COGNITIVE SCIENCE

# Twins May Think Alike Too, MRI Brain Study Suggests

Research on cognitive abilities has generally been split into two noncommunicating camps: cognitive scientists who look for strategies or brain regions that all humans employ for particular tasks, and intelligence researchers who are interested in individual differences.

On page 1737, a European team uses brain imaging with twins to achieve a rare fusion of the two approaches. The researchers show that different people may use different strategies to accomplish the same mental task, and that genes influence the type of strategy used.

A team led by Jan Willem Koten Jr. of RWTH Aachen University in Germany tested 10 sets of siblings, each consisting of a pair of male identical twins and a nontwin brother. While their brains were being scanned in a functional magnetic resonance imager (fMRI), they were asked to memorize a short span of digits. They were then given a "distraction" task to befuddle that memory: either a simple arithmetic problem (2 + 4 = 7, yes or no?) or instructions to categorize a picture of an object. They were then shown a number and asked if it was among the numbers in the memory task. All these chores took at most 7.5 seconds.

The team found that, when distracted by the photo-categorization task, many men used brain areas associated with language for the digit-memory task. When the distracter is the numerical problem, which also employs language areas, says Koten, "then the verbal loop gets interrupted," causing the original memory to rapidly decay. The point at which the subject has to judge whether he's seen a digit before is where "the genetic influences on brain activity starts to come out," says Koten. Subjects who used language areas when encoding the numbers took longer to come up with the answer than did those who resorted to a "visual-spatial memory system"—akin to counting on fingers—that the arithmetic task doesn't interfere with.

The scientists compared twins, who are 100% genetically alike, with each other and with their brothers, who share on average 50% of their genes. Twins used the same strategy more often than brothers did in the roughly 50 trials, suggesting that "there are qualitative differences in how individuals think, and these differences have a substantial genetic component," Koten says. He says the team was able to reliably estimate heritability even in this small sample by doing two identical scanning sessions with each of the 30 subjects. Estimated heritabilities ranged from 60% to 90% in the three phases of the task. Koten says such "highly individualized" responses "are of key importance for a proper understanding of the biological basis of individuality."

Behavioral geneticist Nick Martin of the Queensland Institute of Medical Research in Brisbane, Australia, says "I think this will prove to be a real watershed in how we think about brain activity. There is obviously a high degree of individuality in how the brain responds to external stimuli, and this is strongly genetically influenced." He adds that "studies focusing only on regions identified by averaging fMRI across individuals will miss the activity in regions which are even more important to particular genotypes."

Working memory of the type measured in this study is already known to have high heritability, notes brain imager Richard Haier of the University of California, Irvine, School of Medicine. Now, he says, the group has shown that the accompanying brain activation is heritable, too. "This combination of neuroimaging and genetic analysis," he says, "marks the beginning of new efforts to explain, rather than explain away, individual differences in cognition and intelligence."

–CONSTANCE HOLDEN

**In sync.** Identical twins tended to use the same strategies when faced with memory tasks.



PHYSICS

# Oddly, Too Much Weirdness Slows a Quantum Computer Down

Physicists dream of creating quantum computers that can swiftly solve problems that overwhelm the best conventional computers. Schemes for making the devices rely on a mysterious quantum connection called "entanglement," through which a measurement made on one particle can instantly affect the state of others. But too much entanglement is bad for a quantum computer and makes it run only marginally faster than a conventional one, a new analysis shows. "A lot of people, including myself, were surprised by this," says Richard Jozsa, a mathematical physicist at the University of Bristol in the United Kingdom "It's a thought-provoking result."

If a quantum computer could be built, it would outpace a conventional one by crunching many numbers at once. The trick is to replace a computer's bits, which can be set to either 0 or 1 to spell out binary numbers, with "qubits" that can be set to 0 and 1 at the same time. A qubit could be an ion or other particle that can spin in either of two directions, up or down, or, thanks to quantum weirdness, both ways at once. It's because qubits can express both values at once that a quantum computer could process many numbers simultaneously.

To achieve maximum efficiency, however, the qubits would have to be entangled. Suppose each of 100 ions is put in a both-ways state. If one ion is measured, then its state will instantly and randomly "collapse" so that it is found to be spinning either up or down. But the 100 ions can be entangled so that their undetermined directions are correlated. For example, they can be linked so that if one ion is measured and collapses into the down state, all the others will instantly collapse into the down state, as well.

The correlations can be more complicated than all the spins pointing in the same direction. They are also probabilistic and can be less than 100%, so, unlike pregnancy, entan-

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