Back to Article Click to Print

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Thought Control

By John Cloud / Toronto

Not long ago, a manager at the Ontario Power Generation (OPG) nuclear plant outside Toronto was completing a routine drill. The manager had to demonstrate that he could accurately instruct a computer to open and close a series of simulated valves--valves crucial to controlling the water and pressure that keep radioactive material contained. But this particular demonstration was unusual, since Lanzanin was operating the valves with his mind. He never touched a keyboard. And when his brain was focused enough to tell the valves onscreen to open or close, they obeyed.

The employee was channeling his thoughts through a new device that measures the ebb and flow of the brain's electrical activity. Called the BodyWave, the iPod-size tool straps onto your arm and--via three sensors that touch your skin--detects levels of neurotransmissions flowing through the central nervous system. Scientists have known for years that brain activity can be measured in wave patterns. Broadly speaking, the brain generates four kinds of patterns: delta (seen most often during sleep), theta (when you're daydreaming or catnapping), alpha (often observed when you are aware but relaxed, like during a massage or a long run) and finally--the key one for cognitive processing--beta waves. By measuring these waves, the BodyWave device can determine when your concentration has peaked--and therefore, when you are primed to make an important decision.

The technology is complicated, but the implications are staggering. What if you could wear a device that told you when your brain was focused enough to make a split-second decision: when to put a scalpel into a patient, when to execute a stock trade, when to make a putt on the 18th green--or when to activate a nuclear-plant valve?

The BodyWave device is being used not only in training at OPG but also at NASA, where it is being researched for pilots operating supersonic aircraft. In North Carolina, the Richard Childress NASCAR team is using the BodyWave to help its pit crews learn to focus. Tire changers on a NASCAR team are expected to be able to remove five lug nuts in one second. Losing focus means losing races.

So how exactly does the BodyWave work? The technology is based on electroencephalography (EEG), the study of how brain activity--from automatic impulses like breathing to active thoughts like what to have for dinner--excites neurons to emit brain waves. This electrical activity originates in the brain but is transported along the central nervous system. You can wear the BodyWave on your arm or, actually, anywhere on the skin, which is highly sensitive to changes in the central nervous system. (That's one reason you redden when embarrassed.) The sensors register the electrical charges that occur in your brain when you concentrate hard. The act of concentration necessitates the firing of neurons in careful synchrony. That synchrony produces a unique electrical signature that can be measured. When you stop

concentrating, the synchrony breaks and the signature changes. The BodyWave then transmits this change through a simple receiver plugged into a USB port. A computer can tell you, in real time, whether you've been focused or were pondering what to do this weekend.

True, most people can easily discern when they have been daydreaming. But the evolutionary process hasn't sharpened that discernment enough to prevent stupid accidents--drifting into the other lane, say, or slicing into a finger instead of the carrot on the cutting board. The promise of EEG technology is that it can alert you to inattention before you are aware of it. Right now, the BodyWave is the only EEG device on the market that simply attaches to the skin and requires no wires to be inserted or attached to the head. But it has a serious flaw: it can transmit your data only to a computer screen. If NASA trainers are looking at the screen, they can see that you have lost focus before you know it. But the device itself has no light or sound that can tell a casual user to stop before they do something stupid.

The creator of the device is working to fix this problem. He isn't a Jobs or a Zuckerberg, but rather a former schoolteacher named Peter Freer. Freer, who is 52 and lives outside Asheville, N.C., is a tinkerer, but one possessed of expansive sensibilities. As a child in Millbrook, N.Y., in the 1960s, he would occasionally visit a neighbor's house to play with the kids. The house was populated with strange characters, and its owner turned out to be Timothy Leary.

Freer acquired one of those temperaments that are open to experimentation but are also somewhat aimless. After he eventually got a job teaching science in North Carolina schools, he noticed that many of his students diagnosed with attention-deficit/hyperactivity disorder had little trouble paying attention. "I would see a student daydreaming," Freer recalls. "After class, I would ask him, 'What can you tell me about my class?' He could tell me about a bird he saw outside--its color and where it was on a tree. He could tell me that the AC kept turning on and off at regular intervals. He could remember what the boy next to him was wearing. And he knew a little about the lesson. This kid had paid plenty of attention. It was sustaining and willfully directing attention that was an issue for him."

Freer had taken computer courses at Western Carolina University, and he thought there might be a way to devise software that could measure attention in real time. He discovered that NASA had been using EEG for years to illustrate to pilots that concentration has two murderous enemies: hypoarousal (letting your mind drift) and hyperarousal (trying so hard to focus that the effort itself becomes distracting). Throughout the 1980s and '90s, NASA and other big institutions explored EEG technology using huge, helmet-like apparatuses that surrounded the head with scores of cables.

Freer saw an opportunity: What if a simple consumer device could show ordinary people when their concentration was drifting? It was a very cool, very naive idea. It was cool because Freer, as a science teacher, understood that you don't need cables attached to the scalp to measure neurotransmission. Because skin is a fantastic conductor of electricity, sensors anywhere on the body would be able to detect changes in the brain's electrical pulses. Freer's idea was naive because--again, as a science teacher--he had no money to build a consumer-level EEG sensor. So he took another job, as a martial-arts instructor, and then a third job as a security guard at a restaurant. Freer says he put $300,000 on credit cards before finally seeing the first BodyWave prototype five years ago.

It wasn't long before EEG experts began to notice Freer's technology. Rob Templeton was one of the first.

He helps run the training program at OPG. Like any nuclear plant, it requires not only years of training for employees but also constant retraining. No matter their age, operators who work in the main control room must spend one week out of every six in retraining exercises. A few years ago, Templeton was reading a trade publication when he ran across a story about a company--Freer's--developing portable hardware that could address attention deficits. He cold-called the company.

Giddy and nervous, Freer then developed specific software for OPG. Operators strap on the BodyWave and then see, onscreen, a series of 20 valves. Instructions appear in the top left corner. For instance:

1. Operate hand switch 2QFX96 from OFF to ON. 2. Place selector switch 4P1BEU26 to OFF.

Technicians can execute these commands only by focusing to the point that beta waves start to flow. Once the BodyWave registers peak betas, it instructs the computer to perform the tasks.

The BodyWave is discomfiting to many users because it can detect changes in your thoughts before you do. What if the computer gets it wrong? Trainers at OPG, NASA and NASCAR told me they use the device not to judge performance but rather to improve it. Still, there's a fine line between training and evaluation. If you can't train well with the BodyWave strapped to your arm, doesn't that mean you can't control your thoughts? Shouldn't you then lose your job?

Freer says he doesn't want the BodyWave used as a punishment but as a tool. He and his small team are now developing software for golfers. A player wearing the BodyWave would wait to see a light indicating full concentration before making a putt. Whether the resulting putt would be considered cheating or attaining perfect focus is an open question.