Review

Psikiyatride Güncel Yaklaşımlar-Current Approaches in Psychiatry 2024; 16(1):16-30
doi: 10.18863/pgy.1242958

Interactive Robots: Therapy Robots

Etkileşimli Robotlar: Terapi Robotları

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ABSTRACT

Robots are becoming increasingly common in many areas of human life as technology advances. Considering the usage areas, robots appear in a wide range, from entertainment to psychotherapy. In addition to its role in facilitating human life, its use in the health field has recently been quite remarkable. In this study, interactive robots are evaluated in general and their use in the mental health field is discussed on a large scale. Accordingly, the primary purpose of this study is to examine the need for the development of interactive and therapy robots, their areas of use, and studies on their effectiveness as well as therapy robots that are generally accepted in the relevant literature. The results of the examination show that interactive robots are classified into six groups: social, entertainment, educational, rehabilitation, sex, and therapy robots. In the related literature, Eliza, Woebot, Youper, Wysa, Simsensei Kiosk Paro, NeCoRo, Kaspar, Bandit, and Pepper have generally been accepted as therapy robots. The results of the studies demonstrate the effectiveness and the usage of interactive therapy robots in therapy for different groups and needs, especially for disadvantaged individuals. On the other hand, it is considered that more research on the effectiveness of robots is needed. Considering the effects on mental health and quality of life, it is believed that the usage of robots in therapy is important and its widespread use will have a significant positive effect in the field.
Keywords: Interactive robots, human-robot interaction, robotherapy, artificial intelligence, therapy robots

ÖZ

Teknolojinin gelişmesiyle birlikte robotların kullanımı insan hayatının pek çok alanında gittikçe yaygınlaşmaktadır. Kullanım alanlarına bakıldığında robotlar eğlenceden psikoterapiye oldukça geniş bir yelpazede karşımıza çıkmaktadır. İnsan hayatını kolaylaştırıcı rolünün yanında sağlık alanındaki kullanımı da son zamanlarda oldukça dikkat çekici boyuttadır. Bu çalışmada etkileşimli robotlar genel olarak değerlendirilmekle birlikte ruh sağlığı alanındaki kullanımı geniş bir ölçekte ele alınmıştır. Bu doğrultuda çalışmanın temel amacı etkileşimli robotların ve terapi robotlarının geliştirilmesine duyulan ihtiyacı, kullanım alanlarını, etkililiğine yönelik gerçekleştirilen çalışmaları ve ilgili alan yazında genel olarak kabul görmüş terapi robotlarını incelemektir. Yapılan inceleme sonucu etkileşimli robotların sosyal, eğlence, eğitim, rehabilitasyon, cinsellik ve terapi robotları olmak üzere altı kategoride ele alındığı tespit edilmiştir. İlgili alan yazında Eliza, Woebot, Youper, Wysa, Simsensei Kiosk, Paro, NeCoRo, Kaspar, Bandit ve Pepper'ın genel olarak kabul gören terapi robotları oldukları değerlendirilmiştir. Yapılan çalışmalar etkileşimli terapi robotlarının özellikle dezavantajlı bireylere yönelik olmak üzere farklı gruplara ve ihtiyaçlara dönük kullanımının terapi için yaygın ve etkili olduğunu göstermektedir. Diğer taraftan robotların etkililiğine yönelik daha fazla araştırmaya ihtiyaç duyulduğu değerlendirilmektedir. Ruh sağlığı ve insanların yaşam kalitesi üzerindeki etkileri göz önüne alındığında, terapi alanında robotların kullanımının önemli olduğu ve kullanımın yaygınlaşmasının alanda anlamlı düzeyde pozitif bir etki yaratacağı düşünülmektedir.
Anahtar sözcükler: Etkileşimli robotlar, insan-robot etkileşimi, roboterapi, yapay zekâ, terapi robotları

Introduction

Many emerging technologies that enhance and facilitate daily life are developing with digitalization. The most remarkable of these technologies are robots developed to meet many needs and thus become a part of human life. The first examples of this exist in the industrial sector. Robots are utilized to save time and labor as well as increase production by replacing humans in the industry (Libin and Libin 2004). The functions of robots have expanded over time, and they started to take place in human life with various roles such as teacher (Belpaeme et al. 2018), doctor (Hoorn and Winter 2018), judge (Bilgin 2022) and even psychotherapist (Libin and Libin 2003). The common characteristic of these robots is that they function thanks to artificial intelligence. It is crucial to examine robots which increasingly play a role in almost every part of life in terms of their contributions to human life. In this study which evaluates interactive robots in six categories (social, entertainment, educational,

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Received: 01.02.2023 | **Accepted:** 29.04.2023

rehabilitation, sex, and therapeutic robots), their use in mental health is mainly discussed. In this regard, the study's primary purpose is to examine the need for the development of interactive robots and therapy robots, particularly their usage areas, studies conducted on their effectiveness, and generally accepted therapy robots in the relevant literature.

Artificial Intelligence

With the development and upgrade of machines, the question "Can machines think?" was raised (Turing 1950), and the concept of artificial intelligence started to be discussed. Artificial intelligence is defined as the ability of a system to accurately interpret external data, learn from the data, and use what is learned for specific goals and tasks by adaptation (Kaplan and Haenlein 2019). Thanks to this aspect, interpreted as a kind of imitation of human intelligence, it can be inferred that artificial intelligence parallels the science of psychology, which requires understanding human behavior. This development paved the way for introducing artificial intelligence into psychology. Studies on the field have gained rapid acceleration. It aims to understand humans' thoughts, emotions, and decision processes with the help of the robots developed (Derin and Öztürk 2020). In the literature, there are studies on developing robots that can create artificial emotions (Shibata et al. 1996). A literature review indicates that people respond to robots that they can identify as living beings rather than stimuli that can imitate voices and gestures only from virtual agents. This interaction increases emotional outputs (Shibata et al. 1999).

The study conducted by Shibata et al. (1999) to elicit emotional responses through human-robot interaction started with a robot dog. The process continued with the seal robot, which has a simple structure and limited responses, to observe the emotional outputs of physical interaction and later the robot cat, which can respond more than the seal. These developments led to the seal PARO being designed as an animal imitation and extensively used, making great strides in the studies. The positive impacts of robotic animals on mental health entail examining and developing the concept of robopsychology.

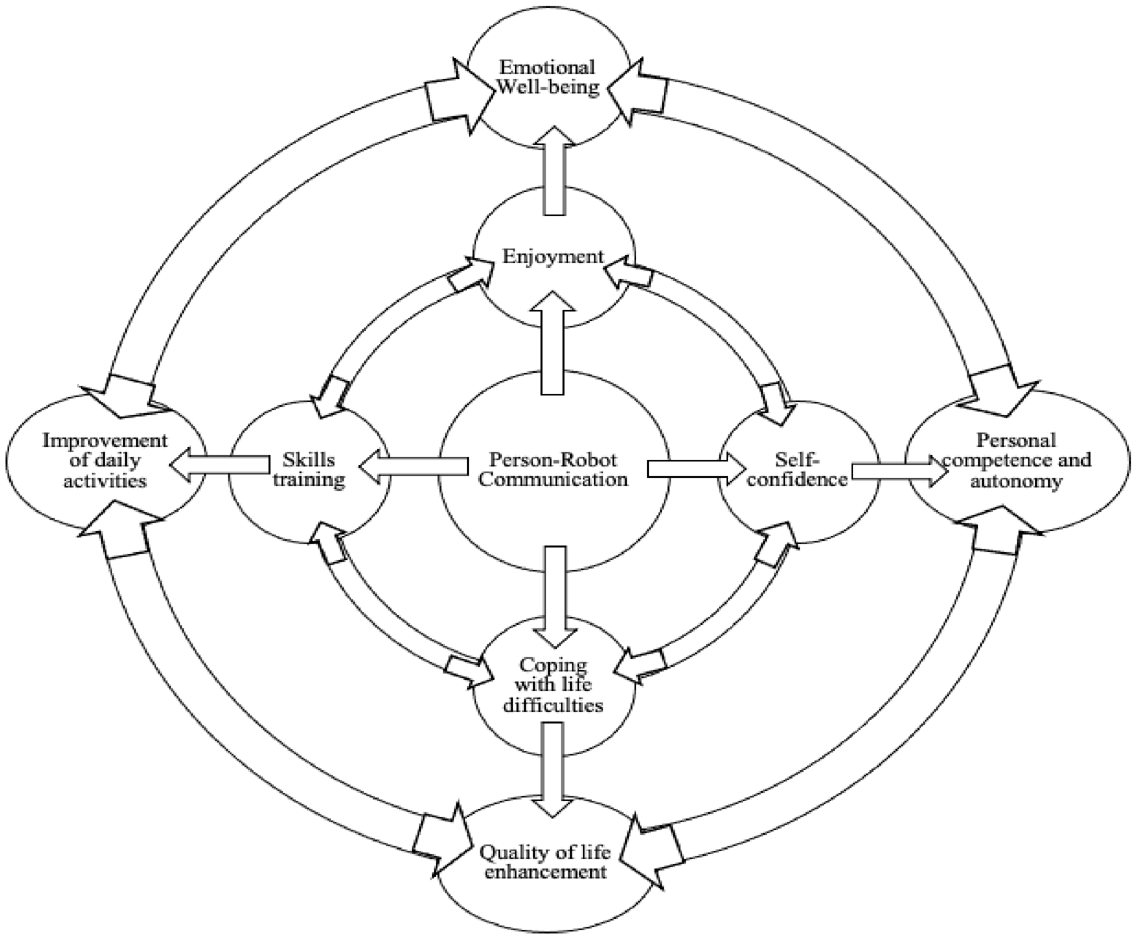

Figure 1. Multidimensional model of human-robot interaction as a Complex Interactive System (CIS) (Libin and Libin 2004).

Robopsychology

As robots with humanoid artificial intelligence become popular, the interaction between robots and humans has become an important issue, and the concept of robotic psychology has emerged. Robopsychology provides a broad perspective on human-robot and robot-robot interactions (Libin and Libin 2004). In this context, Libin and Libin (2004) developed the Complex Interactive System (CIS) (Figure 1) in order to explain the working principle of human-robot interaction based on three principles of interactivity, equifinality, and multimodality. Interactivity is defined as the mutual communication between humans and robots. These interactions occur in many aspects, and human-robot communication involves both technological and social environments. Equifinality means the same goal can be achieved in different means or multiple ways. Multimodality refers to the achievement of communication between humans and robots in different ways, such as verbal and written communication, body language, gestures, and facial expressions. The principle of equifinality allows the robot to switch its system configuration according to the individuality of the person. Thus, the robot may benefit people with different abilities and skills. The principle of multimodality creates a holistic effect that discovers the unique match between the robot's behavioral configuration and the person's individual profile (Libin and Libin 2004).

CIS is considered an analysis of robot-human interaction, consisting of two loops: internal and external. The internal loop is the intended behavior that reflects people's interest and motivation for communication with robots, while the external loop consists of the results of the internal loop. In brief, individuals experience positive outcomes due to the intentional behaviors presented in the internal loop for their benefit, and these outcomes constitute the external loop. This system depicts robots as companions and their evolution as a tool to assist individuals with disabilities or negative states such as loneliness and depression (Libin and Libin 2004).

This model aims to reveal the relationships between system variables (skill, enjoyment, self-confidence, and coping) and the effects of interaction. Enjoyment includes a positive sense of stimulation; skills training includes physical rehabilitation, sensory-motor stimulation, and memory training; self-confidence includes developing a sense of control; coping includes psychological diagnosis, identification of problem areas, and evaluation of needs.

Classification of Interactive Robots

Based on their abilities, interaction robots are classified into social, entertainment, educational, and rehabilitation (Libin and Libin 2004). In addition to the four primary categories, therapeutic agents and sex tools have recently been included in the literature (Cheok et al. 2017). These agents are comprehensively discussed below.

Socially Interactive Robots

Socially interactive robots are described as robots that are designed to interact with people and fully or semi-autonomously follow the behavioral norms expected by humans as a result of the combination of a physical body or structure and artificial intelligence (Bartneck and Farlizzi 2004). These robots model the social behaviors of humans, and they are able to recognize cues such as eye contact, gestures, and emotional responses depending upon the context (Libin and Libin 2004). In order to define a robot as a socially interactive agent, it must have a physical structure, autonomous motion, and the ability to communicate with humans. On the other hand, besides virtual screen characters, non-autonomous robots which do not interact with humans are not considered in this group (Bartneck and Farlizzi 2004). When the relevant literature was reviewed, it was found that the first sociable robot was Kismet which was designed as a head in shape and able to give many human-like reactions (Breazeal 2002).

Entertainment Robots

All robots interacting with others and showing their skills in an environment are considered entertainment robots. The intended use of these robots is shaped depending on the tasks they are specialized for. Their primary purpose is to entertain individuals and elicit positive emotions such as joy (Libin and Libin 2004). Robot dog AIBO the first entertainment robot (Fujita 2001), SDR4x, which can dance and sing (Ishida 2003); and ASIMO, which can read human facial expressions and walk in a balanced way (Sakagami et al. 2002) are considered among the most popular entertainment robots in the literature.

Educational Robots

As technology advances and affects almost every field, robots come to the agenda with various functions in education. Some factors play a vital role in using technology in this domain: offering multi-sensory education opportunities, providing economic advantages, providing personalized content for individuals with different needs, providing access to users from almost all locations, and thus supporting learning. In addition to virtual agents (e.q., computers and smartphones), socially interactive robots are also used in the educational domain (Belpaeme et al. 2018). The physical presence of educational robots provides a higher opportunity for social interaction and behavior outputs compared to the virtual agents commonly used in this field. These advantages may have an impact on the development of educational robots in addition to virtual agents (Belpaeme et al. 2018).

Robots are used for different age groups, and learning needs in education. Some instances of these are the robot Maki and its virtual human model developed to improve the linguistic skills of 6-16-month-old infants with hearing impairment (Scassellati et al. 2018), the robot Pepper used to teach English at home to 4-5 years old children (Tanaka et al. 2015), and the robot Bandit designed as an exercise coach for older people (Fasola and Mataric 2013). The use of robots for educational purposes varies by the robot's role. The robot acting as a teacher has a supportive role in delivering the related curriculum. Beyond the typical role of a teacher, it supports learning through peer-to-peer relationships in the role of a peer. It enables the enhancement and mastery of skills in the educational environment as a beginner or novice to improve learning by teaching (Belpaeme et al. 2018). For educational purposes, robots are deployed as exercise and sports coaches, teachers, peers, and care receivers for older people and children.

Rehabilitation Robots

Designed to help people who have physical and cognitive disabilities in their daily activities, robots allow persons with specific impairments to compensate for their disabilities, improve self-efficacy, and act independently (Libin and Libin 2004). These robots are intended to rid patients of their disabilities, providing them more active lives (Buerger et al. 2004). Designed to improve children's professional, physical, and speech skills, CosmoBOT, which can listen and respond to voice instructions (Lathan and Malley 2001), and Probo, which provides rehabilitation and communication support in hospitals (Saldien et al. 2008) are evaluated in this group.

Sex Robots

Artificial intelligence-assisted robotics have found a place in sexuality and various areas of our lives. The first examples of these robots produced for sexual purposes are called sexbots (Snell 1997). Sex robots are among the most controversial robots developed (Ma et al. 2022). Although these robots are debated in terms of ethical and moral dimensions (Levy, 2007), it is supposed that they will increase the sexual well-being of the disabled and the elderly who do not have sufficient sexual opportunities and will also reduce unintended pregnancies, sexual violence, and abuse (Döring and Pöschl 2018). In addition, their advantages regarding sexually transmitted diseases, criminal activities, and hygiene affect people's orientation to these robots (Levy, 2007). They are considered an alternative to sex workers, and there are businesses in Japan where these robots are hired as sex workers. For example, "Doll No Mori" is a business that serves 24/7 sexbots in southern Tokyo (Levy, 2007).

Moreover, it is predicted that by 2050, humans will be able to marry these robots, though few (Levy, 2009). Some of the advanced sex robots are the female robot Roxxxy manufactured by TrueCompanion in 2010, and the male robot Rocky, developed later (http://www.truecompanion.com). In recent years, research in this field has continued with the sex robot Harmony released by the RealDoll manufacturer Abyss Creations in 2018, followed by the robots Solana and Henry, the robot Samantha developed by the Spanish manufacturer Synthea Amatus, and the robot Emma by the British-Chinese manufacturer AI Tech UK (Döring et al. 2020). These robots are examples of robots developed in the field of sexuality.

Therapy Robots

Therapy robots aim to reconstruct the negative experiences of a person and create positive experiences by interacting with people in multiple ways (Libin and Libin 2003). Every robot is designed for a specific purpose (Shibata and Wada 2011). For instance, the Paro, designed as a seal, was developed to facilitate human life, improve cognitive skills, maintain long-term interaction with people, and provide psychological, physiological, and social benefits (Shibata and Wada 2011). Robot-based psychotherapy, which uses therapeutic robots, robotherapy refers to the evidence-based psychotherapy process via technological tools. Robots are classified into three sub-categories according to their functions in therapy: robot therapist (robo-therapist), mediating robot (robo-mediator), and assistant robot (robo-assistant) (David et al. 2014). David et al. (2014) state that a supervisor programs robots as a therapist (robo-therapist). With advantages in various aspects, including accessibility, cost, and expertise, robots function entirely as a therapist when a therapist is unavailable. In the mediator role, the robot acts as a catalyst in the interaction between the client and therapist to accelerate the treatment. It also assumes a motivating role, making the process more appealing. In this context, using robo-mediators for individuals with autism who are more sensitive to human interactions is an advantage in therapy (David et al. 2014). Other examples are the studies on the robotic cat NeCoRo in the mediator role (Libin and Libin 2003, 2005) and the studies on the robot Paro with older people (Saint-Aimé et al. 2007). The robots implemented in the mediator role demonstrated efficacy in most of the interventions and the widespread use of robots as mediators in therapy for older people and persons with autism (Costescu et al. 2014). The robot, as a helper or assistant (robo-assistant), assists the therapist in performing therapy-oriented practices. Although it functions to reduce the burden on the therapist, it is not necessary to physically include the robot in therapy. However, it can facilitate the process (David et al. 2014).

Therapy robots, which generally have autonomous responses and resemble living creatures, play a mediating role in therapy. Robots in this group have high interaction levels. When the artificial intelligence-aided therapeutic robots in the relevant literature are examined, it would be acceptable to divide them into two categories: therapy robots with a physical form and chatbots. In this respect, this study discusses chatbots Eliza, Woebot, Youper, and Wysa, considered to be generally accepted, and Simsensei Kiosk implemented as a virtual human (virtual human interviewer), as well as Paro, NeCoRo, Kaspar, Bandit, and Pepper in physical form. These robots or artificial intelligence applications are introduced below.

Eliza

The first chatbot, Eliza, was developed from 1964 to 1966 by German scientist Joseph Weizenbaum (1966). It was designed to communicate with humans by processing the directives of scripts. The most famous script file, "Doctor," has an algorithm to convert word inputs into output by mirroring. This way, it responds to what is written without guidance based on the Rogerian approach (Sharma et al. 2017). Eliza, which has the potential to do counseling with humans through artificial intelligence, works on the principle of keyword coordination. It recognizes specific phrases and creates an appropriate response, thus communicating with the user by correspondence. If it encounters an unidentified phrase, it manages the process by asking questions to collect more data (Ranoliya et al. 2017). A human therapist and Eliza were evaluated in a study conducted with two groups with mild psychological problems. It was revealed that users disclose their emotions by attributing human-like characteristics to Eliza, although they know it is a computer program (Cristea et al. 2013).

Woebot

Developed by Alison Darcy, an associate at the Stanford University Department of Psychology, Woebot is a conversational agent that users can access whenever needed. It provides appropriate feedback with daily messages sent to the users to check their mood. It is also integrated with social media apps and based on Cognitive Behavioral Therapy (CBT) (Fitzpatrick et al. 2017). In addition to Cognitive Behavioral Therapy, Woebot has therapeutic process-oriented features: empathic responses, tailoring, goal setting, accountability, motivation and engagement, and reflection (Fitzpatrick et al. 2017). Empathic responses consist of the responses that are appropriate to the individual's mood, while in tailoring, content specific to mood is sent. For instance, in empathic responses, individuals who express that they feel lonely receive feedback showing that it understands the loneliness they feel. In tailoring, content specific to this situation is sent.

Goal setting includes the goals that individuals expect to achieve for a given period. Accountability involves regular check-ins and follow-ups of previous activities to help the individual's sense of responsibility. It is an example of goal setting to ask individuals whether they have a goal they aim to achieve for two weeks. In accountability, it is followed up on how close the goal is currently. Motivation and engagement involve sending personalized messages to individuals daily or every other day to allow them to engage in the process and initiate a conversation. This feature also includes messages (e.q., emoji) that are intended to encourage the task accomplished and the effort symbolically. Finally, reflection includes sending charts showing the individual's weekly mood. For example, the individual's weekly mood can be reflected with "Although you feel tired after your periods of anxiety, this week has been generally stable" and "It seems that your best day was Tuesday" (Fitzpatrick et al. 2017). Described as a friendly and helpful character, Woebot is considered a self-help coach guiding users, not a human or therapist (Prochaska et al. 2021).

In a study of 70 undergraduates aged 18-28 with depression and anxiety, the experimental group (n=34) corresponded with the CBT-driven Woebot. The control group (n=36) was referred to the National Institute of Mental Health e-book about the problem area. Following 2-3 weeks after the applications showed a significant decrease in anxiety levels in both groups, whereas depression symptoms of the participants decreased only in the experimental group (Fitzpatrick et al. 2017). In another study conducted during the COVID-19 pandemic, the use of Woebot for 8 weeks showed efficacy in reducing substance use behavior. Furthermore, significant reductions were observed in the depression and anxiety scores of individuals in the study (Prochaska et al. 2021). Additionally, some studies use Woebot for postpartum mental health interventions (Ramachandran et al. 2020, Suharwardy et al. 2020).

Youper

Youper is a commercial platform that provides mental health services to various professionals. Youper's team states that they needed a new approach to make mental health care services accessible for everyone and increase the quality of the service while reducing its cost. (Youper 2022a, Youper 2022b). To this end, the platform offers a tiered care model, including digital therapy, behavior coaches, therapists, and medication (Youper, 2022a, Youper, 2022c). Youper's digital therapy intervention is delivered through a fully automated chat interface. In the first step, it identifies the current emotional state of individuals and the associated factors. It provides wellness practices or practices for relieving a negative mood by identifying current emotions and intensity (Mehta et al. 2021). Youper's digital therapeutics are based on clinically proven behavioral therapies in depression and anxiety treatment, including Cognitive Behavioral Therapy (CBT), Acceptance and Commitment Therapy (ACT), Dialectical Behavioral Therapy (DBT), Problem-Solving Therapy (PST), Mindfulness-Based Cognitive Behavioral Therapy (Youper 2022d). Thanks to the Youper platform, healthcare providers spend more time on the needs of patients and make the process more efficient (Youper 2022b). The platform listens to the expectations and history of individuals, highlights risk factors, checks in regularly, identifies priorities automatically, and guides them (Youper 2022b). Youper provides a service model in coordination with various experts, from artificial intelligence-aided digital therapy 24/7 for depression and anxiety to online sessions with licensed therapists and behavior coaches in order to alleviate symptoms of stress, anxiety, and depression, and even video calls with doctors and diagnosis, if required (Youper 2022c).

A study in a journal published by the American Medical Association lists Youper among the ten stickiest mobile behavioral mental health applications (Carlo et al. 2020). According to another study that evaluates apps offering smartphone-based mental health services for depression and anxiety problems, Youper is one of the top three apps when considering the number of downloads and daily and monthly active users (Wasil et al. 2020). Similarly, in a study conducted on four mental health service chatbots (Replika, Youper, Sayan, and Woebot), which can interact with humans cognitively and emotionally, are available on mobile devices and easy to access, Youper was found to be the most preferred one by the participant experiences of chatbots (Chung and Lee 2020). Another study on the efficacy of Youper conducted by Mehta et al. (2021), which assessed the results of 4 weeks of app users from the first subscription, showed that Youper was effective in reducing depression and anxiety symptoms and that the first 2 weeks reduced the symptoms. The study results also indicated that improvement in anxiety symptoms continued over 2-4 weeks, but there was a slight relapse in depression symptoms (Mehta et al. 2021).

Wysa

Wysa is a mobile-based chatbot application developed by Touchkin. An app with a text-based chat interface, artificial intelligence, and professional human support, Wysa aims to increase people's mental health resilience and well-being (Inkster et al. 2018, Wysa 2022a, Wysa 2022b). The app's website describes Wysa as a robot and a human, including mental health professionals and the Wysa Artificial Intelligence Coach (Wysa 2022b). The Wysa AI Coach is defined as an "emotionally intelligent" service with artificial intelligence that can respond to the emotions expressed by users, allowing them to have text-based conversations at any time. In contrast, the Wysa Well-Being/Life Coach or therapist offers text-based messaging with trained professionals who are there to listen, support, and encourage users (Wysa 2022b). Designed to help users become mentally stable and enhance their well-being, the Wysa AI Coach provides 24/7 artificial intelligence-based self-help using evidence-based cognitive behavioral techniques, dialectical behavioral therapy, meditation, breathing exercises, yoga, motivational interviewing, and micro-actions (Wysa 2022b). Wysa Life Coaches or therapists are expected to have at least a master's degree in clinical or counseling Psychology and professional experience, as well as affiliations or memberships to leading professional organizations (e.q., American Psychological Association, the British Psychological Society, and the British Association for Counseling and Psychotherapy) (Wysa 2022b). It is possible to have 30-minute sessions through text-based messaging with these professionals (audio and video only in India) (Wysa 2022b). It is free to talk to Wysa AI by accessing the tools it offers in chat. However, for sustainability, access to features or tools of a better version and services involving an actual mental health professional are paid (Wysa 2022b). Wysa Well-being coach and Wysa therapist services are not intended to replace face-to-face psychotherapy. It is considered an enabling and empowering mode of support rather than treating an illness or a health condition (Wysa 2022b). It provides a space for people to express themselves without being judged or under time constraints and an easy and private way to practice skills learned in face-to-face therapy (Wysa 2022b).

When the studies in the literature are examined, a study on the accessible version of Wysa conducted by Inkster et al. (2018) evaluated frequent and less frequent users' self-reported symptoms of depression. Study results revealed that the group of frequent Wysa users had significantly higher improvement scores than the others. In another study, participants who received digital mental health services through Wysa in addition to orthopedic treatment reported a decrease in depression and pain levels and a significant increase in physical functionality over the two months compared to patients who did not receive any mental health services, excluding standard orthopedic treatment (Leo et al. 2022). The study conducted by Malik et al. (2022) showed that users provided highly positive evaluations of Wysa regarding the themes of acceptability, usability, usefulness, and integration (privacy).

Simsensei Kiosk

SimSensei, developed by the USC Institute for Creative Technologies, is a fully automatic system that conducts interviews to assess psychological distress indicators (DeVault et al. 2014). SimSensei Kiosk, a virtual human interviewer, was designed to create face-to-face interactions in which the person feels comfortable talking and sharing information (DeVault et al. 2014). SimSensei Kiosk is embodied in a virtual human named Ellie.

Ellie conducts semi-structured interviews to create interactive situations favorable for an automatic assessment of distress indicators defined as verbal and non-verbal behaviors correlated with depression, anxiety, or post-traumatic stress disorder (DeVault et al. 2014). Developing this system aims to create clinical decision-support tools by objectively measuring the verbal and non-verbal behaviors associated with psychological problems for specialists. The record of the previous information in the system also presents information on the changes in symptoms, thereby helping professionals in the diagnosis process (DeVault et al. 2014).

Ellie uses a computer program based on various algorithms to identify questions and gestures and compiles a list of the characteristic non-verbal behaviors of the person through its sensors as part of its software. It achieves these tasks with its capacity, including audio-visual perception, non-verbal behaviors, natural language, dialogue management, and non-verbal behavior realization and generation (DeVault et al. 2014). It decides when and how to respond by observing different user image points and detecting voice tones and pauses. Ellie reads and analyzes how the users speak, their gestures, facial expressions, and even how often they blink. In addition to their success in interpreting verbal and non-verbal messages, Ellie also allays the fear of being judged by others. Thus, it reduces the anxiety of individuals and increases self-disclosure (Hart et al. 2013, Joinson 2001).

Paro

The Paro is a therapeutic robot used for relaxing patients with dementia and providing therapy for older adults. Resembling a baby seal, Paro aims to provide the benefits of live animal therapies more effortlessly (Sharkey and Wood 2014). It has five types of embedded sensors that enable it to perceive people and their environment and interact with people: sound, light, touch, temperature, and posture. It can recognize light and darkness with its sensor. It feels like being stroked or beaten via the tactile sensor and held via the posture sensor. It can also recognize the direction of the voice, its name, greeting, and praise through the sound sensor (Paro Robots 2022). Paro learns and adapts its behaviors to the users via these sensors and artificial intelligence software. Depending on the reactions from users, it determines whether it will repeat certain behaviors. For example, if the user hugs Paro, it will encourage them to perform this behavior. If the user hits or harms Paro in some way, it will remember that action and will not repeat it. Accordingly, Paro learns the behaviors that the user likes and imitates these behaviors (Paro Robots 2022). It can also express emotions by moving its body and tail, blinking its eyes, and making seal sounds (Sharkey and Wood 2014).

Studies showed that Paro increased communication and social interaction (Kidd et al. 2006, Wada and Shibata 2007, Wada et al. 2002) and reduced anxiety and depression (Roger et al. 2012). In addition to its positive effects on patients, Paro is also known to provide convenience and reduce the stress of caregivers (Kidd et al. 2006, Sharkey and Wood, 2014, Wada and Shibata 2007).

NeCoRo

NeCoRO refers to alternative mental health robots called Max and Cleo, developed by Omron Corporation (Japan). Responding through multiple sensors, NeCoRo has 50 different behaviors. It reacts to the human voice, touch, and movements. It knows its name, and its fur provides the feeling of a real cat (Libin and Libin 2005). Besides its real-life-looking, it imitates a real cat's reactions (Libin and Libin 2005).

A study carried out on NeCoRo included young adults aged 16-25 and older people aged 68-81. It was observed that the older people were more satisfied with the cat's behaviors and reacted more to the cat robot than the young and technology-savvy ones (Libin and Libin 2005). A similar study compared Max, the robotic cat, and Mathilda, the plush cat used for older people living in nursing homes with an average age of 78 and diagnosed with dementia. The study results showed that older people with severe dementia benefited more from Max, and those with low levels of forgetfulness engaged with Max for a longer time (Libin and Libin 2005).

Kaspar

Kaspar was developed by the University of Hertfordshire's Adaptive Systems Research Group, a multidisciplinary group of domain experts conducting pioneering research on artificial intelligence and robotics. Kaspar, a child-sized humanoid robot with a simplified face but an impressive set of features (University of Hertfordshire 2022), is used to improve the social skills of children with autism by enabling them to practice their daily interactions. Kaspar's simple design focuses on basic expressions and gestures and creates a safe environment, allowing users to experience uncomplicated, predictable, and stress-free interactions.

A study that included 54 practitioners who work with individuals with autism from a range of disciplines (e.g., psychiatrist, occupational therapist, special education) and with at least five years of professional experience reviewed the expectations of the potential contribution of Kaspar. According to the results, practitioners expected that Kaspar could significantly contribute to children's development, especially in communication, social interaction, and play (Huijnen et al. 2016). Another study consisted of seven children aged 7-11 with autism and the play sessions with Kaspar. The results of the study indicated that Kaspar had a positive effect on children's social and communication skills. Teachers suggested that Kaspar could improve learning gains by positively impacting children's attention and contributing to their development by meeting their individual needs (Karakosta et al. 2019). In a 10-week study conducted by Wainer et al. (2014), play sessions were run with Kaspar and six children aged 8-9 diagnosed with autism with speech, language, and communication problems. The study revealed that collaborative skills and social behavior outcomes improved in children who played with the robot.

Bandit

Bandit was developed by the University of Southern California Interaction Lab and BlueSky Robotics (USC Interaction Lab 2022). It is a humanoid robot designed for the research into socially assistive robotics in school, home, office, and hospital environments, appropriate for interaction with children and adults (Robots 2022a, USC Interaction Lab 2022). Consisting of a face that can generate emotional expressions, arms with 6 degrees of freedom, and a neck with 2 degrees of freedom, the robot can be mounted on various mobile platforms, including short or long ones (USC Interaction Lab 2022). A study conducted with elderly persons and Bandit as an exercise coach showed that the robot motivated participants to engage in physical exercises. Participants evaluated Bandit as more enjoyable and useful than the virtual robot (Fasola and Mataric 2013).

Similarly, in a study with dementia patients, it was found that the patients were interested in activities that Bandit took part in and that the robot positively affected their sustained attention (Tapus et al. 2009). In the study conducted to rehabilitate paralyzed patients, Mead et al. (2010) observed that participants gave positive feedback due to the practices with the robot. In a study by Feil-Seifer and Mataric (2008) using Bandit to develop a robot-assisted behavioral intervention architecture for children with autism, it was found that Bandit increased the interaction of children with autism. On the other hand, Feil-Seifer and Mataric (2011) stated that 4 out of 8 children who participated in the study reacted positively to Bandit, while four reacted negatively.

Pepper

Developed by SoftBank Robotics/Aldebaran Robotics, Pepper is a sociable humanoid robot designed to interact with humans through a touch screen and dialogues (Robots 2022b, SoftBank Robotics 2022). It can recognize facial expressions, voice tones, and basic emotions (Pandey and Gelin 2018, SoftBank Robotics 2022). Thanks to its size and look, it aims to be appropriate in daily life and acceptable in human-robot interaction (Pandey and Gelin 2018). For various purposes in many areas (e.g., businesses, stores, schools), Pepper can exhibit body language and perceive and interact with its surroundings through talking (Pandey and Gelin 2018, SoftBank Robotics 2022). With a wide range of use, the robot is intended to facilitate human life and reduce the workload. In addition to its role in daily life, its use in rehabilitation, education, and elder care through applications is becoming widespread, and development studies are ongoing (Bechade et al. 2019, Sato et al. 2020, Tanaka et al. 2015, Tanioka 2019, Ujike et al. 2019).

A study conducted with higher education students showed that Pepper created a positive perception of learning and increased learning gains by providing a different learning environment (Donnermann et al. 2020). In a study on elderly schizophrenic patients with low physical functionality and used wheelchairs, it was revealed that Pepper contributed significantly to developing patients' communication and participation in activities and that patients had fun (Ujike et al. 2019). Similarly, in another study conducted for older people with schizophrenia or dementia, the reaction, interaction, and benefit aspects were examined (Sato et al. 2020). In addition, Pepper was used for different purposes, such as teaching English at home to 4-5-year-old children (Tanaka et al. 2015), psychometric assessment for older people (Rossi et al. 2018), and rehabilitation for older people (Tanioka 2019).

Usage Areas of Therapy Robots and Studies Conducted

In the literature on therapy robots, there are robots with a physical form embodied with artificial intelligence and chatbots in the form of artificial intelligence-supported software and applications. It is known that the use of chatbots has increased in recent years, and they have widespread use in the field of mental health (Abd-Alrazaq et al. 2019, Bendig et al. 2019). Chatbots are used in mental health interventions for many conditions (e.g., depression, autism, anxiety) based on various counseling theories/approaches, particularly Cognitive Behavioral Therapy (Abd-Alrazaq et al. 2019). In addition to the artificial intelligence of chatbots, the support of various field experts, especially mental health professionals, has been recently included in the applications (Wysa 2022a, Youper 2022a).

Significant studies on using robots with a physical structure in mental health are directed at disadvantaged groups (Cifuentes et al. 2020). These groups are generally persons with autism, older people, physically disabled persons, and persons with cognitive impairments (Cifuentes et al. 2020, Costescu et al. 2014, Libin and Libin 2005). Therapy robots are frequently used when working with children with autism (Aresti-Bartolome and Garcia-Zapiraini 2014, Eliçin 2016). It can be observed that these individuals have difficulty adapting to other people's behaviors (Williams et al. 2004) and play with their toys alone in social environments (Wing et al. 1977). Playing with robots whose movements are more predictable is a pleasant experience for children with autism (Dautenhahn 1999). It is noted that children with autism perform better in response to robot movements compared to human movements in therapy (Pierno et al. 2008). In parallel to this, a study evaluating scientific articles shows that socially assistive robots are effective in improving the social skills of children with autism in mutual attention, verbal communication, and imitation skills and in reducing stereotypical behaviors. In addition, it is generally accepted that the robot assumes a supportive role, not substituting the teacher or therapist (Syriopoulou-Delli and Gkiolnta 2020). Robotics used in robot interactive studies on persons with autism are very diverse (Scassellati et al. 2012). In this study, Kaspar and Bandit are discussed in detail, which are generally accepted robots when working with children who have autism. The research and the results are included under the relevant title. There are also projects carried out in the literature. One of these projects is AuRoRA (Wainer et al. 2014). It started in 1998 and pioneered the use of robotic toys for children with autism. These robots are designed to teach children basic social skills, allowing them to communicate and interact with their environment (Wainer et al. 2014).

Paro also called the compassion robot, demonstrated compelling results in elderly care according to the studies conducted with elderly persons (Bemelmans et al. 2012). The robot Pepper which can perform tasks to facilitate and support the daily life of older people (Bechade et al. 2019), is also used in these areas. Studies indicated that Woebot achieved effective results on depression and anxiety symptoms (Fitzpatrick et al. 2017). Bendig et al. (2019) researched to examine the current status of chatbots. Although they demonstrated the effectiveness of robots for conditions such as well-being, depression, and stress, studies in the relevant literature are mostly pilot ones. Some study results revealed the effectiveness of chatbots, but further research is needed due to various limitations of the studies in the literature (Abd-Alrazaq 2020). Studies on therapy robots and chatbots are discussed separately under the title "Therapy Robots," Their results are given in detail.

Conclusion

This study aims to examine the need for the development of interactive robots and therapy robots, the usage areas and effectiveness of robots, as well as generally accepted robots. As a result of the study, interactive robots are considered in six categories: social, entertainment, educational, rehabilitation, sex, and therapy robots (Libin and Libin 2004, Cheok et al. 2017). Although there is a wide range of therapy robots, Eliza, Woebot, Youper, Wysa, Simsensei Kiosk, Paro, NeCoRO, Kaspar, Bandit, and Pepper are generally accepted therapy robots. These robots are widely used for children and older people with social, emotional, and developmental problems (Cifuentes et al. 2020, Libin and Libin 2005). In this context, studies are frequently carried out on robots and children with autism (Huijnen et al. 2016, Karakosta et al. 2019, Wainer et al. 2014).

This study categorizes therapy robots into two groups: chatbots and robots with a physical form. Chatbots reach a wider audience at a lower cost 24/7 and can provide mental health services regardless of the physical environment (Youper 2022a, Woebot 2022, Wysa 2022b). In addition, chatbots can potentially provide effective results and positive experiences (Vaidyam et al. 2019). Sweeney et al. (2021) emphasize that clients are more likely to open up to chatbots than mental health professionals. Similarly, a person may find getting support from a robot easier than a counselor for various reasons (e.g., fear of being judged and embarrassed) (DeVault et al. 2015, Fiske et al. 2019). Although the perceptions and opinions of users about chatbots are generally positive (Abd-Alrazaq et al. 2021, Bickmore et al. 2021), clients and mental health professionals express various concerns and risks regarding the process (e.g., displaying emotions, competence, confidentiality, and security) (Sweeney et al. 2021).

Artificial intelligence-supported robots with a physical structure can contribute to the individual competencies of older people by reducing their dependence on staffing, especially in disadvantaged groups (Bechade et al. 2019). On the other hand, it has been revealed that the balance of human interaction is essential in processes carried out with robots (Mordoch et al. 2013), and cultural factors effectively accept robots (Coco et al. 2018). In this context, it is thought necessary to conduct large-scale studies with various robots in different cultures (Broekens et al. 2009). According to the studies, robots with physical form are generally involved in therapy processes with three main functions robo-therapist, robo-mediator, and robo-assistant. They are considered to be effective in most of the studies (David et al. 2014).

The relevant literature confirms that using robots in therapy for different groups and needs is common and has demonstrated efficacy (Cifuentes et al. 2020, Costescu et al. 2014, Martin et al. 2013). Robots can provide advantages in terms of objectivity and impartiality in decision-making processes, providing personalized service, being available 24/7, and not having vital needs (Canel 2020). However, human-machine interaction is an issue that needs to be emphasized in the ethical context. It would be beneficial to conduct studies on this issue and include robots in therapy environments as a supportive technology (Canel 2020).

When the mentioned technology is evaluated, research results reveal the effectiveness of therapy robots in various cases. However, these robots are far from replacing the current mental health service providers. The use of these technologies in therapy environments will be beneficial and may play an essential role in the future of the field of psychology. In this context, increasing the number of studies and obtaining findings on the positive and negative effects of human-robot interaction, limitations, and legal dimensions (e.g., confidentiality, storage of personal data, cyber threats, and determination of supervisory authorities) will make a contribution to the field. In Turkey, no artificial intelligence application or program is widely used in the mental health field. It is claimed that the utilization of therapy robots in the education of children diagnosed with autism will be effective and increase the quality of elderly and disabled care services. It is also considered to provide broader access to mental health services and benefit people with limited access to mental health professionals. Adapting and developing artificial intelligence-aided robots that provide mental health services in our culture will enhance the field and enrich the therapy processes. In summary, this study will increase awareness of artificial intelligence-assisted practices in mental health. It is aimed to inspire experts working in the relevant field in the country to develop and use artificial intelligence-supported robots in this field.

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Authors Contributions: The author(s) have declared that they have made a significant scientific contribution to the study and have assisted in the preparation or revision of the manuscript
Peer-review: Externally peer-reviewed.
Conflict of Interest: No conflict of interest was declared.
Financial Disclosure: No financial support was declared for this study.