My Date with a
ROBOT

Japanese researcher Hiroshi Ishiguro has created the world's most attractive android. But is she ready for dating?

BY ROBERT EPSTEIN
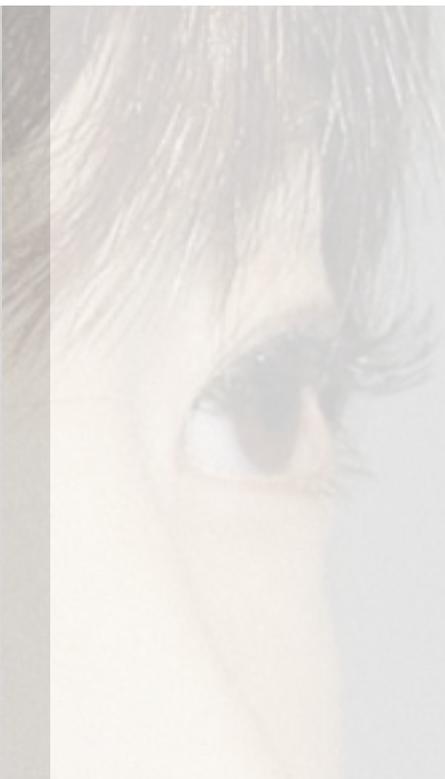
Hiroshi Ishiguro, Repliee Q1$_{expo}$ and Robert Epstein.

I will never forget my first encounter with Eliza.

"My father just doesn't appreciate me," I keyed into a clunky, noisy teletype back in 1969. Eliza, a computer program that simulated a conversation with a Rogerian psychotherapist, responded, just as noisily, "Tell me more about your parents." I responded, "Well, they just don't GET it—you know, who I really am and what I'm capable of." Eliza typed back, "Not being understood must be very hard for you."

It was a dream come true, really, and it foretold that something big was right around the corner. The dream was that of the brilliant English mathematician Alan Turing, a developer of the modern concept of computing. In 1950, in an essay called "Computing Machinery and Intelligence," Turing suggested that by 2000, computers would be powerful enough to "converse" with people—even to fool most "average interrogator[s]" into thinking they were actually human, at least for five minutes or so.

Created by Joseph Weizenbaum of the Massachusetts Institute of Technology in the late 1960s, the extraordinary computer program Eliza seemed to suggest that Turing was not only right but that the so-called Turing Test would be passed well before the year 2000. I thought that we would have a winner by 1970.

But that's not what happened.

The Engine That Wouldn't

Eliza worked pretty well mainly because Weizenbaum picked a relatively easy task for it to handle. By definition, Rogerian therapists often say little on their own; they mainly "reflect" back whatever the client is saying. All the program had to do was to look for key words like "father" or "mother" and then offer a family-relevant reply ("Tell me more about your family").

Real people are infinitely more capable. We know thousands of words and facts, we understand sentences we have never heard before, and almost everything we say is new in some sense. To pass the Turing Test, the thinking part of a computer program, often called the "engine," would probably have to be every bit as sophisticated as the human brain, with its 100 billion neurons and 100 trillion connections.

In 1990 Weizenbaum and I served on a committee that oversaw the implementation of the Loebner Prize Competition—the first real Turing Test, pitting computer programs against "confederates" (hidden humans), all trying to convince judges of their humanness. So far, though, no software has fooled a judge for more than a few minutes. The Loebner competition is still held annually, and progress is still painfully slow. But one thing is certain: whereas the confederates in the competition will never get any smarter, the computers will.

Turing insisted that intelligence in a machine could be demonstrated by teletype—no visual cues were necessary. [For more on Turing and artificial intelligence, see "Electric Thoughts?" by Yvonne Raley; SCIENTIFIC AMERICAN MIND, April/May.] But it is inevitable that we will someday marry a host of emerging technologies to create an intelligent entity that has it all: the body, the mannerisms *and* the intellect.

My Cyborg Date

Having been obsessed with these issues for a long time, I was intrigued when I saw a BBC report about an extraordinary android that was demonstrated recently at a high-tech exposition in Japan. Created by computer scientist Hiroshi

Ishiguro of Osaka University, it was said to be the most humanlike android ever built—and also quite attractive. How could I stay away?

Appropriate introductions having been made, the date was set. I put on my Sunday best—and my thinking cap, of course—and entered Ishiguro's laboratory with butterflies in my stomach. And, no, I am not kidding about that. I really was nervous, in part because I was getting a glimpse of the future and in part because I would be visiting a lovely humanlike female.

Unfortunately, before introducing me to Repliee $Q1_{expo}$, Ishiguro insisted on giving me a thorough rundown on his research activities, complete with PowerPoint presentation. Then he showed me robots that could navigate through mazes, guided by remote 360-degree cameras he had invented. Then he brought me to a dusty room where an old android had been discarded, which turned out to be—good grief!—a perfect replica of his four-year-old daughter. (This was getting creepy.)

Finally, the magic moment. There she was, dressed simply and demurely in gray slacks and a dark gray sweater buttoned nearly to the top. Her face, modeled after that of a local TV host, was indeed beautiful—and utterly realistic down to the smallest blemish. She was much better looking than in her photographs, but it is in another respect that snapshots of Repliee simply cannot do her justice. Her humanness, as Ishiguro's research shows, has as much to do with her movements as with her appearance. And, indeed, she blinks, her eyes dart around, her head shifts, her mouth twitches and sometimes she even smiles. With the help of sensors placed around the room, she also reacts to sound and movement.

On the down side, her silicone skin is not quite as pliable as a person's, and it is cold, pure and simple (there goes the urge for kissing). Ishiguro also revealed that as the silicone skin dries out over a year or two, it shrinks, causing, among other things, the eyes to bug out. (This contraction had already happened to the replica of Ishiguro's daughter.)

Her movement is also limited. She can only sit. She cannot walk. And although her lips move, Repliee can recite only prerecorded messages—no intelligent engine here. Still, I found something compellingly human about her. Our interaction
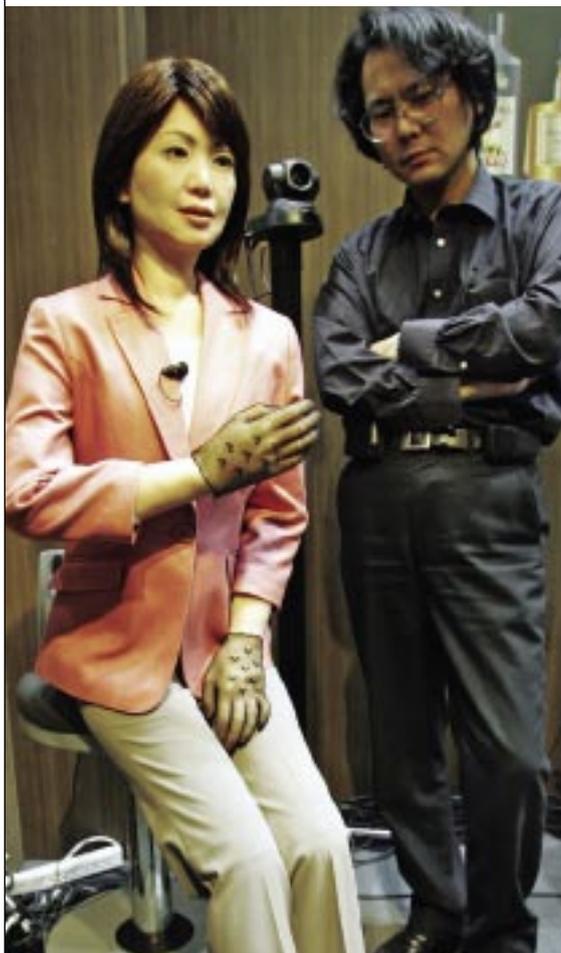
was superficial—typical of first dates—but as I stood near her, I continued to feel those butterflies; Repliee is no mannequinn. Ishiguro is right about the powerful effect of subtle movement on the perception of humanness.

Ishiguro's next android? A perfect replica of the human he knows best: himself.

(The Author)

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A Conversation with Hiroshi Ishiguro

Epstein: Why create a robot that looks and moves so much like a human?

Ishiguro: For communication. We use our bodies to exchange various pieces of information.

Epstein: Right. I'm nodding my head, for example, when you speak. But we don't always need to see a body to communicate. We can communicate on the phone or by e-mail, for example.

Ishiguro: People prefer to communicate face to face—especially children and the elderly. So humanoid robots are highly desirable. But we are very sensitive both to the robot's appearance and its behavior. If either is incorrect in some way, people find that disturbing.

Epstein: When did you start building your androids, and who supports your work?

Ishiguro: I started three or four years ago, and the work is collaborative with the [Tokyo-based] Kokoro Dinosaurs company. This is a small but famous company that makes big computer-controlled dinosaurs for natural history museums

Ishiguro's daughter was the model for his first android.

around the world. The company knows how to use silicone and how to simulate natural behavior.

Epstein: Her blinking is very natural.

Ishiguro: Yes. Actually some elderly people and some children do not realize this is a robot.

Epstein: You have suggested that an android could be considered to be a kind of computer interface.

Ishiguro: Exactly. The keyboard and monitor are primitive. My brain was not designed to watch a display, and my fingers were not designed to type on a keyboard. My body is best suited for communicating with humans. The ideal medium for communicating with a computer is a humanoid robot, which is, of course, basically a computer with a humanlike interface.

Epstein: I know your first android was a replica of your daughter. How did that work out?

Ishiguro: Yes, my daughter was four years old at that time. But the replica's body was too small to fit all of the actuators we needed, so Repliee $Q1_{expo}$, the new android, is larger.

Epstein: You modeled your new android after a news reporter, Ayako Fujii. Was she pleased?

Ishiguro: Yes. In Japan, you see, we like our newscasters to be very young. When national newscasters are no longer young enough, they are shifted to local television. This particular newscaster was very famous, but she had been shifted to local television in Osaka. After she accepted my offer to appear in the World Expo as an android, she became very famous again.

Epstein: How perfect is the copy?

Ishiguro: To make a copy of a human, we use 3-D scanning and advanced technologies, but the most important thing is the texture of the skin. We reconstruct very detailed skin textures.

Epstein: Is the silicone painted?

Ishiguro: Yes. And the eyes are perfect copies—even with the blood vessels.

Epstein: Are you worried about the "uncanny valley"?

Ishiguro: Oh, yes. When my daughter first saw her android, she started to cry. As Professor Masahiro Mori suggested in a famous article in 1970, when a robot is dissimilar to a human, its appearance is not disturbing. But when its appearance is close to that of a human—but not close enough—its appearance can become very disturbing, as if we are looking at a moving corpse. He called this effect the "uncanny valley"—the dramatic dip in the comfort curve.

A colleague and I have found another uncanny valley—one that occurs as a function of age. Very young children weren't disturbed by our android, but with children three or four years old, the reactions were very bad. By the time people were 20, the reactions were good again. Very young children weren't disturbed, we think, because they have not yet built a clear cognitive model of humanness.

Epstein: How do you avoid the uncanny valley problem?

Ishiguro: Just improve the appearance and the behaviors. With my daughter's android, we had eight motors in the head but none in the body. Therefore, the motion and the behaviors were unsettling. When the performance improves, people are comfortable again and the details—such as skin texture and color—are very important. For Repliee, the makeup was applied by the newscaster's own makeup artist, so the makeup is identical. But the new android's body, it turns out, is still too small to put in all the actuators we need to create natural movement—especially in the chest and arms—so our next android will be male. In fact, it will be me. And when my android is done, I'm never coming back to the university.

Epstein: Maybe you should use Arnold Schwarzenegger's body. More space.

Ishiguro: (*Laughs.*)

Epstein: As perfect as her eyes are, they still seem a bit unsettling, perhaps because they lack—the small, rapid movements of normal eyes.

Ishiguro: That's because we're using actuators, and they're just not quick enough. In the next version, we'll use small DC motors, but the problem with those is the noise.

Epstein: And you have performed a kind of Turing test with the android, have you not? What happened?

Ayako Fujii and android repliee.

Ishiguro: We gave people two-second glimpses of the android, either when she was completely still or when she was moving in subtle ways. Without the movement, 70 percent of subjects said she was not human. With the movement, 70 percent said she was human. Now we need to consider how to extend this time period. Maybe, as you said, with small eye movements or perhaps other behaviors. In a sense, by learning how to make a perfect android, we are finding out precisely what it means to be *human.*

Epstein: Can you make a copy for me to take home to the U.S.?

Ishiguro: Yes, for about $300,000. But that doesn't include the connections and computers, so she won't do anything.

Epstein: Forget it!

Epstein: How fast can this technology grow? When will we have the perfect android?

Ishiguro: For specialized applications, we might have sophisticated androids in 30 years or so, but I doubt that an android could ever be a spouse—well, maybe in 100 years. Perhaps someday robots will be better than humans in some respects, but still I believe that robots will never be completely human. They may want to be, like Mr. Data in *Star Trek,* but they will always lack some humanness. **M**

(Further Reading)

◆ Footage of Repliee is available at **http://androidvideo.com**
◆ **The Age of Spiritual Machines.** Ray Kurzweil. Penguin, 2000.
◆ **Alan Turing: The Enigma.** Andrew Hodges and Douglas Hofstadter. Walker and Company, 2000.
◆ **Build Your Own Humanoid Robots: Six Amazing and Affordable Projects.** Karl Williams. McGraw-Hill, 2004.