

asktheBrains

What are ideas?

—Celine Joiris, via e-mail
Psychologist **Richard J. Haier** of the University of California, Irvine, School of Medicine replies:



WHEN AN IDEA pops into your head, it is unlikely the result of a single event—like the click of the proverbial lightbulb—in your brain. Studies have shown that no solitary brain area is an exclusive thinking center where ideas emerge. A musical inspiration may start in a different part of the brain than a mathematical concept or a notion about what to eat for dinner. Every idea, like thinking in general, probably arises from a cascade of neural events, which we should be able to discern by scientific means.

In some ways, it is the holy grail of cognitive brain research to detect an isolated thought or idea, so that by knowing only the physical data, such as which neurons fire and when, we could infer exactly what is in a person's mind. Such mind reading is theoretically possible but a daunting challenge.

Nevertheless, neuroimaging has already had some limited success. For example, by analyzing activity in the brain while a person watches a video, it is possible to get a general sense of the content of the video. Though impressive, this feat is a long way from distinguishing the signature of a specific spontaneous thought or insight from the constant cacophony of billions of neurons firing on and off, randomly and in dynamic patterns. How many neurons must fire for an idea to emerge? Where are these neurons located? Does one person require more neurons than another to form an idea? Why do some people have more or better ideas than others?

Imagine knowing the answers to even some of these questions—we might unlock the mysteries of creativ-

ity and intelligence. My colleagues and I are currently trying to identify brain areas where structure and function correlate with intelligence. In the near future, this research will evolve into experimental studies in which specific brain regions, networks and neurotransmitter systems will be manipulated by chemical, electrical or magnetic means. These experiments will aim at facilitating learning and memory, enhancing creativity and increasing intelligence. This possibility of cognitive manipulation is why there is growing interest and enthusiasm—and some concern—regarding these ideas about the nature of ideas.

How does being confident in your knowledge affect the way you apply that knowledge?

—Paul Stranahan, via e-mail



Susana Martinez-Conde, a neuroscientist at the Barrow Neurological Institute in Phoenix, explains:

SCIENTISTS DO NOT yet fully understand how confidence, knowledge and other variables interact to guide our behavior. We all make use of two types of knowledge every day: explicit knowledge (the “know what” type) and implicit knowledge (the “know how”). We are conscious of our explicit knowledge, and we can easily communicate it to others with high confidence: I know that one plus one equals two. Implicit knowledge, however, is hard to communicate to others: I know how to ride a bike, but I cannot describe the exact actions necessary because many of them arise unconsciously. Because this know-how knowledge is largely hidden from our awareness, our confidence in it may be low.

From an experimental point of view, determining how much of our

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behavior comes from implicit versus explicit knowledge poses a challenge. Recent brain-imaging research, however, has pinpointed explicit and implicit learning in different areas of the brain. Activity in the striatum, an area near the brain stem critical for motor control and reward, corresponds to the implicit component of performance. Explicit learning occurs in the anterior cingulate cortex, a region associated with information processing, cognition and emotions, and in the mesial prefrontal cortex, a region that may be involved in risk and reward.

When varying degrees of confidence are added to the mix, the results become more complicated. One recent study compared real memories (high accuracy and high confidence) with fake memories (low accuracy and high confidence). The researchers found that the activated brain areas were clearly different in the two high-confidence situations.

There is still much to discover about confidence, learning and knowledge and about how these variables affect behavior—I, for one, am confident that we will see a lot of future research on these topics. **M**

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