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Charting Creativity: Signposts of a Hazy Territory



Mark Holm for The New York Times

Rex Jung at the Mind Research Network's M.R.I. center.

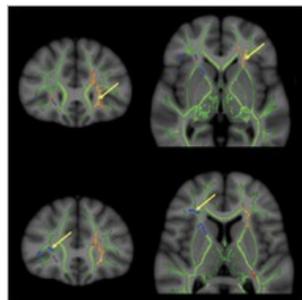
By PATRICIA COHEN
Published: May 7, 2010

Grab a timer and set it for one minute. Now list as many creative uses for a brick as you can imagine. Go.

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The question is part of a classic test for creativity, a quality that scientists are trying for the first time to track in the brain.

They hope to figure out precisely which biochemicals, electrical impulses and regions were used when, say, Picasso painted "Guernica," or Louise Nevelson assembled her wooden sculptures. Using M.R.I. technology, researchers are monitoring what goes on inside a person's brain while he or she engages in a creative task.

Yet the images of signals flashing across frontal lobes have

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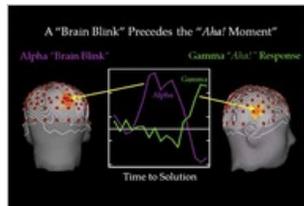
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Rex Jung, Mind Research Network
Images from brain research conducted by the Mind Research Network. While intelligence and skill are associated with the fast and efficient firing of neurons in the brain, subjects who tested high in creativity had thinner white matter and connecting axons that slow nerve traffic. In these images, the green tracks show the white matter being analyzed. The yellow and red spots show where creativity corresponds with slower nerve traffic. The blue areas show where "openness to experience," associated with creativity, corresponds with slower nerve traffic.

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John Kounios, Drexel University

Left, before an insight, activity drops in the visual cortex; right, in the "aha! moment," activity in the right temporal lobe spikes.

pushed scientists to re-examine the very way creativity is measured in a laboratory.

"Creativity is kind of like pornography — you know it when you see it," said Rex Jung, a research scientist at the Mind Research Network in Albuquerque. Dr. Jung, an assistant research professor in the department of neurosurgery at the [University of New Mexico](#), said his team was doing the first systematic research on the neurology of the creative process, including its relationship to personality and intelligence.

Like many researchers over the past 30 years or so, Dr. Jung has relied on a common definition of creativity: the ability to combine novelty and usefulness in a particular social context.

As the study of creativity has expanded to include brain neurology, however, some scientists question whether this standard definition and the tests for it still make sense. John Kounios, a psychologist at Drexel University, argues that the standard "has outlived its usefulness."

"Creativity is a complex concept; it's not a single thing," he said, adding that brain researchers needed to break it

down into its component parts. Dr. Kounios, who studies the neural basis of insight, defines creativity as the ability to restructure one's understanding of a situation in a nonobvious way.

Everyone agrees that no single measure for creativity exists. While I.Q. tests, though controversial, are still considered a reliable test of at least a certain kind of intelligence, there is no equivalent when it comes to creativity — no Creativity Quotient, or C.Q.

Dr. Jung's lab uses a combination of measures as proxies for creativity. One is the Creativity Achievement Questionnaire, which asks people to report their own aptitude in 10 fields, including the visual arts, music, creative writing, architecture, humor and scientific discovery.

Another is a test for "divergent thinking," a classic measure developed by the pioneering psychologist J. P. Guilford. Here a person is asked to come up with "new and useful" functions for a familiar object, like a brick, a pencil or a sheet of paper.

Dr. Jung's team also presents subjects with weird situations. Imagine people could instantly change their sex, or imagine clouds had strings; what would be the implications?

In another assessment, a subject is asked to draw the taste of chocolate or write a caption for a humorous cartoon, as is done in [The New Yorker](#) magazine's weekly contest. "Humor is an important part of creativity," Dr. Jung said.

The responses are used to generate what Dr. Jung calls a "Composite Creativity Index."

Dr. Jung's tests are based on ones created by [Robert J. Sternberg](#), one of the country's pre-eminent intelligence researchers and the man partly responsible for the standard definition. Dr. Sternberg uses similar types of tests at [Tufts University](#), where he investigates how people develop and master skills. He explained that his team asked

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subjects to think through what would have happened if, say, [Rosa Parks](#) had given up her seat for a white woman when that Montgomery bus driver told her to move to the back, or if [Hitler](#) had won World War II. They might also present them with a fanciful headline, like “The End of [MTV](#).”

As for Dr. Jung, his research has produced some surprising results. One study of 65 subjects suggests that creativity prefers to take a slower, more meandering path than intelligence.

“The brain appears to be an efficient superhighway that gets you from Point A to Point B” when it comes to intelligence, Dr. Jung explained. “But in the regions of the brain related to creativity, there appears to be lots of little side roads with interesting detours, and meandering little byways.”

Although intelligence and skill are generally associated with the fast and efficient firing of neurons, subjects who tested high in creativity had thinner white matter and connecting axons that have the effect of slowing nerve traffic in the brain. This slowdown in the left frontal cortex, a region where emotional and cognitive abilities are integrated, Dr. Jung suggested, “might allow for the linkage of more disparate ideas, more novelty and more creativity.”

Dr. Kounios, of Drexel, said that Dr. Jung was doing original and interesting work, but he maintained that trying to find a correlation between creativity and a single area of the brain is an “old-fashioned approach.”

“Creativity is a collection of different processes that work in different areas of the brain,” Dr. Kounios said, so the creative act must be broken down into tiny pieces. He also rejects utility as part of the definition, arguing that there can be brilliant and creative failures — what he calls near misses.

Last year he and Mark Beeman, a psychologist at [Northwestern University](#), published a paper on what he calls the “Aha! moment,” the sudden insight that solves a problem, reinterprets a situation or explains a joke. In their test, they used simple word puzzles that could be solved either with an instant creative insight or a quick analysis.

For example, here are three words: crab, pine and sauce.

Now, think of a single word that could be combined with each of the three to form a familiar term.

(Time’s up. The answer is “apple.”)

About half the subjects came up with a solution by methodically thinking through possibilities; with the other half, the answer popped into their minds.

A lot of different areas of the brain are involved in devising a solution, no matter which process is used, but during the Aha! moment, there is a burst of high-frequency activity in the right temporal lobe, Dr. Kounios said. What’s more, he said, he and Dr. Beeman could predict in advance which process a subject would use. They watched the brains of systematic problem solvers prepare by paying closer attention to the screen before the words appeared. Their visual cortices were on high alert.

The brains of those who got a flash of creative insight, by contrast, prepared by automatically shutting down activity in the visual cortex for an instant — the equivalent of closing your eyes to block out distractions so that you can concentrate better. In this case, Dr. Kounios said that the brain was “cutting out other sensory input and boosting

the signal-to-noise ratio” to retrieve the answer from the subconscious.

According to Kenneth Heilman, a neurologist at the [University of Florida](#) and the author of “Creativity and the Brain” (2005), creativity not only involves coming up with something new, but also with shutting down the brain’s habitual response, or letting go of conventional solutions.

Risk taking and addictive behavior should also be measured, since both traits play a role in creativity, he said.

There may be, for example, a dampening of norepinephrine, the neurotransmitter that sets off the fight-or-flight alarm. That’s why creative connections often occur when people are most peaceful — relaxing under a tree, like [Isaac Newton](#), or in a dream state, like Coleridge when he thought up “Kubla Khan.”

John Gabrieli, a professor of cognitive neuroscience at the [Massachusetts Institute of Technology](#), cautions that there is always a gap between what happens in the lab and the real world: “It seems that to be creative is to be something we don’t have a test for.”

This article has been revised to reflect the following correction:

Correction: May 8, 2010

An earlier version of this article misstated the city in which Rosa Parks made her famous bus ride. It was Montgomery, Ala., not Birmingham.

A version of this article appeared in print on May 8, 2010, on page C1 of the New York edition.



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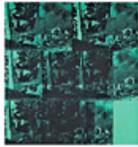
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