Could an Electric 'Thinking Cap' Prod You to Think Out of the Box?

By Jim Schnabel
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Unable to solve a problem? Stuck in a cognitive rut? Consider putting on a "thinking cap," to see the world afresh.

As fanciful as it seems, researchers now claim to have developed such a device. In this week's issue of PLoS One, neuroscientist Allan Snyder and graduate student Richard Chi from the University of Sydney in Australia report that by delivering weak electrical currents from scalp-mounted electrodes over the left and right hemisphere anterior temporal lobes (ATLs), they enabled most of a group of subjects to solve a problem requiring creative insight—a problem that most untreated subjects could not solve.

"The idea would be to use this temporarily, when you're stuck on a problem," says Snyder. "Turn it on and look at the problem differently."

Hidden talents?

Snyder began his career with an interest in the biology of vision, then became an accomplished physicist whose work influenced the designs of modern fiber-optic networks. Often lauded for his ability to think "out of the box," he began to study the neural roots of creativity in the 1990s. The major theme of his recent research has been that creativity and other hidden talents are normally suppressed by the modern functional architecture of the brain. In 2006, for example, he reported that transcranial magnetic suppression of the left ATL unleashed autistic-savant-like number-processing skills in ordinary subjects. His experimental setups for delivering magnetic pulses or electric currents to the brain have often been described in the popular press as "thinking caps."

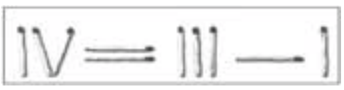
The "transcranial direct current stimulation" (tDCS) technology used in the current study is more than a century old and was once touted as a way to cure depression. It was nearly relegated to the ash-heap of forgotten, quackish medical fads. However, in recent years, it and other magnetic and electrical brain-stimulation techniques have drawn renewed interest, as tools in neuroscience experiments and as therapies. The tDCS technique is now used to enhance the recovery from a stroke, for example.

The technique is essentially electroencephalography in reverse: Instead of using scalp-mounted electrodes to detect faint electrical currents on the adjacent surface of the brain, it uses scalp-mounted electrodes to deliver such currents. Typically, current is delivered over a broad area through sponge electrodes, powered by a standard nine-volt battery, for up to fifteen minutes at a time. The current apparently increases or decreases the excitability of nearby neurons—depending on the current's direction—by altering the resting voltage between the inside and outside of brain cells, thus making them more or less likely to "fire."

In this case Chi and Snyder wanted to see what would happen if they applied current in a way meant to enhance the activity of the right ATL and simultaneously decrease the activity of the left ATL. A brain-imaging study in 2004 suggested that the right ATL becomes more active during *aha*!-like insight during problem-solving tasks; and there is some evidence that the *in*activation of the left ATL, through certain kinds of brain damage, can enhance creativity.

Freeing their minds?

Chi and Snyder applied this electrode configuration to 20 healthy people; another 20 wore the electrodes in the reverse-current configuration, and a third group of 20 had a "sham" treatment in which they were led to believe that the current was turned on when it wasn't.



Just prior to this stimulation period, the subjects were given a series of 27 "matchstick" images (see image) in which an incorrect arithmetic statement using Roman numerals can be made correct by moving a single matchstick.

The 27 problems were meant to trap the subjects into dependence upon a single problem-solving strategy, for they all required the same type of solution, involving a movement of one of the sticks that made up a Roman numeral.

After this induction period, the tDCS began, and five minutes later the subjects were presented with a new type of problem, requiring—though they were not told this—that a single stick be moved from one of the equals signs or other arithmetic operators. Within a six-minute time window, only about 20 percent of the sham and reverse-current subjects could solve the new problem—but about 60 percent of those in the “treatment” group were able to solve it.

The caveats

“This is an intriguing study, offering complementary evidence about the brain bases of insight,” says Northwestern University’s Mark Beeman, lead author of the 2004 right-ATL insight study. But he cautions, and Chi and Snyder acknowledge, that the new study is preliminary and needs to be repeated by other labs with different types of insight problems, and ultimately with a better understanding of how tDCS affects brain areas.

Beeman also notes that the ATLs are not the only brain structures involved in lateral thinking and insight during problem solving: “One which our work shows to be very important, and sensitive to factors that increase or decrease insight solving, is the anterior cingulate cortex. But it’s a deep, midline frontal structure that would be difficult to specifically affect with the tDCS method.”

Snyder and Chi say that they plan to do further experiments to try to determine the neural mechanisms through which tDCS seems to work, and also to use the technique to demonstrate how hidebound human thinking tends to be in various situations.

“The dominant cognitive strategy in our minds is to become fast at the familiar,” says Snyder. “But can we temporarily go uphill against this evolutionary design? It’s not a natural thing to do in general, but it’s very useful for creative leaps.”

About Jim Schnabel

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