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The Line Between The Engineered And The Born Is Blurring!

Jeffrey R. Harrow
Principal Technologist, The Harrow Group

In issues of [The Harrow Technology Report](#) I've explored several laboratory experiments involving direct neural connections between living brains and computers. Perhaps the most interesting is the one where monkeys were first taught to play joystick-controlled video games. Their brains were then hard-wired into computers that learned to isolate and interpret the monkeys' thoughts that specifically controlled the joystick. Once this was accomplished, the actual signals coming from the joystick were replaced with similar signals that were generated from the computer's analysis of the monkeys' thoughts.

And the monkeys happily continued playing the video game -- by thought control!

It gets even more interesting -- eventually, the monkeys came to realize that moving the joystick was no longer necessary; they continued to play the video games with their hands resting comfortably in their laps. True non-trivial direct thought control!

Training US!

Now, recent follow-up research described in the May 10, 2005 [DukeMed News](#) yields the fascinating insight that at the same time that these monkeys were learning to play their games, and later control remote robotic arms by simply 'thinking it so,' this mental activity was physically altering their brain to better accommodate this new way of thinking!

"...the analysis revealed that, while the animals were still able to use their own arms, some brain cells formerly used for that control shifted to control of the robotic arm [through the 'mental joystick']."

"This finding supports our theory that the brain has extraordinary abilities to adapt to incorporate artificial tools, whether directly controlled by the brain or through the appendages" said Nicolelis. "Our brain representations of the body are adaptable enough to incorporate any tools that we create to interact with the environment. This may include a robot appendage, but it may also include using a computer keyboard or a tennis racket. In any such case, the properties of this tool become incorporated into our neuronal 'space'," he said. According to Nicolelis, such a theory of brain adaptability has been controversial."

"[We're] suggesting that a fundamental trait of higher primates, in particular apes and humans, is the ability to incorporate these tools into the very structure of the brain. In fact, we're saying that it's not only the brain that is adaptable; it's the whole concept of self. And this concept of self extends to our tools. Everything from cars to clothing that we use in our lives becomes incorporated into our sense of self. So, our species is capable of 'evolving' the perception of what we are."

A growing number of Sci Fi authors have been exploring some of the personal and societal light and dark sides of such an innovation. Not to mention the 'competitive advantage' that such 'almost no reaction time' control would give to military pilots, and even to automobile drivers.

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As is so often the case, Sci Fi has again led reality: As described in the [May 16, 2005 Washington Post](#), twenty-five year old Matthew Nagel, who was paralyzed when stabbed through the spine, had a "jack" installed into the side of his head that connects to various wires throughout his brain. When he "jacks-in" to a specialized computer, just as for the monkeys, it interprets the neural impulses that would have controlled his natural hand and, instead, causes a robotic hand to do his bidding! Just by 'thinking it so.'

Training Something Else...

This is pretty impressive, to say the least, with incredible potential to ease the impact of certain disabilities, and far beyond.

But looking in a different direction, a University of Florida team headed by professor Thomas DeMarse has now grown a purpose-built **biological** brain that acts as an autopilot to keep a plane (an F-22 in a flight simulator) flying straight and level!!

And it gets even more interesting: I can attest, having been a Commercial and Instrument Flight Instructor for 30+ years, that it's HARD to get a new student to the point where he or she can control the plane with precision, especially when it involves recovering from unusual attitudes or in rough weather conditions. Yet DeMarse's 25,000 neuron "purpose-built bio-brain" is able to do exactly that!

It works like this, according to a [U of F press release](#): neurons are removed from a rat brain and cultured in a dish that contains a base of 60 electrodes. The neurons begin to grow and to reach out and touch the other neurons around them. In many cases, the first few contacts are not to the neurons' liking, and they withdraw their probes and hunts for new neurons to court. Finally, all of the neurons have "found love in all the right places" and interconnected themselves in just the way they like -- and they begin functioning as a living neural network!

The electrodes then provide information about the plane's attitude *to* this "brain," and simultaneously receive "correction signals" *from* the brain that instruct the simulated plane's controls to bring the plane into straight and level flight, and maintain it that way. (It takes about 15 minutes for the "brain" to learn to do this, which it apparently does by itself.)

According to DeMarse,

"There's a lot of data out there that will tell you that the computation that's going on here isn't based on just one neuron. The computational property is actually an emergent property of hundreds or thousands of neurons cooperating to produce the amazing processing power of the brain."

Yes, our current electronic autopilots work just fine, thank you, but this early work demonstrates the vast potential for harnessing Nature's computing, life, to do our bidding.

Just The Beginning...

Ex-Microsoft technology chief Nathan Myhrvold points out that,

"... it cost \$12 billion to sequence the first human genome. You will soon be able to get your own done for \$10..."

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If an implant in a paralyzed man's head can read his thoughts, if genes can be manipulated into better versions of themselves, the line between the engineered and the born begins to blur."

Noted futurist Ray Kurzweil says,

"In the next couple of decades ... life expectancy will rise to at least 120 years. Most diseases will be prevented or reversed. Drugs will be individually tailored to a person's DNA. Robots smaller than blood cells -- nanobots, as they are called -- will be routinely injected by the millions into people's bloodstreams [a \$3.7 billion bill for such research that was signed in 2003 certainly adds credibility]. They will be used primarily as diagnostic scouts and patrols, so if anything goes wrong in a person's body it can be caught extremely early."

Where this will lead is still anyone's guess, but it's certainly one of the first faint writings on the wall that suggest how NBIC research (the converging of Nanotechnology, Biology & medicine, Information sciences, and Cognitive sciences) is going to change ALL the rules. Even the definitions of Man and Machine...

Don't Blink!

This essay is original and was specifically prepared for publication at Future Brief. A brief biography of Jeff Harrow can be found at our main [Commentary](#) page. Other essays written by Jeff Harrow can be found at his [web site](#). Jeff receives e-mail at jeff@theharrowgroup.com. Other websites are welcome to link to this essay, with proper credit given to Future Brief and Mr. Harrow. This page will remain posted on the Internet indefinitely at this web address to provide a stable page for those linking to it.

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