

Q&A Maja Matarić The social roboticist

Maja Matarić, a computer scientist and neuroscientist at the University of Southern California in Los Angeles, makes robots that assist people with disabilities, children with autism and elderly people — a phenomenon explored in the film Robot and Frank (2012). On the eve of its release, she talks about the future of socially assistive machines.

How does *Robot and Frank* portray the human-robot interface?

The film asks whether people can relate to machines, and how robots can bridge the gap between what ageing people need and what their families can provide. In it, an elderly jewel thief convinces his caretaker robot to help him pull off a heist.

Did the film use a real robot?

The film-makers make a human in a robot suit look like a robot trying to look human. The robot's capabilities are necessarily beyond the current state-of-the-art: it serves as butler, nurse, chef and maid. Robots that manipulate objects in the real world are harder to engineer, and because these tasks require coordination and strength, safety is a major concern.

Are you designing those kinds of robots?

There's a whole realm of need that doesn't demand any physical work. Robots can help people to cope with depression, isolation, exercise and even social disorders such as autism. Most robotics is about getting the robot to do the right thing, whereas we make robots that get the person to do the right thing. Our socially assistive robots provide coaching, encouragement and companionship. We would never want to coerce people; rather, we aim to influence their behaviour. Someone who has had a stroke may need to spend hours each day working to regain function in an arm. A robot can use persuasion, motivational techniques and social manipulation to help the patient to persist with that. One student in my lab is studying how a robot might use the human quality of reciprocity. By helping a person with a task, such as shelving books, it would make it more likely that the person would adhere to the robot's requests, such as to do more exercise.

Can robots help with diagnosing autism?

With about one in every 100 children affected, early diagnosis is badly needed. We are designing a robot for diagnostic use in paediatric waiting rooms: as kids play with it, it could flag those with autism-like symptoms.

What about treatment of autism?

We have demonstrated that child-sized humanoid robots can encourage some children with autism to be more verbal and empathetic. The robots' life-like appearance and responsive behaviour seem to stimulate children to play with them and express empathy; when our robot didn't obey a com-

NATURE.COM For more on the

ethics of robotics, visit: go.nature.com/lwx6ow bobt didn't obey a command, one child said, "Now I know how my teacher feels." We're using a robot to model an autism behavioural therapy that aims to help a child gradually improve on a task. It will use verbal feedback and encouragement while playing games to encourage the child to imitate its poses and gestures. Ultimately, we hope to see the results of this research in affordable products for home use.

How can robots motivate people?

In a study we used Bandit, a child-sized humanoid robot on wheels, as an exercise coach. A person was seated across from Bandit and they played 'chair aerobics'. Sometimes Bandit led the exercises, and sometimes the user taught exercises to Bandit - many people love to be in charge some of the time. In another game, Bandit gave ever-longer exercise sequences to test memory and stamina. Through the use of computer vision, Bandit was able to detect the person's behaviour and performance, and respond appropriately by providing encouragement, increasing the levels of challenge and making humorous comments. We found that users strongly preferred Bandit to a computer simulation with the same games and behaviours, rating the robot as knowledgeable and caring. It effectively motivated people to exercise consistently.

Will caretaking robots take jobs from people?

Thirty years from now, there will be about as many old people as children and workingaged people in the United States. The population demographics are already creating a gap in care. Even if we expanded the immigration rate, we couldn't afford to fully train and pay everyone to be caregivers for the entire elderly population. Technology, including robotics, will have to be part of the solution.

Do assistive robots pose ethical issues?

I am concerned about claims that salespeople might make about these machines' capabilities. We don't want snake-oil promises of health benefits that aren't clinically validated. Other issues could arise from companies failing to advertise necessary software upgrades or implement recalls. And, as with people, when you put robots in the 'wild', their behaviour is not entirely predictable. If robots are continually learning and adapting to their users, it will be interesting to see the relationship dynamics that emerge between the two.

How can long-term robot-human relationships be managed?

We don't want attachments between humans and their robots to become dysfunctional. As with human-human relationships, it is best that people do not become overly dependent, submissive or abusive. Some ask what will happen if a well-loved robot breaks down. Its memory will be backed up and, for a price, an identical body can be built for its data to live in. The real question is, what is the warranty?

INTERVIEW BY JASCHA HOFFMAN