Similar brain connectivity during rest and tasks linked to better mental performance

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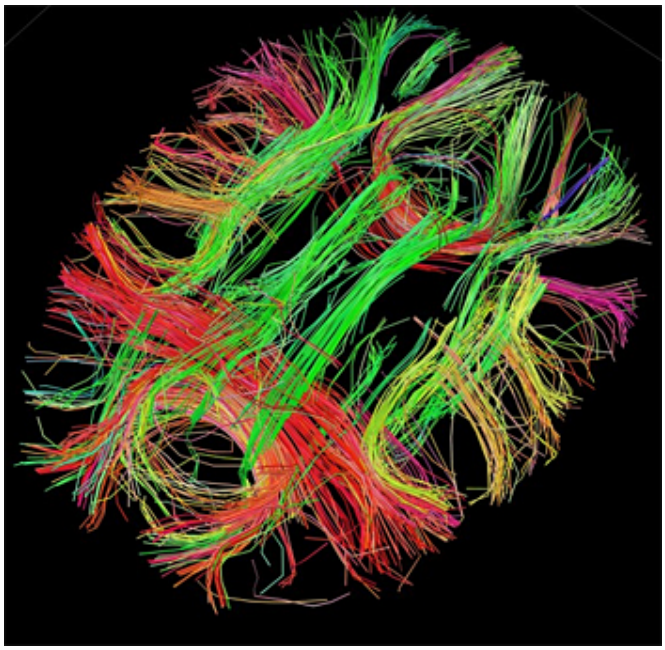

White matter fiber architecture of the brain. Credit: Human Connectome Project.

A brain on task differs from a brain at rest. But, how much it differs could depend on the cognitive ability of the person whose brain is being studied. New research published August 17 in *The Journal of Neuroscience* suggests greater similarity between brain connectivity at rest and on task may be associated with better mental performance.

The study suggests that general cognitive ability may be the result of well-tuned brain network updates, said study author Michael Cole of Rutgers University. "The results also suggest that if we can figure out how to better tune these networks, we can possibly influence cognitive ability generally."

Different types of cognitive tasks spur activity in various regions of the brain, as indicated by studies using functional magnetic resonance imaging (fMRI). The regions activated depend on the specific task, and scientists believe regions active at the same time work together as a network. Even when our brains are at rest, collections of regions remain active in "resting-state networks." However, Cole and study author Douglas Schultz previously found the resting and on-task networks were highly similar. This led the researchers to propose that the brain has an intrinsic network that reconfigures itself when we switch from resting to performing a task, and they hypothesized the reconfiguration of this intrinsic network relates to how well we perform a given task.

To test this, Schultz and Cole analyzed brain imaging data obtained by researchers at Washington University in St. Louis and the University of Minnesota as part of the Human Connectome Project. One hundred healthy adults had their brains scanned with fMRI while they rested quietly and while they performed various cognitive tests. To study brain network reconfiguration, the Rutgers scientists compared participants' resting-state networks to the networks active during language, reasoning, and memory tasks and computed how similar each task-related network was to the resting-state network.

When they compared these similarity ratings to the participants' performance on each task, they found individuals who performed better had more similar resting and task networks. The researchers also compared the networks active during each of the three cognitive tasks and created a composite generalized task network pattern. They found that the more similar this generalized task network pattern was to the resting-state network pattern, the better the participant performed on each task, suggesting individuals who performed well had resting-state networks optimized to switch to any of a variety of new tasks. In other words, high performers appeared to use their brains more efficiently, only needing to make small changes when switching tasks.

The results of the study suggest that "people's performance on various cognitive tasks is better the fewer changes they have to their brain connectivity," said John Dylan Haynes, a neuroscientist at the Bernstein Center for Computational Neuroscience in Berlin who studies cognition and was not involved in the study. "The efficiency with which a brain engages in a task might be a predictor of intelligence."

The researchers are planning additional studies to examine how training may improve cognitive abilities by influencing the brain's intrinsic network and its reconfiguration during different tasks.

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