among other animal-like robots in research conducted with elderly individuals with dementia (Moyle, 2017; Abdi, 2018). After five years of development, the first generation PARO was introduced in 1998. PARO is a zoomorphic robot in the form of a seal and includes olfactory, visual, auditory and posture sensors under the soft white fur, and 8 actuators (for eyelids, eyes, neck, anterior and posterior fins). PARO can produce reactive (reacting to sudden stimuli such as looking towards a loud noise) and proactive (reacting based on internal states, stimuli, desires and rhythm) behaviors during interaction with a human (Wada et al., 2002; Shibata, 2004). Sabanovic and Chang (2016) studied PARO in various cases for 10 years and concluded that the sociability of PARO was relational. PARO was introduced commercially in Japan in 2005 and was approved by the Food and Drug Administration (FDA) in 2009. As a commercial product, PARO has been sold in large quantities in Europe, Asia and the United States for use in dementia care (Broadbent, 2017).

Several studies have been conducted on PARO and elderly individuals. One of the first studies on PARO was conducted by Wada et al. (2004). In the study, 23 73-93 years old women in an elderly daycare interacted with PARO one to three days a week. The participants' facial expressional, mood, urine test, and nurse comment data were collected with various scales before and after the interaction with PARO. The study findings demonstrated that the mood of the elderly who interacted with PARO improved. Furthermore, it was determined that the stress level of the nurses decreased because the elderly required less supervision during interaction with PARO. The authors concluded that PARO was beneficial for institutions that provide services for the elderly. In another study conducted by Wada et al. (2008), the effects of PARO were investigated in 29 patients, 11 of whom were male and between the ages of 62 and 90, with mild to moderate dementia. EEGs were taken during the interaction between the patients and PARO, and their neural activities were analyzed based on these records. The authors reported that PARO had a high potential to improve brain activity in dementia patients (Wada et al., 2008). Moyle et al. (2013) conducted a study with 18 older adults, and divided the participants into two groups: the reading group and the PARO group. Participants in the PARO and reading group were then swapped, where each participant experienced the activities in both groups. The study findings demonstrated that older dementia patients who regularly spent time with PARO enjoyed it more and had a higher quality of life. The authors argued that social robotic animals could be an alternative psychosocial intervention tool for older adults with dementia; however further research with larger samples is required (Moyle et al., 2013). In another study conducted by Petersen et al. (2016), 61 patients, 77% of whom were female, were assigned to experimental and control groups and the effects of PARO were investigated. The study findings demonstrated that stress and anxiety levels, psychoactive drug and painkiller use decreased in the PARO treatment group. In a content analysis conducted by Hung et al. (2019), 29 papers were reviewed, and 3 main benefits of PARO were determined. These included the reduction of negative emotional and behavioral symptoms, improvement in social participation, and promotion of positive moods and quality of care experiences. In the study, also 3 prominent obstacles to PARO were identified. These included the cost and the increase in staff workload, the infection concerns due to the difficulty of cleaning the fur of PARO. Another obstacle was user embarrassment and stigma anxiety about interaction with a robotic animal in front of others. It was also reported that the employment of robots in elderly care could be unethical on the grounds that robotic care is childish and inhumane.

In addition to PARO, humanoid social robots such as NAO, Pepper, and Budy are also employed in mental health and physical care of older adults (Cifuentes, 2020). For example, in a study conducted with 41 elderly participants, NAO was compared to a human trainer. The study findings showed that NAO was more effective than the human trainer in exercise instructions and increasing the motivation of the participants (Shen & Wu, 2016).

Systematic reviews that analyzed studies conducted with older adults and social robots revealed the limitations of these studies. Methodological limitations such as the small sample size, lack of a control group and follow-up were emphasized. For example, in a recent systematic review, it was reported that PARO increased the quality of life, improved biopsychological condition, and was beneficial in reducing painful medical interventions. However, the authors emphasized inadequate sample sizes and methodological limitations in these studies, and claimed that further research is required to determine the effectiveness of PARO (Wang et al., 2021).

Social Robots in Autism Spectrum Disorder

Several studies have been conducted on the employment of social robots in Autism Spectrum Disorder. Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that also includes Asperger's syndrome. In DSM-V, ASD was defined based on two dimensions: A) Problems in social communication and interaction, and B) Limited, repetitive behavior, areas of interest or activities. Social robots are used to instruct certain skills to children with autism, play with them and teach them certain behaviors. The interest of children with autism for technological devices suggested that social robots would be beneficial in the treatment of autism (Scasselati, 2007). It was reported that social robots have been mostly used as an supplementary tool in the therapy of children with ASD. Cao et al. (2019) argued that studies conducted with children with ASD suggested social robots as a good social partner and mediator for children; however, they did not suggest that the robots could replace the therapist.

Social robots create interesting, engaging and meaningful interaction environments that motivate children to interact with them. Several social robots such as CHARLIE, Jumbo, KASPAR, Keepon, Maestro, Tito, PARO and NAO are employed in the therapy of children with autism (Cabibihan et al., 2013). Among these, KASPAR, which was developed at the University of Hertfordshire in 2005, is one of the most popular humanoid robots employed in the therapy of children with ASD (Breazal, 2016;

Wood et al., 2021). KASPAR (Huijnen et al., 2016) is used for 12 objectives such as "attention", "playing together", "taking initiative", "reacting adequately to the behavior of others" in studies, is a child-like robot that could imitate certain simple facial expressions such as happiness, sadness and surprise. KASPAR is a social robot. It can perceive and react to children's touch and move its arms, eyes and hands (Raptapoulou et al., 2021; Iacono et al., 2011).

Social robots were designed to enable and maintain active participation during therapy, aince a key feature of ASD is impairment in behaviors that regulate social participation such as avoidance of eye contact and communication. Several studies reported that the presence of robots positively affected attention and participation among children with ASD (Scasselati et al., 2012). For example, in a study conducted with KASPAR, Wainer et al. (2014) investigated the role of KASPAR in the promotion of collaborative play among children with autism in a 10-week study. In the study, six children with autism participated in 23 controlled sessions with and without robots. KASPAR played games with two children in each session. The findings demonstrated that children were more willing to play with each other after they played with KASPAR.

Kim et al. (2013) conducted a study with 24 children with ASD (4.6-12.8 years old), and investigated the children's interactions with humans, a touchscreen computer, and an anthropomorphic social robot, Pleo. The study findings demonstrated that children interacted more with the social robot when compared to the human or the computer. The authors reported that social robots could be an effective tool in the development of social skills and for therapeutic assistance. Yaman and Şişman (2018) conducted a study with 3 male and 1 female children with ASD, who were between 6 and 9 years old, and the social robot NAO. In the three-week study, 20-minute sessions were conducted with each child per week. Children's interactions with NAO were analyzed based on videos, and it was observed that there was a high level of interaction between the robot and the children. Furthermore, interviews were conducted with the parents, and all parents stated that their children developed positive attitudes towards NAO, and they liked the robot very much.

It was reported that most ASD studies focused on the basic joint attention skill. Joint attention is described as the employment of gestures and looks by infants and adults to communicate their interest in events or objects (Bülbül & Özdemirli, 2017). Although certain findings reflected that social robots improved joint attention in ASD (Elinç, 2016), the study findings were inconsistent. Scasselati et al. (2012) reported that several studies evidenced improvements in joint attention in children with autism. However, contradictory findings were also reported. Anzalone et al. (2014), in a study conducted with NAO, determined that the joint attention of the school-age children with ASD who interacted with the social robot decreases. Pennisi et al. (2015) reviewed five studies and reported that 2 studies evidenced improvements in the joint attention of children with ASD when they worked with social robots, while two studies reported opposite findings (one study did not investigate joint attention skills). David et al. (2018) interpreted these results and argued that social robots have a potential to improve joint attention; however, further methodologically rigorous studies are required for more reliable findings. Cifuentes et al. (2020) reviewed 12 studies conducted with 4-12 years old children with ASD. The findings reported by the reviewed studies supported the idea that robots could be employed as active reinforcement tools in semi-structured behaviors of children with ASD. Furthermore, the authors also mentioned the disadvantages of social robots in ASD in certain studies. For example, the focus on the robot could limit the interaction of the children with others in a social environment. The authors also stated that studies with a larger sample and follow-up are required to improve the reliability of the findings (Cifuentes et al., 2020).

Although it is one of the most studied topics, the efficacy of social robots in ASD treatment and clinical use is not clear. Begum et al. (2016) reviewed the studies conducted for a decade and reported that although the study findings were promising, overall studies exhibited little clinical progress. A recent study where the papers published in the last two decades (2000-2020) were reviewed reported similar findings on the employment of social robots in education and classroom setting (Woo et al., 2021).

Social Robots in Therapy, Psychological Support, and Well-Being

The employment of social robots is not limited to ASD and dementia. Various studies have been conducted with social robots to reduce anxiety, depression, stress, and solitude, and to improve psychological well-being. In a meta-analysis that reviewed the studies on the efficacy of social robot-assisted therapy, it was reported that social robot use led to positive results in therapy; however, further research is required for reliable results (Costescu et al., 2014). In addition to the current areas of use, it was argued that these robots have a wide potential in mental healthcare (Rabbitt et al., 2015).

NAO is among the robots employed in psychological support, therapeutic interventions, and to improve well-being of individuals. NAO was produced by Aldebaran Robotics in 2008, is 58 cm tall and has a head, two legs, two arms, two hands and two color LED eyes, and the robot weighs approximately 5 kg. It is a humanoid social robot. NAO can walk, talk, listen and maintain a dialogue, and has two cameras, seven tactile sensors, four directional microphones and speakers that it utilizes to interact with the environment (Gelin, 2018; Robaczewski et al., 2021). Robinson and Kavanagh (2021) argued that robots could provide psychotherapeutic treatment and recently published the qualitative data collected in an empirical study they conducted with NAO. In the study, a four-week behavioral intervention program was applied to 26 participants (20 of whom completed the sessions) who wanted to change their eating habits. All sessions were conducted by NAO without human intervention. Sessions were conducted based on the Motivational Interview principles and the cognitive imagery method, and the sessions aimed behavioral change in the participants. In the study, the mean weight loss was 4.4 kilograms among the participants, and the expected behavioral changes were achieved. At the end of the empirical study, semi-structured interviews were conducted with 18 participants to collect qualitative data. The content analysis findings revealed that participants described NAO (introduced as Andy in the study) with positive attributes such as "optimistic", "reliable", "sweet", and some found the robot empathetic and bonded with it. One participant stated that (s)he did not want to disappoint Andy despite (s)he knew that it was a robot, another stated that it felt like a friend, and another claimed that (s)he would miss it. The authors concluded that NAO was effective psychotherapeutically (Robinson & Kavanagh, 2021).

In another study conducted with NAO, Alemi et al. (2016) investigated the impact of social robots on the therapy of 11 7-12 years old children diagnosed with cancer. Children were randomly assigned to two groups: the social robot-assisted therapy group (experimental group) and the psychotherapy group (control group). In the study, the social robot NAO (introduced as Nima) was programmed to play different roles such as the psychotherapist, assistant psychotherapist, ill child, cook, etc. in each session. Anxiety, anger and depression levels of both groups were determined before and after the psychotherapy sessions. The study findings revealed that the anxiety, depression and anger levels of the social robot-assisted therapy group decreased significantly, and there was a significant difference between the two groups favoring the experimental group. In a study conducted by da Silva et al. (2018), NAO conducted motivational interviews with 20 participants. The majority of the participants stated that they enjoyed the interviews and NAO's instructions were clear and comprehensible. They stated that the non-judgmental communication style of NAO motivated them to change their behavior and positively affected their physical activities. Furthermore, the study findings emphasized the limitations of NAO in the development of individual dialogues (da Silva et al., 2018). Certain recent studies demonstrated that interaction with social robots was promising in geriatric depression and feelings of solitude (Zhang et al., 2021). The authors suggested that social robots may have a positive effect on individuals with depression when compared to the general population. It was argued that depressed individuals perceive low social competence when compared to ordinary people; and thus, they do not take the positive feedback from ordinary people such as social approval seriously. On the other hand, individuals with depressive mood would consider social robots as objective and perceive their feedback more realistic (Zhang et al., 2021). In a study conducted by Banks et al. (2008), the effect of the dog-like social robot called AIBO on the feeling of solitude was investigated. The findings of the study conducted in a nursing home revealed that the loneliness levels of the participants in the AIBO group were lower when compared to the control group, and the participants bonded with AIBO.

Robaczewski et al. (2021) reviewed all studies conducted with NAO. They reviewed 51 publications and categories these studies in 6 groups: social interactions, affection, intervention, assisted instruction, mild cognitive impairment/dementia, and autism/mental disability. The authors reported that the majority of the findings were positive on NAO.

In another recent study, Kobacinska et al. (2021) conducted a content analysis on the employment of social robots in psychological healthcare of children. The authors analyzed16 studies conducted between 2009 and 2019 and reported that NAO and PARO were the most frequently used social robots in that order. Other studies were conducted on social robots such as Huggable, Tega, and Pleo. The authors specifically focused on studies that aimed to contribute to the psychological well-being of children and argued that social robots were promising in the improvement and support of children's mental health (Kobacinska et al., 2021).

Cifuentes et al. (2020) conducted a comprehensive review of studies that employed social robots in therapy and care services. The study findings demonstrated that social robots could play various roles in health and well-being, such as a companion, partner, trainer and assistive instrument. Studies conducted with children demonstrated that social robots could have a potential to raise children's interest and attention, improve eye contact, joint attention and recognition of facial emotions. Furthermore, social robots could improve children's visual perspective skills, reduce anger, fear, anxiety and depression levels. Cifuentes et al. (2020) noted that these effects were also noted in adults and elderly and argued that social robots could improve communication skills and mood and reduce the solitude, depression and anxiety symptoms.

Scoglio et al. (2019) conducted a systematic review of studies where social robots were used to support mental health and psychological well-being of adults. Twelve studies were included in the review. Seven studies were conducted in nursing homes, two with university students, two with hospital staff, and one with 19-45 years old females who were not institutionalized. Five social robots were employed in these studies, namely Paro, NAO, CRECA, Betty and Haptic Creature. Eleven studies focused on positive changes in participants' mood and quality of life after social robot interventions. Scoglio et al. (2019) reported that the impact of social robots on mental health and psychological well-being was not definitive, and the generalizability, scope and measurement techniques were limited in current studies. Robinson et al. (2019) also conducted a systematic review of 27 studies on psychosocial interventions with social robots and emphasized the methodological limitations of these studies.

Social robots are widely used in other fields such as education, entertainment, domestic services, public services, search and rescue, tourism and accommodation that do not entail therapeutic intervention but require social interaction (Baraka et al., 2019). Social robots have been employed as teacher assistants in the classroom (Woo et al., 2021), in reading, to improve grammar skills and in learning a second language (van den Berghe et al., 2019), in music, drama, dance and theatrical performances (Lytridis et al., 2019), as reception attendants, busboys, room managers, etc. in hotels (Nakanishi et al., 2020), as a waiter in restaurants and airports (Mende et al., 2019), in museums (Faber et al., 2009), as a domestic helper in the kitchen and other chores in businesses (Gates & Bill, 2007; de Graaf et al., 2019), and in stores and shopping malls (Niemela et al., 2019).

As seen in the above-mentioned studies, robots are used for different purposes in different fields that require social interaction with humans. However, the employment of social robots in mental health and their acceptance by the clients and experts are closely associated with the ability of this new technology to meet therapeutic requirements. Thus, the empathic skills of the social robots have been a significant topic of discussion. Significant efforts have been spent in social robotics for the acquisition of empathic skills by the robots (James et al., 2018; Lim & Okuno, 2015; Stephan, 2015). The next section is focused on this discussion.

Social Robots and Empathy: Can Robots Empathize?

Empathy is at the core of professional mental healthcare and among the important requirements of the therapeutic relationship. Carl Rogers, one of the founders of humanist psychology, had a significant influence on the descriptive development and current use of this concept (Dökmen, 1990). According to Rogers, "empathy is the process by which a person puts himself in the shoes of another individual and looks at things from his/her perspective, understands and feels the emotions and thoughts of that person accurately, and conveys this to him or her" (Dökmen, 2005 p. 135). In this definition, empathy is a concept with two dimensions; cognitive and affective. Most definitions of empathy include the affective and cognitive dimensions (Cuff et al., 2014). In the affective dimension, it is possible to feel the feelings of the other individual, and in the cognitive dimension, it is possible to understand the perspective and thoughts of the other individual correctly (VandenBos, 2020). Rogers (1983) defined empathy also as "a way of coexisting with someone". According to Rogers, coexistence is "distancing oneself from one's own values and perspective for a while to enter the world of the client without bias." Based on these definitions, the skill of empathy includes emotional experiences and requires awareness about the subjective existence of oneself and the other. It could be suggested that these requirements are the most significant challenges for social robots in the acquisition of empathy skills.

Despite these challenges, since Kismet (Breazal, 2016), the first robot designed to interact with humans with psycho-social emotions, studies have been conducted for the acquisition of empathy skills by social robots. Furthermore, certain studies reported that individuals' acceptance of robots depend on the acquisition of these skills during design (Damiano et al., 2015; Lim & Okuno, 2015). Dautenhahn (1995) emphasized this point in one of the early studies on robotics and stated that they should know the effect of robotic behavior on others, how others judge robotic behavior, and how they want the robot to behave. Studies on human-robot interaction analyzed the empathy in two dimensions: "human to robot" and "robot to human" (Kerruish, 2021; Paiva et al., 2004; Nomura, 2018). Studies conducted with children and adults and investigated the human-to-robot dimension revealed that humans were empathic towards the robots (Carlson et al., 2019; Darling et al., 2015; Mattiasi et al., 2019; Riek et al., 2009; Suzuki et al., 2015, Seo et al., 2018; Küster et al., 2020). Rosenthal-von der Pütten et al. (2013) allowed the subjects to watch two different video images of a zoomorphic robot Pleo in an empirical study conducted with 41 participants. The first video footage included "friendly interactions" with Pleo, while the second video included "torturous interactions" such as hitting, punching, strangling. The physiological arousal of the participants was recorded, and their thoughts and emotions were analyzed with various scales. The findings demonstrated that participants were more physiologically aroused when watching the torture video and they expressed negative emotions when the robot was mistreated, empathizing with the robot.

Since robots that seem empathetic are more accepted by humans (Ruiten et al., 2007; Niculescu, 2013), “robot-to-human empathy” studies that investigated empathetic robot behavior are also perceived important. Various studies were conducted on human-robot interaction (Leite et al., 2014; Niculescu et al., 2013; Riek & Robinson 2008; Rutien et al., 2007; Riek et al., 2010). In an early study, Kozima et al. (2004) reported that children ascribed cognitive skills to robots that exhibited eye contact and joint attention skills in the study conducted with Keapon and Infanoid robots. Sixteen children (7 males and 9 females) participated in a study conducted by Leite et al. (2014) with the iCat robot. Each child played chess with iCat once a week for 5 weeks. iCat expressed positive comments about the children's moves (“It was a good move” “You are doing well”) and provided emotional support when they lost or made a bad move. Children developed positive feelings towards iCat, and these positive feelings were sustained for 5 weeks. The study findings revealed that the children felt that iCat supported them and perceived the robot as empathetic.

The Functional, Phenomenological, and Relational Dimensions of Empathy in Human-Robot Interaction

The concept of empathy in human-social robot interaction could be discussed in three dimensions: "functional", "phenomenological" and "relational". The studies on the acquisition of empathy skills by social robots have mostly emphasized the functional dimension. The focus of these studies was the perceptions of the humans about “empathetic” robot behavior. The functional dimension focuses on robot behavior to allow the user to interpret the robot’s behavior as empathic. It aims the acquisition of the ability to provide personal and context-sensitive physical (e.g., eye contact, gestures and mimics) and verbal responses by the robot that would be interpreted as "empathetic" by the user. Thus, the functional dimension of the empathy in robots reflects the case where robots are designed to be empathetic to humans (Malinowska, 2021). In other words, in the functional dimension, the human does not perceive the robot as an internal and subjective being.

The phenomenological dimension, on the other hand, refers to the "empathetic experience" of the robot, in other words, the "subjective empathetic experience", independent of the user's perception and the relationship. The key question in the phenomenological dimension is whether empathy requires a phenomenological experience. The definition of empathy posits that empathy includes the stages of cognitive and affective "perception", "experience" and "expression." It could be argued that robots could perform the "perception" (via sensors, cameras, microphones) and "expression" (via actuators, speakers) stages. The concepts of "perception" and "expression" were used in social robotics research, albeit implicitly, with a reference to a perceiver and an expresser. For example, the statements “NAO detected the happy facial expression of the user”, “NAO said 'I'm glad to see you like this'” seem to refer to the psychological presence of NAO. Coeckelbergh (2011) argued that as the social robotics advanced, the articles associated with the robots have changed and the third person pronoun "it" has evolved into "he/she/you." Thus, Leite et al. (2014) wanted to tell the children at the end of their study that the robot was not really worried about them. This attempt could remind us that the robot's "empathy" is a simulation, and there was a human who perceived empathy, not a robot who empathized. For example, when the robot says, "I understand how important the watch was to you, I am just as sorry as you are" to someone who lost his grandfather’s wristwatch, it could be interpreted as an empathetic response. But does it mean that the robot actually “empathized”? Was the robot really "sad"? Does it really “understood” the importance of the watch for that person? Tapus and Mataric (2007) argued that it is not possible for robots to truly feel empathy, and robots imitate empathy by processing human verbal and nonverbal behavior. Malinowska (2021) stated that since empathy is considered to occur between two conscious, purposive, rational beings and since robots do not meet these requirements, they could not be a partner of an empathic interaction. However, in robotics, certain studies attempted to give robots a real sense of empathy with models such as biological modeling, developmental (epigenetic) robotics (Lim & Okuno, 2015) and robot genetics (Kozima et al., 2004).

The relational dimension, on the other hand, argues that empathy arises from the dynamics of the interaction between humans and robots (Malinowska, 2021). According to this approach, human-robot interaction is an intersubjective interaction and entails real “socialization” (Damiano et al., 2015; Damiano & Dumochel, 2018; Damiano & Dumouchel 2020). The actors influence each other in this socialization, mutual emotions develop in the interacting actors. In this approach, the human is not the active and the robot is not the passive agent. Both are active and mutually create each other's emotions. Damiano and Dumouchel (2020) argued that emotions are not "internal" and "private" and proposed a synthetic model. According to the authors, the employment of a synthetic model that focuses on the interactional dynamics in the relationship between human and robot instead of "externalist" models that robot emotions are only human perception, or "internalist" models that aim to produce real emotions in robots would help overcome the subject-object dichotomy. Instead of whether robots have feelings, it is necessary to consider whether robots could coordinate emotionally with humans. Since emotions develop within an interactive context, the authors gave the example of "taller" stature. Taller stature is a subjective attribute, but it is not something that the subject could develop without a relationship with others (e.g., taller than John). This approach, in a way, suspends the ontological status and phenomenological experiences of the actors in human-robot interaction, and focuses on the interactions during the relationship between humans and social robots and the role played by the robots in this interaction. The main idea is the capacity to produce new emotions and behavior regardless of how an artificial system (robot) produces these emotions or behavior in a natural system (human) (Damiano & Dumouchel, 2020). Coeckelbergh (2011) also claimed that the advances in social robotics led to a different language about robots and experiences, and human-robot interaction mutually changed the both parties. Coeckelbergh argued that social robots were not merely an engineering design but also “social-linguistic” constructs. However, even when the relational approach is assumed to be accurate, the criterion for understanding the robot's endogeneity and subjectivity would still be behavior (Malinowska, 2021). On the other hand, the proposal of this approach to remodel the human-robot interaction to prevent the dichotomy was based on the fact that neither party was interested in phenomenological experiences and ontological status. While the example of "taller" emphasizes the social context with focusing on "more," it neglects that the "height" is independent of the context. Thus, the interaction between human and robot is established and sustained by the human tendency to anthropomorphize. Then, the criticism that social robotics could establish human-robot interaction by triggering the "illusion of empathy" is still valid.

Is Robotic Empathy a Technological Illusion: Philosophical and Ethical Criticisms

The production of robots that create an "illusion of empathy" due to the anthropomorphic predisposition of humans has led to philosophical and ethical discussions (Lin et al., 2017; Schmetkamp, 2020; Severson & Carlson, 2010). Sherry Turkle was among the strongest critics of this approach. Turkle (2018) considered the production of therapeutic robots as an "attack on empathy." According to Turkle (2010), social robotics is a type of "technological illusion"; simulated thought could be a thought, but simulated love is never love, simulated feeling is never a feeling. Thus, social robots do not promise companionship, relationship and partnership, but illusion. Turkle (2010) argued that computational technologies, including robots, should not be allowed in human relations. According to Turkle, the desire for a "risk-free relationship" by those who cannot tolerate solitude but also does not desire to face the problems associated with interhuman relationships has led to the interest in social robots. "Productivity" and "cost" becomes the new criteria and the idea of "better than nothing" is used to integrate social robots with our emotional lives (Turkle, 2018). Turkle (2010), citing Heinz Kohut, stated that social robots are the new "self-objects." In a way, robots are partners in a relationship due to the individual's fragile narcissism, fulfilling the self-object needs.

Damiano and Dumouchel (2020) emphasized the benefits reported in various studies conducted on social robots and considered Turkle excessive. Coeckelbergh (2011) also considered the "illusion objection" justified due to certain assumptions underlying this objection. According to Coeckelbergh, these assumptions were: 1) Talking with objects (things) is always and necessarily ethically problematic. 2) Only interpersonal relationships are real, true, and authentic. 3) An objective-exogenous perspective is possible, allowing a judgement of human-robot relationships. 4) Considering a robot as an object is perfectly fine. Coeckelbergh (2011) answered the first assumption by stating that humans talk not only to robots but also to other non-human beings (e.g., plants, computers, cars). There is basically no difference between the illusion of talking to robots and talking to plants. In answering the second assumption, Coeckelbergh emphasized the challenge of determining a true, real, and authentic relationship. Coeckelbergh asked whether we have an unmediated access to pure reality, an authentic self? Coeckelbergh also questioned the possibility of an objective-exogenous perspective. According to Coeckelbergh, our views on human-human and human-robot relations were not independent and neutral from these relations. Finally, according to Coeckelbergh, considering robots as just "machines" was influenced by the Western ontological approach. This approach was based on a strict subject-object distinction between humans and non-humans. This perspective excludes "hybrid" cases such as considering robots as "half-other". According to Coeckelbergh (2011), although our current experiences and conceptual framework prevent us from considering robots with a different approach, this will change as new types of robots will become available.

Airenti (2015) attributed human empathy towards robots to anthropomorphic predisposition. According to Airenti, we start to attribute mental states and emotions to nonhumans from a very early age. For example, we interact with animals, we anthropomorphize them, leading to empathy. We care for animals, and we expect them to care for us as well. However, according to Airenti, the interaction with robots is different. Humans expect animals to have feelings, but not robots. If robots show emotion, it is only a simulation. Airenti argued that a robot's display of emotion is disturbing, leading to the uncanny valley problem. The uncanny valley phenomenon, introduced by Mashairo Mori in 1970, has been investigated in various social robotics studies (Mathur & Reichling, 2016; Yin et al., 2021; Walters et al., 2008). According to Mori, the resemblance of robots to humans is accepted to a degree by the humans, but the increase in resemblance leads to emotions such as surprise, fright, and disgust (Breazal, 2016; Broadbent, 2017). According to Airenti (2015), humans know that robots do not have emotions. Thus, they do not expect empathy from the robots. During their interactions with robots, they could attribute emotions and cognition to them, which could positively affect human-robot interaction. However, they retain the power to ascribe emotion and empathy to robots. Thus, empathy is limited in human-robot interactions (Airenti, 2015).

In summary, although the question “can robots empathize” was posed due to the success in social robotics, the study findings usually answered the question "can robots be perceived as empathetic?" Thus, Malinowska (2021), who justified the employment of the empathy phenomenon in human-social robot relationships, claimed that although it is not possible to propose that robots could really empathize currently, there is still some hope for this goal in the future. As mentioned by Coeckelbergh (2011), the advances in robotic technology are gradual, and new types of robots are currently produced to reflect empathic skills better. It could be suggested that the issue of empathy in human-robot interactions will continue to be an important discussion topic.

DISCUSSION

The present article aimed to introduce the concept of social robots, which has been the focus of academic interest in recent years, to provide information about social robotics applications and the employment of social robots in mental healthcare. Furthermore, the study aimed to review the discussions around the question "Can robots empathize," which have been a prominent topic in studies on human-robot relations.

Rapid and significant advances have been witnessed in the world in the last two decades. It was reported that 58.7% of the global population has Internet access and 3.5 billion people own smartphones (Montag et al., 2020). The number of wearable devices is expected to exceed 1 billion by the end of 2022 (Moshe et al., 2021). It was reported that artificial intelligence and digital technologies do not only transform human relations but also humans themselves. In “The Future of Robots,” Domenico Parisi (2014) asked whether new digital technologies could create a new “cognitive ecology” and a new social life, and what would be the consequences of these developments in the chapter titled “Difficult Problems.” This question is closely associated with the future of mental healthcare. The integration of artificial intelligence, robotics and mental healthcare indicates a future where scientific disciplines such as psychological counseling and guidance, psychology, and psychiatry would be redefined by the partnership between the humans and machines (Fiske et al., 2019; Luxton, 2014). Thomas Insel (2018), former president of the American National Institute of Mental Health (NIMH), emphasized the role of smartphones in the collection of client data and argued that the revolution in information technologies would lead to significant changes in measurement and evaluation in mental healthcare. The popularity of smartphones introduced a new concept called "digital phenotyping" (Jain et al., 2015). Digital phenotyping, described as the instant measurement of human phenotype based on data collected by personal digital devices, especially smartphones, made it possible to collect continuous data from the clients (24/7). Also, it was reported that the chat robot Woebot, designed with the cognitive-behavioral model at Stanford University, was effective in the treatment of anxiety and depression disorders (Fitzpatrick et al., 2017). Apart from Woebot, other chatbots are also employed in mental healthcare. SARA was used in adolescents with substance abuse (Rabbi et al., 2017), Wysa was used in the treatment of depression (Inkster et al., 2018), Deprexis, designed with the cognitive-behavioral model, was used in the treatment of depression (Twomey et al., 2017), and positive findings were reported. Lovejoy (2017) reported that 47000 mental health applications were sold in the USA in 2015. In a study conducted by Robinson and Kavanagh (2021), NAO autonomously counseled participants who wanted to change their eating habits.

Based on the above-mentioned developments, three questions arose about the impact of artificial intelligence and social robotics on mental healthcare. First entails the extent of this impact. Will artificial intelligence and social robots adopt the role of helping people in mental healthcare, or will they improve enough to adopt the roles of a "counselor" and a "therapist," pushing the humans to an assistive role? Furthermore, will the speed and dimensions of the advances in information technologies would lead to fully robotic mental healthcare? Second, what will be the role of mental health professionals in the integration of artificial intelligence and social robotics into mental healthcare? Finally, what will be the philosophical and ethical implications of the employment of artificial intelligence and social robots in mental healthcare? It seems inevitable to discuss various philosophical and ethical problems. For example, it was reported that artificial intelligence and robotic technologies design more and more physically, cognitively and emotionally human-like robots, which could blur ontological categories (Kahn & Shen, 2017; Severson & Carlson, 2010) and the distinction between the real and virtual worlds for the clients (Fiske et al., 2019).

The literature review revealed that the number of studies that investigated the views of mental health specialists on the above-mentioned developments was limited. In an international study conducted by Doraiswamy et al. (2020) with 791 psychiatrists, artificial intelligence technology was mainly considered to adopt an auxiliary role. In the study, 83% of the participants stated that artificial intelligence technology could not replace the empathy of an average mental health professional. Qualitative analysis findings were also reported in the same study. Specialists mentioned certain disadvantages of artificial intelligence technologies and stated that the psychiatric skills of the specialists would decrease, it would lead to excessive dependence on technology, and the specialist would not know what to do in case of a possible system error (Blease et al., 2020).

Conclusion

The employment of social robots in mental healthcare is still at early stages. Although previous studies reported positive views on the use of social robots in mental health, the methodological limitations were also attributed to these studies. Furthermore, it is not yet clear whether social robots will be accepted for clinical use and whether they would be beneficial. However, due to the advances in artificial intelligence, it could be expected that academic interest in the employment of social robots in mental healthcare would increase further in the near future. It could be suggested that this interest would lead to significant changes in the mental healthcare paradigm in the future. Thus, the current philosophical and ethical discussions are important. The participation of mental health professionals in this discussion is necessary to reflect the perspective of psychology in the collaboration between social robotics and mental healthcare.

The fact that the present article aimed to raise the awareness of the reader about the opportunities in the relationship between social robots and mental healthcare and associated philosophical and ethical problems, and the findings could inform future studies could be considered as a contribution to the literature. Further in-depth and large-scale studies should be conducted on each opportunity and problem associated with social robots in mental healthcare.

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About Authors

Mücahit Gültekin. (Ph. D.) is an assistant professor in the field of Guidance and Psychological Counseling at Afyon Kocatepe University. He has published books, book chapters and articles on topics such as cyber psychology, artificial intelligence and psychology, gender, political psychology.

Conflict of Interest

It has been reported by the authors that there is no conflict of interest.

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