Social Robots, Robotic Assistants, and Home Health Monitoring Devices

A Gerontological Research Perspective

"Hey Siri, what's the weather today?" More people are using voice-enabled digital assistants for simple tasks such as checking the weather or answering simple factual questions. The rise in popularity of these devices and their ability to connect with other devices to complete more complex tasks is interesting to gerontological researchers. As the capabilities of these assistive devices evolve, the marketplace is exploring innovative technologies for their potential to address myriad needs facing a rapidly growing demographic of older adults. Staving off cognitive decline, staying out of the hospital, and living at home are increasingly common reasons for older adults and their caregivers to consider technological solutions.

To date, engineers and software developers have done a significant amount of technology-based research on digital aids. Evidence on therapeutic effectiveness is limited but growing. If society is on the cusp of a new era of digital therapeutics in gerontology, older adults, scientists, scholars, and ethicists from a variety of health care disciplines need to contribute to research efforts. This editorial will address some of the considerations needed to navigate the development and testing of social robots, robotic assistants, and health monitoring devices for older adults.

SOCIAL ROBOTS

Humans have long strived to find ways to connect with each other. As software and computational science engineering continue to evolve, society has continued to be intrigued by finding new ways to apply this learning to the human experience. *Social robots* are artificial intelligence systems that are designed to interact and communicate with humans by following social behaviors and rules attached to their role (Huber, Lammer, Weiss, & Vincze, 2014). Social robots may be physically embodied with facial features, a voice, and expressions, or they may have interactive screens that are amorphous with limited to no human-like features. Interactions between social robots and humans offer potential to engage people on a social-psychological level, and researchers in the robotics field see a lucrative market for social robots in addressing negative impacts of social isolation on mental health in older adults.

Animated animals like the PARO seal, or Hasbro's Joy for All cats and dogs are examples of social robots in use today. These robotic pets display a variety of emotions and respond to a user's touch and voice, provide comfort and companionship, promote engagement, as well as provide other benefits, including a decrease in loneliness and isolation (Sabanovic, Bennett, Chang, & Huber, 2013). There are mixed results from randomized controlled studies that used social robots to treat symptoms of depression in older adults (Chen, Jones, & Moyle, 2018). A meta-analysis of social robots found no significant statistical benefits, but findings suggested the possibility of improvements in agitation, anxiety, and quality of life (Pu, Moyle, Jones, & Todorovic, 2018).

ROBOTIC ASSISTANTS

Social robots may be designed to provide social interaction or to complete tasks. For example, HOBBIT, a socially assistive robot, provides emergency detection and fall prevention in addition to providing feelings of safety and support (Vincze et al., 2014). These feelings are generated through reciprocity fostering dialogues in which the robot can provide help to the user and ask the user for help. Smart speakers, such as Amazon Echo and Google Home, have become well-recognized devices in many homes and may be simple, but can also aid users. As more home automation technologies reach the mainstream, smart speakers may become the de facto control hub, allowing consum-

ers to control their lighting, heating/cooling, and other internet-enabled home systems through a common interface.

The newest entry into the social robotics field for older adults is a robot named ElliQ (Intuition Robotics, Inc.). Marketed as "The Sidekick for Happier Aging," ElliQ is positioned to be more than a digital assistant. The robot is designed to handle ordinary user requests, such as voice updates on news and weather, to more complex capabilities, such as understanding the daily routine of users and reminding older adults of routines or alerting family members when those routines change. With a clear focus on robot–human interactions, the creators of ElliQ are developing a solution that grows and adapts to the user's specific likes and needs. These types of adaptive solutions get away from a "one size fits all" model and are based on the belief that interaction between robots and humans is genuine and ever changing as with any real relationship. ElliQ can begin conversations by learning its users' interests and suggesting content (e.g., music, videos, news articles) that may be of interest. It is not meant to replace social interaction, but merely augment reduced social interaction common in older adults. As more focus is being placed on the mental and physical effects of social isolation in older adult communities, these solutions are intended to impact quality of life for users.

HEALTH MONITORING

Social robots and health monitoring are becoming more closely related. In addition to the impact on social well-being, health monitoring and telehealth devices have entered the marketplace and show great promise for identifying and treating health conditions earlier in their course. This technology helps prevent hospitalization, emergency department use, and reduces health care costs. Health monitoring technologies include everything from health tech wearables, such as smart watches and fitness trackers, to technology solutions that allow a consumer to consult with a clinician from anywhere in the world 24 hours a day. The ability of older adults to launch an application and have a face-to-face consultation with a clinician can increase access at an affordable cost, especially when accessibility is an issue.

As social robots becomes more sophisticated, the opportunity for these devices to become a portal of entry for data and health monitoring may change how clinicians and researchers generate and use information. Social robots may act as "data ushers"—helping collect and deliver information regarding how older adults interact and move through their day, and providing insights into mood, motivation, and decision making. In this way, they will "usher" new data points into algorithms that can bring new insights into healthy aging or how clinicians may assess and treat older adults.

Sensors on the patient and in the home can provide clinicians with more data about the lives of their patients than ever before. Instead of a geriatric clinician making a clinical diagnosis or treatment plan based on a 15-minute consult, more robust data can be collected along a time trajectory. Activity levels, medication use, sleep habits, and even passive systems that monitor breathing and heart rate information throughout the day can lead to a much more holistic view of older adults' health. Trying to sift through endless streams of data is not feasible. All this information must be delivered in a usable format. Hence, preliminary research must be done for these devices to have practical clinical utility. For example, the work of developing algorithms to identify and alert users of collected data outside of predicted norms for various age groups will require an enormous amount of development work. Thus, the tools of tomorrow, which take advantage of artificial intelligence, can help narrow the information to just the critical pieces necessary for diagnosis.

Lists of possible uses for these robots seems limitless, but greater understanding of benefits versus risks is needed in wide scale adoption. As the democratization of data continues to make more data available to consumers, what are the risks? Will there be an increased risk of "self-diagnosis" by older adults and their families that may cause a delay in identifying the change in condition? Or overuse of health care services when not needed? Cueing an older adult to complete tasks such as taking medications or the steps for dressing may be done by a robotic assistant, but at what price? Home safety for older adults may be enhanced with many features, such as those that automatically lock doors at night, detect safety hazards on the floor, prevent wandering in unsafe areas, or send alerts when appliances are used unsafely, but who responds when an issue is detected?

THEORETICAL CONSIDERATIONS

Social robotics is an emerging field that is challenging people to think about what connecting, engagement, and communication really means. Evidence is unclear on whether robots can be programmed to have emotional intelligence and adapt to and respond to human behavior in a therapeutic way. Because social robots engage people on a social-psychological level, their use must be informed by a depth of understanding of psychosocial and behav-

ioral theory. The most desirable mental capacities of social robots in one study were forms friendships, empathizes, has values, and feels attachment to specific people (Malle & Thapa Magar, 2017). The sample used in the Malle and Thapa Magar (2017) study was familiar with artificial intelligence and might not represent all older adults' needs and preferences.

For older adults to engage with robots, the robot must be perceived as interesting, appealing, easy to use, and trustworthy. Theory and research are being used to determine the optimum qualities of anthropomorphism, animation, likeability, and perceived intelligence of robots (Bartneck, Kulić, Croft, & Zoghbi, 2009). Several studies have found that humans are more likely to engage with a robot and find it to be more human-like than machine-like when it behaves somewhat unpredictably (Litoiu, Ullman, Kim, & Scassellati, 2015; Waytz et al., 2010).

A "one size fits all" approach does not work well in gerontology. Researchers should try to determine if certain psychosocial characteristics of people make them a good "match" with the psychosocial qualities programmed into a robot. Just as individuals prefer interacting with some people more than others, it is likely that research will uncover a match between the human qualities of users—such as personality characteristics and degree of extroversion—to the social qualities of robotics. Although some older adults may find an empathetic robot comforting, others may prefer a robot who completes tasks without trying to establish a social relationship.

RESEARCH CONSIDERATIONS

For science to move forward in determining efficacy, a robot should be tested not as a device, but as a device plus an intervention given to meet specific needs or uses. Other things to consider are whether the robot will be used individually or in groups, the length of use hypothesized to be efficacious, choice for a control condition, desired outcomes, and explication of mechanisms by which the outcome is hypothesized to be achieved. In one systematic review of social robots for treating depression, group interventions showed more benefit than individualized use, which raises the question of whether the opportunity for social interaction played a role in achieving benefit (Chen et al., 2018).

As social robots, robotic assistants, and home health monitoring devices are an emerging trend, the idea of how to integrate these systems into the home or congregate care settings is a mystery. Do these systems have positive or negative effects on long-term health and well-being of their users? How does social interaction through digital mediums compare to true human contact? Older adults and researchers can help during the development process by providing information on user needs and requirements and help choose meaningful and clinically important outcomes to be attained. It will be incumbent upon clinicians, researchers, older adults, families, and other stakeholders to find ways to engage with developers to deliver feedback and contribute to testing and guiding development of future solutions. This research is in its infancy, so steps forward should be taken with the need for researchers to verify effects.

For all health care interventions, it is important for researchers to study safety and measure adverse events. When adverse events are identified, researchers need to weigh risks versus benefits and ways to mitigate potential negative effects through strategies, such as training, providing safeguards, or mechanical redesign. For example, added convenience of grocery delivery should be studied for concomitant losses in exercise, geospatial awareness, and social interaction. Having assistive robots in the home could promote a feeling of security that is unwarranted and compromises safety and health.

ETHICAL CONSIDERATIONS

Advances in technology are part of modern society and living in the modern world requires an openness to new uses for technology. Robots, particularly when used with older adults and vulnerable groups, such as persons with dementia or mental illness, necessitate a consideration of ethical issues that may arise. If human–robot interaction is used to replace human–human interaction, it may further alienate older adults, especially those whom caregivers find difficult or unpleasant.

Researchers must also ask if there is a degree of deception involved in using pets and human-like robots with persons with mental illness and if that deception is justified by potential benefits. A robot named Jibo® expresses likes and dislikes, although these are fabrications from computer algorithms (Weir, 2018). If verbalizing feelings and problems to robots or receiving positive feedback from pet-like robots will have benefits, does it matter that robots do not really care about you or understand your situation? *Persuasive robotics* is the study of persuasion as it applies to human–robot interaction. Using a robot to change another person's belief or behavior can be used for good or bad and raises ethical questions (Siegel, Breazeal, & Norton 2009).

Beyond personal one-to-one interactions between social robots and individuals is the perception that fam-

ily members may have about perceived benefits of social robots for their loved ones. If family members rely on technology to receive information about their relative's condition, how does this impact the relationship between them, how much importance do they attach to the robot's information, and are privacy rules being violated? Although it is not within the scope of this editorial or *Research in Gerontological Nursing's* mission to address ethical questions, the need to discuss and sort out some positions is clear.

CONCLUSION

The development of new technologies to assist older adults is continuing to grow. The research base underlying these developments from fields outside of robotics engineering has not grown at a similar rate. It is not unusual for innovations to be developed with enthusiasm that is followed by more critical discourse and demand for evidence. There is an urgent need to build an empirical base in gerontology that can inform and guide the development of social robots, robotic assistants, and health monitoring devices.

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