Robotics Technology in Mental Health Care

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INTRODUCTION

This chapter discusses the existing use of and future potential use of robotics technology in mental health care. Robotics technology primarily refers to robots, which are physically embodied systems capable of enact- ing physical change in the world. Robots enact this change with effectors that either move the robot itself (locomotion), or move objects in the environment (manipulation), and often use data from sensors to make decisions.

Robots can have varying degrees of autonomy, ranging from fully teleoperated (the operator makes all decisions for the robot) to fully autonomous (the robot is entirely independent). The term robotics technology also broadly includes affiliated technology, such as accompanying sensor systems, algorithms for processing data, etc.

As a discipline, robotics has traditionally been defined as "the science which studies the intelligent connections between perception and actions," though in recent years this has shifted outward, becoming focused on problems related to interacting with real people in the real world (Siciliano & Khatib, 2008). This shift has been referred to in the literature as human-centered robotics, and an emerging area in the past decade focusing on problems in this space is known as human-robot interaction (HRI).

The use of robotics technology in mental health care is nascent, but represents a potentially useful tool in the professional's toolbox. Thus, the goal of this chapter is to provide a brief overview of the field, discuss the recent use of robotics technology in mental healthcare practice, explore some of the design issues and ethical issues of using robots in this space, and finally to explore the potential of emerging technology.

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Background

Human-Robot Interaction

Goodrich and Schultz (2007) describe the HRI problem as seeking "to understand and shape the interactions between one or more humans and one or more robots." They decompose the problem into five principle attributes: (i) the level and behavior of a robot's autonomy, (ii) the nature of information exchange between human and robot, (iii) the structure of the human-robot team, (iv) how people and robots adapt and learn from one another, and (v) how the task shapes interaction.

All of these factors play a role in how a mental healthcare professional might consider the use of robotics technology in their practice. However, there are two additional factors that may be of particular importance to practitioners. The first is the morphology, or form, of the robot itself. Robots can range in appearance from very mechanical-looking to very anthropomorphic in appearance (Riek, Rabinowitch, Chakrabarti, & Robinson, 2009). Morphology is a richly debated topic in the research community, with many studies showing people will anthropomorphize and form attachments to nearly anything conveying animacy. Some researchers worry this not only conveys inaccurate expectations to people about a robot's capabilities, but may also be unethical when treating vulnerable populations (Riek, Hartzog, Howard, Moon, & Calo, 2015; Riek & Howard, 2014). For example, individuals with cognitive impairments or children may be more susceptible to deception and manipulation by robots.

A second factor that can impact the HRI problem is individual differences between people. People have a wide range of existing cognitive and physical attributes which can greatly influence how they perceive, interact with, and accept robots (Hayes & Riek, 2014). These factors may be particularly important when considering the use of robotics technology for clients in mental healthcare settings, who may have further unique needs.

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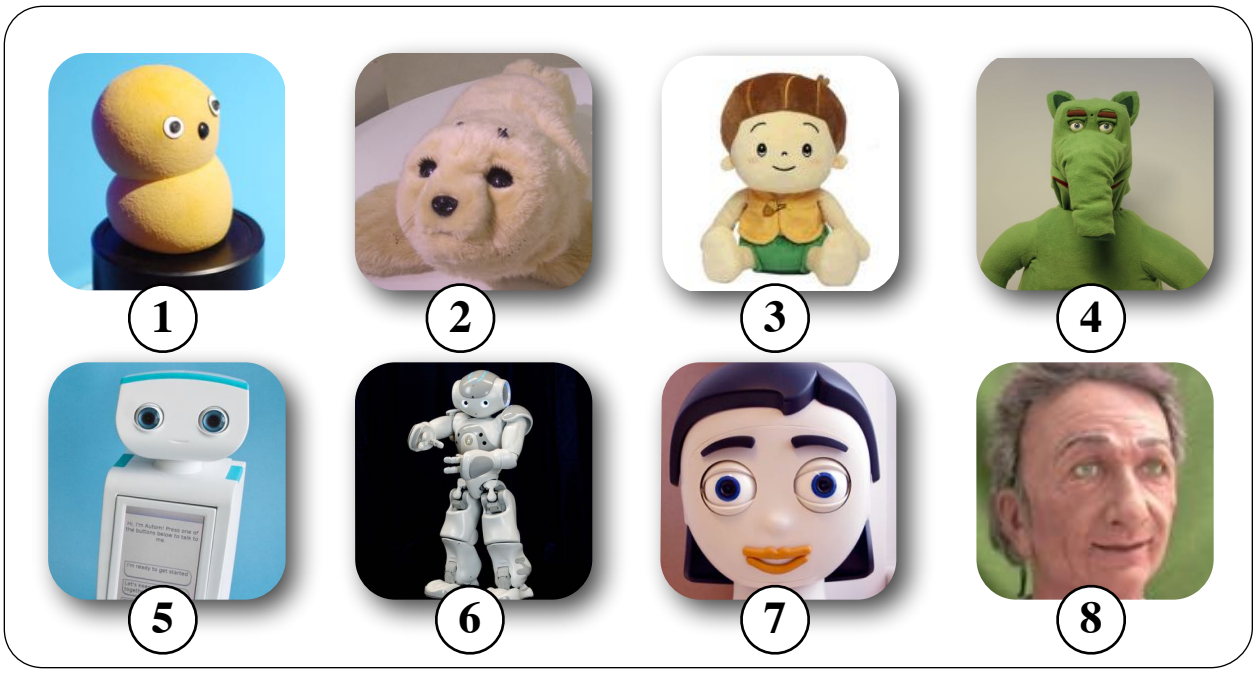

Figure 8.1 Robots currently used in mental healthcare vary greatly in their morphology, and include zoomorphic, mechanistic, cartoon-like, and humanoid representations. These robots have been used for helping treat people with dementia, autism, and cognitive impairments; have helped provide companionship for people who were lonely; have been used to help educate children with developmental disabilities; and have been used to help improve how people with visible disabilities are treated. (1) KeepOn (Kozima, Michalowski, & Nakagawa, 2009), (2) Paro (Shibata, 2012), (3) Kabochan (Tanaka et al., 2012), (4) Probo (Vanderborght et al., 2012), (5) Autom (Kidd & Breazeal, 2008), (6) NAO (Diehl et al., 2014), (7) Flobi (Damm et al., 2013), and (8) Charles (Riek & Robinson, 2011).

Robot Morphology

Figure 8.1 depicts several consumer and research robots used in mental healthcare applications, many of which will be discussed in next section. The robots in this figure are representative of the state-of the-art for socially interactive robots. Robots with more mechanistic appearances have been used in other applications, though very few in mental health care.

While zoomorphic, anthropomorphic, and cartoon-like morphologies are the most common, some robot designers have explored other unique representations. For example, actuating "everyday objects" like balls, drawers, and ottomans (Michaud, Duquette, & Nadeau, 2003; Sirikin & Ju,

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2014). These robots are quite engaging, due to people's innate tendency to anthropomorphize anything with animacy (Heider & Simmel, 1944; Waytz, Cacioppo, & Epley, 2010). They may serve a useful role in therapeutic applications with clients who are less comfortable with anthropomorphic or zoomorphic representations, such as individuals on the autism spectrum (Diehl et al., 2014).

Often a robot's morphology is directly related to its functional capability requirements; for example, a robot that needs to manipulate objects is likely to have a grasper, and a robot that needs to climb stairs is likely to have legs. However, consumer robots often have appearances that reflect science fiction depictions in their color (grey) and shape (boxy). They also sometimes convey extreme feminine representations (i.e., fembots), which has raised ethical concerns in some research communities (Riek & Howard, 2014).

While consumers do not have much choice over the appearance of the robot they purchase, they frequently dress, name, and otherwise take steps to personalize it. For example, extensive, long-term, in-home studies of the Roomba vacuum cleaning robot reflect this consumer personalization (Forlizzi & DiSalvo, 2006; Sung, Guo, Grinter, & Christensen, 2007).

As will be discussed in the "Ethical Issues" section of this chapter, it is important that mental healthcare professionals are careful when selecting a robot morphology to use in treatment. Many people have a latent fear of robots due to 60 years of sordid science fiction depictions, and these fears could be exacerbated in a mental healthcare scenario. On the other hand, some morphologies may inhibit or delay transfer of learned skills from the therapy setting to everyday life. In general, when selecting a platform, mental healthcare professionals need to carefully weight the capabilities of the robot against the therapeutic needs for the patient.

Robot Capabilities

Current robots have an extensive range of physical capabilities, and as the service robotics industry continues to blossom these capabilities will only grow. In terms of physical capability, robots of various morphologies can

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