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Could I put a computer chip in my brain to make me smarter?

People are already getting assistance from cochlear implants, which convert sound into signals that a deaf person's brain can understand, and deep brain stimulators, implanted electrodes which offer relief from pain and depression to neurological patients. First-generation on-brain chips, now in advanced development, are expected to add capabilities like seizure prevention and the ability to control wheelchairs or other assistive equipment using brain waves.

Even more remarkable, though less mature, is the prospect of bi-directional interfaces between neurons and computer chips—in essence, adding a "co-processor" to the brain to create new orders of intelligence. "The goal for the next century will be to discover the principles of controlling neural circuits, and to invent new technologies to support these control algorithms," explains Ed Boyden, leader of MIT's Synthetic Neurobiology Group.

There are, of course, numerous practical challenges. An on-brain chip or interface has to be small and bio-compatible, and must not radiate excessive heat or require battery replacement or other maintenance. And they must interact with the brain's natural "circuitry," electronically, chemically, or (as in the case of Boyden's prospective co-processor) optically.

Several MIT groups are addressing aspects of the ongoing engineering effort; Boyden's team is conducting a worldwide survey of plant, bacteria, and fungus species, seeking natural genes that sensitize neurons to being activated or shut down by light. In this way, using optical fiber arrays, they can control neural computations done by specific cells in the brain, a first step towards being able to close the loop to make functional brain co-processors. — *Peter Dunn*

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