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Will 'Upgrades' Enhance Our Bodies?

Engineers are building strong suits and brainy prosthetics; meet humanity 2.0

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Forget sit-ups. Soon, people bent on betterment may well be able to turn to neural implants, wearable robotics, and brain-tweaking software to become smarter, stronger, and faster. We are entering the age of neuroengineering. This polymathic discipline capitalizes on new advances in neuroscience, computation, and biomedicine to engineer work-arounds to the frailties of humankind, be they brains crippled by Parkinson's or simply a desire to bench-press 200 pounds without breaking a sweat. Projects already in the works include a robotic exoskeleton that would allow wearers to deploy superhuman strength, a prosthetic arm that would let users feel what it touches, and an implanted light switch that would literally turn on damaged regions in the brain.

In the process, neuroengineers are learning how hard it is to duplicate nature, let alone do it one better. The exoskeleton in the works at Raytheon Sarcos of Salt Lake City uses micro electromechanical systems that mimic a wearer's motions but with 10 times the strength. "It's like power steering," says Stephen Jacobsen, the company presi-dent. Speed, strength, and low drag are essential to making an exoskeleton comfortable and safe. Hydraulic actuators turn out to be lighter and faster than electrical ones. But the Sarcos exo-skeleton still sucks so much electricity that it can't work without being plugged into a hefty umbilical cord. Solving the power puzzle is the next challenge for the project, which was launched with $75 million from the Defense Advanced Research Projects Agency, with the aim of developing armored versions for the battlefield. Someday, civilians such as stroke victims and loading-dock workers might don one, too.

Neural control. Neuroengineers are also tackling the vexing problem of prosthetic arms. The current versions given to wounded veterans are so clumsy that many amputees reject them for a simple hook. A new DARPA-funded prototype is much lighter and gives the wearer sensory feedback. Phase 2, approved in February, will have 25 hydraulic-driven joints that begin to approach natural speed and flexibility and will connect the limb to nerves in the chest, giving users enough neural control to go fishing and put on makeup. A version of that arm, which is being developed at the Rehabilitation Institute of Chicago, will be available to patients later this year. Neural controls are in the works for leg prostheses, too.

And these are the more mundane applications of neuroengineering. Ed Boyden, a neuroengineer at MIT, has built a tiny LED light switch he intends to stick in the brain as a stoplight, turning neurons on and off in a thousandth of a second. It has toggled mouse brains already, and Boyden anticipates it being used to treat Parkinson's, blindness, and other neurological disorders. He also foresees using precision brain stimulation to enhance thinking or creativity. "That will take some time," he notes. "It's very hard to define creativity."

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