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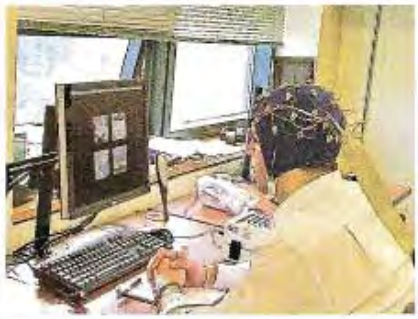

## TEST-DRIVING THE FUTURE Will Mind-Controlled Robots Steal Our Hearts?

**I am seated at a network of computers** with an electrode-studded swim cap suctioned to my head, watching a colorful trail of EEG signals unfurl across a nearby screen. A mess of wires conducts these signals from my brain to the computers, which—based solely on what I'm thinking—then relay instructions halfway across the room to my humanoid proxy: a shiny chrome robot named Morpheus, currently awaiting his next command. A video feed from a camera in the robot's skull appears on a monitor directly in front of me, letting me see what he sees. Right now he's contemplating two foam blocks, one red and the other green, which rest on a small makeshift table by the far wall. "Just focus on one of the blocks," the experimenter tells me. I concentrate on the red one, cradling it purposefully in my mind for about five seconds. Suddenly Morpheus springs to life, buzzing like an electric razor. He walks over to the table, extends his shiny arms, and picks up the red block. Pivoting, he carries it six feet over to another table, the destination I've chosen in my mind, and gently sets it down. I'm a bit stunned; I feel like Keanu Reeves in *The Matrix*, when he discovers his awesome new powers in a computer-generated world ("I know Kung Fu?!").

Roughly two feet tall and worth more than a Lexus, Morpheus—or "Moe" for short—is the latest in noninvasive brain-controlled robotics. He shares his name, aptly enough, with Reeves's helper and guide in *The Matrix* but also with the shape-shifting Greek god of dreams, who, by acting out the thoughts of the dreamer, becomes an agent of that person's consciousness. Yet it's the brain-computer interface, not Moe, that is the real star here today. Once a computer can reliably read our thoughts, "in principle you could substitute any kind of robot," says Rajesh Rao, professor of computer science and engineering, and Moe's Geppetto, here at the University of Washington in Seattle. The ultimate goal is to develop a variety of "helper robots" that can assist the disabled; work alongside doctors as aides; perform dangerous tasks for soldiers, bomb squads, or firefighters; or simply offer amity to anyone who, finding human interaction deeply unsatisfying, pines in the dark for a robot companion.

Before I'm hitched to Moe, I undergo a 10-minute training session so the brain-computer interface can adapt to my unique brain patterns. Four objects appear on-screen, and my job is to focus on just one while flashing borders highlight each object, one at a time, in random order. "When the border around the object you want flashes, your brain says 'Aha!'" explains graduate student Pradeep Shenoy, who designed the training software. During this split second of surprise, electrodes in the cap register a cascade of electrical impulses known as a P-300 response. That signal reveals which foam block I have chosen; the interface picks this up and relays my choice to Moe.

Reality isn't always as smooth as theory, however. At first the system can't make out my P-300 signal, and over on his side of the room Moe is acting fussy. I begin to wonder if it's my fault. (Does Moe not like me? Is it my hair? My breath?) The lab techs tell me not to worry, that the calibration worked fine, but last-minute changes—a drift in the placement of the electrodes or a break in my concentration—can cause glitches. I admit to feeling a bit sluggish and unfocused, having spent most of the night at one of Seattle's many casinos. A staff member brings me a large coffee, which seems to do the trick. With my ability to concentrate restored, Moe and I ace a series of four trials with only minor fumbling of the blocks. "We did it!" I cheer, unable to contain my excitement. Unmooring from the terminal, I walk over and give him a big hug.

As I leave the laboratory, I envision a day when prehensile android extensions of our minds perform our surgeries, fight our wars, file our taxes, coddle our young, bury our dead, walk our robotic pets and change their batteries, fish the remote from underneath the sofa, fetch us a turkey potpie, and steal our hearts. I don't know about you, but I can hardly wait. **Alex Stone**

# contributors


Stone


Gild


Ellison


Griffith

ALEX STONE ("Suspended Animation," *page 42*, "Death Star," *page 56*, and "Test-Driving the Future," *page 72*) is an associate editor at DISCOVER, where he has covered physics and technology for three years. In this photo Stone is wearing "the latest in EEG haute couture" at a University of Washington computer science lab. The electrodes monitor his thoughts so he can control a humanoid robot (named Moe) with his mind. Stone volunteers at a Columbia University cosmology lab, building electromagnetic filters used to study the cosmic microwave background. Also a professional sleight-of-hand artist, he recently competed at the World Championships of Magic in Stockholm, Sweden. Stone has written for *Science*, *The New Republic*, *The American Prospect*, and *The Washington Monthly*.

DORON GILD ("Mendel's Mouse," *page 30*, and The DISCOVER Interview, *page 62*) has published photographs in *New York*, *Newsweek*, *Details*, and several international magazines since emigrating from Israel in 1998. Versatile with portraits, he recently shot a rock band in a former Vermont dairy barn—a far cry from the sterile inner sanctum of the Jackson Laboratory, which he photographed for this issue. "I had to walk in with a mask, gloves, and a net over my beard," he says. "Even some of the scientists who work on the project don't get to go into this room."

KATHERINE ELLISON ("The Elastic Brain," *page 46*) is an investigative journalist whose Pulitzer Prize–winning series on Ferdinand and Imelda Marcos contributed to the fall of the Philippine dictatorship. A former foreign correspondent for Knight Ridder, she has been taken captive by Mexican peasants, arrested by Cuban police, and chased by killer bees. She met Michael Merzenich while researching her most recent book, *The Mommy Brain: How Motherhood Makes Us Smarter* (2005). "He jump-started my enthusiasm for my own topic, telling me that motherhood 'is a revolution for the brain,'" she says. Ellison won the Overseas Press Club and the George Polk awards and has written for *Smithsonian*, *Fortune*, and *The Atlantic*.

CHRISTOPHER GRIFFITH ("Mining for Dark Matter," *page 36*) is a photographer specializing in architecture, portraits, and still lifes whose work appears in *Esquire*, *Wallpaper*, and *The New York Times*. His first book, *States*, won silver medals for photography and book design at the New York Art Directors Club in 2001. His second and third books focus on autumn leaves and tire treads, respectively. Griffith rode an 80-year-old elevator half a mile into the ground to document the search for dark matter in this issue of DISCOVER. It's so pitch-black in the lift that "really for the first 30 seconds, you almost panic," he says. "I think they do it for effect; there *is* a light in the damn thing."