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Aha! Study finds eureka moments light up brain

By Julia C. Keller

Eureka! Scientists have found the part of the brain that says, "Aha!"

By monitoring brain activity as people worked on simple word puzzles, scientists found a distinct signature in the right side of the brain as they gained insight to solve the problem. The research could provide direction for other avenues of research into revelation, whether mundane or spiritual.

Mark Jung-Beeman and Edward Bowden, psychology researchers at Northwestern University, teamed up with John Kounios, an EEG specialist from Drexel University, to monitor the brain during a "eureka" moment.

The research, published in the April issue of the Public Library of Science's biology journal, has its inspiration in the 200 B.C. story of Archimedes' charge to find whether King Hiero's crown was truly made of gold.

"In Archimedes' case, he knew that he needed to get the volume of a crown to get its density," Jung-Beeman said, "but it's not until he stepped into a bath that he understood he could solve the problem using displacement."

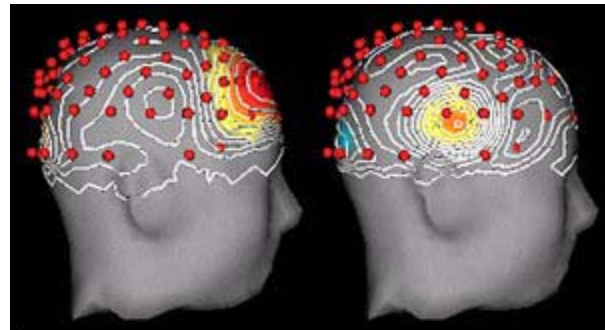
The connection between getting into a bath, the volume displaced by water and its relation to gold's density was so powerful that Archimedes streaked through the town shouting "Eureka!" without clothes.

"In real life, you can have these sorts of moments; you suddenly become aware of new information," said Jung-Beeman. Like Archimedes stepping into the Grecian baths, "some environmental cue might bring to the fore some thing of which you were only dimly aware before," he continued.

Jung-Beeman's work is not news to Mario Beauregard, a neuroscientist at the University of Montreal. Beauregard is conducting a study with Carmelite nuns to uncover the neural basis of insight stemming from their mystical connection with God. Though both research groups use electric and magnetic scans to study the brain, Beauregard said everyday insight and the revelation of *Unio Mystica* are fundamentally different experiences.

"In the case of insight, this phenomenon is the product of unconscious processing," Beauregard said, "whereas *Unio Mystica* would be triggered, according to Christian theology, by God's will."

Like Beauregard, who couldn't induce nuns' spiritual experiences, Jung-Beeman said he could not wait for people to have a life-changing, revelatory experience: "We can't just put someone in the



Images courtesy of Jung-Beeman's research team

Pictures of the scalp's electrical activity from the last half second before volunteers indicated they solved a problem with insight. Activity was seen in the front of the brain, a part also associated with problem solving, but more research is needed to understand its role. It may be a "gatekeeper" allowing other activity in the brain to come forward to solve problems.

magnet and wait for someone to have one of these moments.” Instead, the researchers had to create a series of word problems that could be solved by insight.

Participants were shown a series of three words — for example, pine, crab and sauce — that when paired with a fourth word would form a compound word or phrase.

As the participants attempted to solve the puzzle within 30 seconds, the team monitored the brain’s activity by recording electrical activity with EEG, as well as the internal working of the brain through functional magnetic resonance imaging.

They found part of the brain called the anterior superior temporal gyrus, in the temporal lobe, lit up with activity just before the respondent gleaned the word “apple” as the solution.

This activity, Jung-Beeman said, coincides with “when people experience the ‘tip-of-the-tongue’ state, thinking that they have the solution in there somewhere, but can’t quite articulate it.”

The study participants were then asked to evaluate whether they had solved the problem with insight.

Though Jung-Beeman admits asking participants to evaluate themselves is subjective, brain activity in the right anterior superior temporal gyrus showed significant activity across the board.

An interesting development, Jung-Beeman said, considering that traditionally the left half of the brain has been understood to process language.

Moreover, it seems the brain solves problems by insight best when a solution word appeared fleetingly in the left field of vision, thereby using the right half of their brain, Jung-Beeman said.

The technique unconsciously alerts the brain to a future solution, causing a faster solution time and works because “when you’re working on a problem and you see the solution, you respond to it very quickly because you were — unconsciously — thinking about it already,” wrote Jung-Beeman.

The idea of finding clues in problem-solving contexts is an idea studied by Steven Smith, a cognitive psychologist at Texas A&M University. Though he called the insight study groundbreaking, he said there are important caveats to keep in mind. “Did other conditions in the brain contribute to or allow the insights that were observed?” he questioned.

There are also many different types of insight, including “the sudden experience of an idea or a memory, the construction of a new understanding, the use of an analogy or mental model to discover new ideas and so on,” Smith said.

Jung-Beeman conceded that there are gradations of insight to explore: from problem solving to, he said, “when people talk about an ‘Aha!’ moment in a life-changing way, like ‘After I got fired from my job, I spent time with my family and I realized that it was family that mattered.’”

Bowden said that despite the gradations and Beauregard’s dissent, all insight phenomenon are most likely related.

“We do think that some of these bigger moments in science and in personal life work similarly,” Bowden said. “You’ve heard these stories where someone’s working in a business, making a lot of money and they realize that it’s not their purpose in life and they go work in an inner-city school. I think that could work in the same way.”

Julia Keller is acquisitions editor of Science & Theology News.