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A Passion to Build a Better Robot, One With Social Skills and a Smile

By CLAUDIA DREIFUS

CAMBRIDGE, Mass. — Dr. Cynthia L. Breazeal of the Massachusetts Institute of Technology is famous for her robots, not just because they are programmed to perform specific tasks, but because they seem to have emotional as well as physical reactions to the world around them. They are "embodied," she says, even "sociable" robots — experimental machines that act like living creatures.

As part of its design triennial, the Cooper-Hewitt National Design Museum in New York is exhibiting a "cyberfloral installation," by Dr. Breazeal, which features robotic flowers that sway when a human hand is near and glow in beautiful bright colors.

"The installation," said Dr. Breazeal, 35, "communicates my future vision of robot design that is intellectually intriguing and remains true to its technological heritage, but is able to touch us emotionally in the quality of interaction and their responsiveness to us — more like a dance, rather than pushing buttons."

Dr. Breazeal (pronounced bruh-ZILL) wrote about her adventures as a modern-day Mary Shelley in her book "Designing Sociable Robots," released this year by M.I.T. Press. She was also a consultant on the Steven Spielberg movie "A.I.: Artificial Intelligence."

Q. What is the root of your passion for robots?
A. For me, as for many of us who do robotics, I think it is science fiction. My most memorable science fiction experience was "Star Wars" and seeing R2D2 and C3PO. I fell in love with those robots.
Q. R2D2 and C3PO were good robots, friendly. But so many of the robots of science fiction are either hostile, or at least misunderstood, like Frankenstein's monster and HAL of "2001: A Space Odyssey." Why have fictional robots been so menacing?
A. We have a lot of suspicion of robots in the West. But if you look cross-culturally, that isn't true. In Japan, in their science fiction, robots are seen as good. They have Astro Boy, this character they've fallen in love with and he's fundamentally good, always there to help people.

In a lot of Western science fiction, you need some form of conflict, whether it's aliens or robots. I think in Western culture, being more

suspicious of science, and hubris, you'll see a lot of fear of creating something that goes out of control. Also a lot of Western sci-fi books and movies are about the basic notion of taking responsibility for what you create. If you're talking about creating any new technology, this is always an issue.

Q. How did you get into robot building?
A. I was raised on technology. I grew up in Livermore, Calif., a town of physicists and cowboys. My parents worked at the government laboratories there. So technology was very normal for me. Before college, I wanted to be a doctor or an engineer. At college, U.C. Santa Barbara, I considered NASA and becoming an astronaut. At college, they had just started up a center on robotics and it was this cool new thing. I remember sitting with one of my friends who was talking about building planetary rovers for NASA, and that seemed so wonderful. So when it came to applying to graduate school, I was naturally drawn to Prof. Rod Brooks's robotics lab at M.I.T., where they were doing pioneering work developing micro-rovers, those robotic vehicles that might do experiments on other planets for NASA.

Q. The first robots you worked on were made for use in space?
A. Yes. A lot of my early work was actually a precursor to these micro-rovers that are in use today at NASA's Jet Propulsion Laboratory. Rod Brooks, my adviser, had been developing these rough-terrain robots that were insect-like in the way they looked and how their computerized brains functioned. Rod went on a sabbatical and when he came back, he said, "I've got one big project left in me and we're going to do a humanoid robot now." The common wisdom was first you do robot insects, then reptiles, dogs and eventually humans.

The thing that really intrigued me about a humanoid project was the chance to work on the robots' ability to interact with people. This would no longer be the robotics that others had done: robots in space, in minefields, as substitutes for humans in dangerous environments. This was about bringing robots into human environments so that they could help people in ways that hadn't been possible before.

I was curious to see if benevolent interactions with people could accelerate and enrich the learning process of machines. In short, I wanted to see if I could build a robot that could learn from people and actually could learn how to be more socially sophisticated. It was that thinking that led to Kismet; my work on it was my doctoral thesis.

Q. Does your robot Kismet look like a human?
A. No. It is more a robotic cartoon. It doesn't have arms and legs; its mechanical parts are uncovered. In fact, it is mostly a face. It has eye-brows, surgical tubing for lips so that it can smile and frown, pink ears used for expression and showing arousal and things like that. The engineering on Kismet was inspired by the social development of human infants.

In Japan in the 1980's, they were already starting on humanoid robots. But Kismet was the first developed to specialize in face-to-face social interactions with humans. Kismet was started in 1997, and I intentionally created it to provoke the kind of interactions a human adult and a baby might have. My insight for Kismet was that human babies learn because adults treat them as social creatures who can learn; also babies are raised in a friendly environment with people. I hoped that if I built an expressive robot that responded to people, they might treat it in a similar way to babies and the robot would learn from that. So, if you spoke to Kismet in a praising tone, it would smile and perk up. If you spoke to it in a scolding tone, it was designed to frown. There were models of emotion conveyed through its face.

Q. Did your robot Kismet ever learn much from people?
A. From an engineering standpoint, Kismet got more sophisticated. As we continued to add more abilities to the robot, it could interact with people in richer ways. And so, we learned a lot about how you could design a robot that communicated and responded to nonlinguistic cues; we learned how critical it got for more than language in an interaction — body language, gaze, physical responses, facial expressions.

But I think we learned mostly about people from Kismet. Until it, and another robot built here at M.I.T., Cog, most robotics had little to do with people. Kismet's big triumph was that he was able to communicate a kind of emotion and sociability that humans did indeed respond to, in kind. The robot and the humans were in a kind of partnership for learning. Our newest robot, Leonardo, is even more expressive. It has arms, a torso, legs and skin, which is very important in terms of raising the bar on robotic sophistication. Leonardo's facial expressions are characteristic of human facial expressions. The gestures it can make are characteristic of human gestures.
Q. What is the purpose of building sophisticated robots? Some might say that you're just building very expensive Furbys.
A. We want to see if we can build robots that are more than tools. I'd

like to push robotics to the point where we are creating machines that cooperate with people as partners. For instance, right now, I'm working with NASA on developing Robonaut, which is envisioned as an astronaut's assistant.

Q. Why did you feel you needed to give your newest robot, Leonardo, limbs and a skinlike covering?

A. We wanted to make a robot with more of a body to push our experiments to the next level. Leonardo has the ability to shrug its shoulders and sway its hips. It has 32 motors in the face, so it can do near-human facial expression and near-human lip synchronization. It's just an incredibly rich platform for social interaction, and that's what it's designed for. It can manipulate objects, which is very different from the armless Kismet.

Q. Do you miss your robots when you're not with them?

A. I miss Kismet — I do! What people might not understand is that when I talk about robots, it's not just a physical robot in the lab, it's the vision of what I see them becoming. It's almost embarrassing for me to talk about Kismet, because people think it's so odd that I could have this attachment to this robot. At scientific conferences, I find it hard to quantify what you have when you interact with Kismet and what is so special about it. But the essence of that is what I am now trying to distill into Leonardo. Kismet has been retired to the M.I.T. Museum. I would rather have him stay up at the Media Lab, with me. But he's done his job. Kismet isn't gone; it's just now taking the next step in its own evolution through Leonardo.