Robo therapy

A new class of robots provides social and cognitive support.

By Kirsten Weir

Yale University psychology professor Dr. Alan Kazdin (right) and doctoral student Molly Crossman (left) have developed the Innovative Interactions Lab at Yale to explore the use of socially assistive robots in mental health care interventions. They are working with Paro — a six-pound baby harp seal that can see, hear, touch and learn from its experiences.

Mel Evans

Photos courtesy of the Yale Parenting Center

These Dragonbots are being used for a collaborative project with the Yale Parenting Center. The social robots interact with children to help them better learn how to handle real-world problems. After learning three key steps from a trained professional, the child transitions roles and teaches the robot the steps.

A child with autism spectrum disorder sits in a room with his mother. Across from them is a robot, with a human-like head and upper torso perched atop a rolling platform. The child backs away, and the robot hangs its head and whimpers. The child moves closer, looking the robot in the face. When he does, the robot responds with smiles, happy sounds and a cascade of bubbles.

It sounds like a game, but this so-called "bubblebot" is an important early step in the budding field of socially assistive robotics. The bubblebot was designed to help children with autism develop social skills, but the possibilities for therapeutic robots don't end there. Socially assistive robots could provide companionship to lonely seniors, teach coping skills to adolescents with depression or even help someone quit smoking or lose weight.

Robot therapy isn't as out there as it sounds. For decades, robotic systems have helped provide physical therapy, says Brian Scassellati, PhD, a social robotics researcher at Yale University. Recovering stroke victims, for instance, have used a robotic system to help guide their limb movements during physical rehabilitation exercises. "Socially assistive robots don't offer physical support, but rather cognitive or social support," he says. "Anytime you could use a good personal coach or trainer, we're starting to see robots involved in that kind of application."

While children with autism spectrum disorder often have trouble interacting with human peers or adults, many of these children are drawn to technology. Dozens of research groups worldwide have begun exploring robots for children with autism, Scassellati says. "In almost all the cases, you see kids with autism get very excited to interact with the robot, and they have sustained interest."

The goal isn't merely to provide kids with a robotic playmate. Rather, researchers hope that robotic systems can help the children learn valuable social skills such as imitation, taking turns and maintaining joint attention with another person. "The ideal is that the robot is a peer. It encourages the child to exercise those social behaviors that the child otherwise couldn't or wouldn't do," says Maja Mataric, PhD, a robotics researcher at the University of Southern California who developed the bubblebot with her then-graduate student David Feil-Seifer, PhD, now a robotics researcher at the University of Nevada, Reno.

To see Dr. Maja Mataric discuss using robots in the treatment of autism, visit our digital edition at www.apa.org/monitor/digital/robots.aspx.

Yale psychologist Alan Kazdin, PhD, agrees that stronger evidence is needed to confirm the therapeutic benefit of these robots. Nevertheless, he sees potential in the field of socially assistive robotics. A robot could, for example, nudge a child to practice the violin, or urge someone trying to lose weight to lace up those gym shoes. "Anywhere there is behavior change, there might be a role for robots," he says. "The key to behavior change is practice, and practice with feedback is always better."

The ultimate objective, of course, is that the child would extend those behaviors to his or her interactions with other people. And there's evidence that happens. As Scassellati and Mataric describe in a recent review, a variety of studies have reported that kids with autism will look from the robot to a parent and back again, or excitedly point out some feature of the robot to an adult or another child (*Annual Review of Biomedical Engineering*, 2012). In their excitement, the children seem to naturally seek out those joint displays of attention that are so important for social interaction.

Mataric describes one child with autism who engaged with the bubblebot. The boy tried to tell the robot what to do, but became frustrated when the robot was unable to follow his instructions. "Then he said, 'This is how my teacher feels when I don't do what the teacher says,'" she recalls. "This was an incredible narrative of empathy that the therapist was just jumping up and down about."

Robots for behavior change

The research on socially assistive robots for children with autism is still at an early stage, and the devices aren't yet being used therapeutically. But robotic devices are being used to provide companionship to older adults in some hospitals and nursing homes. One of the most widely used is Paro, a furry robot designed to look like a baby harp seal.

Developed by Japanese scientists, Paro coos and wiggles in response to being petted or spoken to. It blinks when the lights go on, turns toward sounds and responds to its name. And it appears to be a comfort. The $5,000 plush seal has been reported to reduce stress and stimulate social interactions between a patient and his or her caregivers and peers. Some reports also suggest that Paro helps reduce problematic behaviors, such as wandering and agitation, in patients with dementia.

Yet the quality of research varies widely. A 2009 review by Dutch researchers concluded that robots such as Paro do seem to have positive benefits for older adults, in areas such as reduced stress and loneliness, improved mood and increased social connections. However, the reviewers noted, the methodology behind the studies was often lacking. More work is needed for robust evidence of the robots' benefits, they concluded (*Gerontechnology*, 2009).

Part of the problem, says Mataric, is that robotics research is expensive, and funding has been hard to come by. "We can barely get funds to pay for one or two robots and recruit a handful of families," she says. Without adequate support, she says, it's impossible to design studies large enough to generate statistically significant findings. That may be starting to change, however, as federal funding sources such as the National Science Foundation are beginning to support socially assistive robotics projects.

Yale psychologist Alan Kazdin, PhD, agrees that stronger evidence is needed to confirm the therapeutic benefit of these robots. Nevertheless, he sees potential in the field of socially assistive robotics. He's recently begun studying Paro, trying to understand at a basic level which facets of the robotic interaction might reduce stress in children. But he envisions broad uses for socially assistive robotics, far beyond mechanical seals. A robot could, for example, nudge a child to practice the violin, or urge someone trying to lose weight to lace up those gym shoes. "Anywhere there is behavior change, there might be a role for robots," he says. "The key to behavior change is practice, and practice with feedback is always better."

Yet most important, in Kazdin's view, is the potential for robots to help address untreated mental illness. "About 70 percent of people in need of psychiatric services in the U.S. receive nothing," he says. "What can we do to help reduce the burden of mental illness?" He wants every option on the table, whether that's smartphone apps, self-help programs, online therapy or, yes, robots.

Individual psychotherapy is excellent for the people who have access to it, Kazdin says. But there simply aren't enough providers to reach everyone who needs help. If a robot could help alleviate anxiety or depression, why not?

For now, though, robotics researchers think of their creations as tools, not substitutes. "No one thinks these things are going to replace teachers or therapists," Scassellati says. "We think the real benefit is increased one-on-one tutoring time, and we're drawn to these domains where there's just not enough human support to cover the need."

Tailor-made technology

Robots may offer certain advantages that other technology does not. "With a physical robot, you learn much faster than you would from a character on a screen," Scassellati says. People are also more compliant when a robot asks them to do something.

In one amusing illustration of this tendency, Scassellati and colleagues used a robot to direct volunteers to shelve books in an office — and put a pile of new textbooks in the trashcan. Half of the participants received instructions from a robot that was in the room with them, while the rest took orders from the same robot broadcast in real time on a video screen (*International Journal of Social Robotics*, 2010). "With the real robot, more than 70 percent of people threw the books away, no questions asked. With the same robot making the same gestures but on [video], only about 20 percent did it," he says. "When we're asking people to do something hard, we want that leverage."

Still, researchers have a lot of questions to sort out before we welcome a fleet of social robots into our daily lives. Any kind of behavior change takes time, and robots need to be pretty sophisticated to hold a person's interest over the long term. "We know how to build things that are durable enough and expressive enough," Scassellati says. "The challenge is in terms of putting enough intelligence into a robot so it can really be engaging and motivating over a period of weeks or months."

It's hard enough for a person to understand what makes another person tick. But robotics developers need to tell a machine how to figure out what's going on in a person's head — and then respond accordingly. That's an enormous challenge, says Feil-Seifer.

Social cues can be subtle, but it's important that socially assistive robots give and receive such cues in ways that are both expected and helpful. While working with the bubblebot, for instance, Feil-Seifer realized that the robot would take the most efficient path when moving across the room. But a child could easily feel snubbed by a robot zipping away. To counteract that, he programmed in pauses in which the robot would stop and wait for the child to catch up. "That's a nice social cue that the robot was trying to maintain connection," he says. "Interaction is fragile and we don't ever want to break that."

Another issue is determining what physical form the robot should take. Is a fluffy seal the best choice? A cartoonish dragon? A humanoid with a friendly face? "There's not one form that's right for everything we want to do. A robot that helps a child learn social skills will probably look different from one that helps a 40-year-old quit smoking," Scassellati says.

Yet while such questions are important, Mataric adds, the field won't move forward if researchers get hung up on every detail. Though it may be uncomfortable for scientists to accept, she says, traditional research that tries to look at each element of human-robot interaction one at a time is all but impossible. "Human social interaction is incredibly rich, and we can't control all these factors," she says.

She thinks of socially assistive robots as a kind of personalized behavioral health care. "I really think we're doing a disservice to people with special needs when we are seeking solutions for everybody," she says. With 3-D printing and similar fast-evolving technologies, kids will soon be able to design their own robots, she says. "I don't want to worry about whether an oval head or round head is best. Who cares if it has seven ears, if it works for the kid?"

Robot behavior, too, could be customized. While working with children with autism in Mataric's lab, Feil-Seifer saw that some responded well to the robot while others did not. He developed a computer program that recognized within two seconds whether or not the child was having a positive interaction. This kind of early-detection system could be used in the future to turn any number of robot features on or off depending on how a person responds to them.

As robotics researchers continue to develop new and better systems for socially assistive robots, psychologists can offer important insight into the complexities of human behavior. "Technologists, psychologists, neuroscientists: We all have to shed the arrogance of our own specific field and work together," says Mataric. "It's way too soon to make any conclusions, but it is absolutely time to invest in really developing these technologies to see how they can complement human care — because the need is huge." ■

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Further reading

• Rabbitt, S. M., Kazdin, A. E., & Scassellati, B. (2014). Inegrating socially assistive robotics into mental healthcare interventions: Applications and recommendations for expanded use. *Clinical Psychology Review, 35,* 35–46. http://dx.doi.org/10.1016/j.cpr.2014.07.001

• Scassellati, B., Admoni, H., & Mataric, M. (2012). Robots for use in autism research. *Annual Review of Biomedical Engineering, 14,* 275–294.

• Shibata, T., & Wada, K. (2011). Robot therapy: A new approach for mental healthcare of the elderly — a mini-review. *Gerontology, 57,* 378–386.