The creators of Robovie, a boxy robot the size of a child, had a pretty good idea what would happen when they rolled it out as a conversation partner for the elderly at a Nara day care center in 2009. They expected the humanoid robot with its buglike eyes and mechanical voice would lift the seniors’ spirits with cheery greetings, a sympathetic ear for their health woes, and encouraging words while they exercised. But a surprise came after the 14-week experiment ended: The seniors missed Robovie so much that they wanted to visit it in the lab.

The seniors knew they were participating in an experiment, but they assumed Robovie is autonomous. In fact, a 29-year-old researcher was at work in a control room, steering the wheeled robot through the hallways, triggering its hand waves, and feeding Robovie its lines. The researchers, based at the Advanced Telecommunications Research Institute International (ATR) in Nara, were not engaging in deception for fun. Rather, says Hiroshi Ishiguro, an engineer who heads both the ATR team and a second robotics group at Osaka University, they were studying how humans will interact with the sophisticated robots of the future.

For 2 decades, Ishiguro’s teams have deployed various robots—some with vaguely human forms, others crafted to look indistinguishable from people—as customers in cafes, clerks in stores, guides in malls and museums, teachers in schools, and partners in recreational activities. The roboticists, who use both autonomous robots and ones under human remote control, have come to some startling conclusions. In some situations, people prefer to speak with an android instead of another person, and they feel that robots should be held accountable for mistakes and treated fairly. And as the seniors here showed, humans can quickly form deep emotional bonds with robots.

Ishiguro’s approach is “pretty brilliant,” says Kate Darling, who studies robot ethics at the Massachusetts Institute of Technology’s (MIT’s) Media Lab in Cambridge. Some find the implications of the work worrisome, however. If interactions with robots can substitute for interactions with other humans, says Peter Kahn, a psychologist who studies the relations between humans and technology at the University of Washington, Seattle, “we’ll dumb ourselves down socially even as our technologies advance.” But Ishiguro and others believe robots are more likely to expand rather than narrow our horizons.

The debate is no longer academic. Simpler robots are creeping into daily life, serving as pets, vacuuming houses, and comforting dementia patients. A new wave of more sophisticated social robots is about to hit the mass market. In the coming days, for example, semiconductor giant Intel is expected to start selling a $1600 bipedal robot kit called Jimmy, for which hobbyists can design a body and fabricate it on a 3D printer. Intel claims Jimmy will be able to fetch a beer from a fridge and play games with a kid.

In February, a child-sized rolling bot called Pepper will go on the market in Japan. Able to recite stories to children and banter with adults, Pepper has microphones to track the direction of voices, an infrared sensor to measure distances, two cameras to recognize faces, touch sensors scattered over its body, nimble five-fingered hands, and Internet connectivity. And the $2000 price tag means “this is a robot for you,” said Masayoshi Son, CEO of technology conglomerate SoftBank in Tokyo, which developed Pepper, at its unveiling in June. He claimed that Pepper “marks a turning point for humankind.”

LIKE THEIR MAKER, the Geminoid HI robots dress in black, wear tinted glasses, and are perpetually scowling. The androids bear an uncanny resemblance to Ishiguro, who has won renown among roboticists for his Geminoids. But the robot falls short of fully capturing Ishiguro’s stern demeanor, as an experiment in Linz, Austria, showed. On different days, either Ishiguro or Geminoid HI-1 sat at a table in a cafe. Random passersby rated the android friendlier than they did the real Ishiguro.

The latest Geminoids have 50 motors
controlling facial expressions; head motions; and even subconscious movements like breathing, blinking, and shifting position. As they cannot walk, they are typically seated. And, as I learned when coming face to face with a female android, Geminoid F, in Ishiguro’s Osaka lab, they can, for a brief unsettling moment, be taken for human—before their slightly unnatural movements and off-the-mark eye contact erase any doubts.

It’s out in the field, however, where Geminoids truly are conversation starters. In one experiment conducted over 2 weeks last fall, Ishiguro’s group installed Geminoid F as a sales clerk in an Osaka department store. Operating autonomously, the android answered customer questions and made suggestions regarding a selection of $100 cashmere sweaters. Geminoid F handled 45 customers a day, versus 20 on average for the human sales clerks, in part because the android never took breaks and was a novelty. Some customers also sought out the android—apparently to avoid a human clerk’s subtle pressure to make a purchase. “With the android it was easy to reject the [sales] offer,” Ishiguro says. (As a result, Geminoid F’s sales success did not match that of the store’s best human salespeople.) In an upcoming trial, the Geminoid F will offer to help male customers choose gifts for wives and girlfriends.

Longer encounters can forge emotional bonds between human and machine. In the experiment at the elderly care center, some participants said it was more pleasant to converse with Robovie than with relatives. One remarked that the robot never talked back—unlike her grandchildren. For others, Robovie was a welcome substitute for grandchildren they rarely saw. “Even when I felt sad, I could feel brighter by talking with Robovie,” one senior told the researchers. When the trial ended, the seniors held a farewell party for Robovie, giving it a card with handwritten notes of thanks and best wishes for the future. A month later, they visited the robot in the ATR labs.

Ishiguro’s team has noted a similar phenomenon in dementia patients. Many people with brain impairments find it difficult to talk with other people, Ishiguro says, perhaps out of fear of what the healthy conversation partner may be thinking. “But they love to talk to robots,” he says, after observing dementia patients interact with a humanoid robot that his team developed called Telenoid, which has a minimalistic human form and is held on a lap like a small child.

That’s also the premise of PARO, a robotic baby harp seal intended to comfort dementia patients. Developed by Takanori Shibata of Japan’s National Institute of Advanced Industrial Science and Technology in Tsukuba, PARO chirps when stroked and looks in the direction of a voice. Many reports from around the world indicate that interacting with it improves dementia patients’ mood and social interactions and reduces agitated behavior.

Such emotional ties with robots disturb some researchers. PARO and similar robots “push our Darwinian buttons, by making eye contact, for example, which causes people to respond as if they were in a relationship,” wrote Sherry Turkle, a sociologist at MIT, in a 2007 paper. Turkle, who studied PARO’s use in a Boston-area nursing home, wondered whether it is ethical to encourage relationships based on such a “fundamentally deceitful interchange.”

Still, widespread use of social robots as assistants is inevitable in many countries, including Japan, where more and more elderly will need care while the number of young people dwindles, says ATR roboticist Takayuki Kanda. Endowing these robot caregivers with social skills will improve acceptance and effectiveness, he says.

**THE RISE OF SOCIAL ROBOTS**

 raises other ethical issues, including whether the bots should be accorded rights and responsibili-

Hiroshi Ishiguro’s strikingly humanlike Geminoids speak during a press preview at the Miraikan museum in Tokyo in June.