Scanning the Brain to Predict Behavior, a Daunting 'Task' for MRI

June 03, 2020

Summary: *To study the brain "in action," researchers use a specialized form of brain imaging known as task-based functional MRI (task-fMRI), which shows how the brain responds to stimuli. While this technique can reveal much about the general workings of the average human brain, new research indicates that task-fMRI lacks the reliability to predict individual behavior or how a person might respond to mental-health therapies.*

MRI scanners have an unparalleled ability to peer safely inside the human body to detect otherwise hidden maladies, like soft-tissue injuries or newly formed tumors. They can also be used to map activity in the human brain, a process known as functional MRI (fMRI).

A further application of this technology, dubbed task-fMRI, has shown great promise in understanding how the brain responds to certain stimuli, like the confrontational image of an angry face compared to a neutral face. Because of this capability, some researchers have proposed that task-fMRI might aid in identifying individuals at greater risk of developing a mental disorder like anxiety and depression or who might respond most favorably to certain medications like antidepressants.

New research published in the journal *Psychological Science*, however, reveals that while task-fMRI provides important insights into the general functioning of the average human brain, it cannot yet predict how individuals will respond to specific situations or their future mental health.

"Our findings do not question the validity of task-fMRI studies and what they reveal about the average human brain. In fact, task-fMRI does a great job at measuring an average brain's functioning," said the study's lead author, Ahmad Hariri, who heads Duke University's Laboratory of NeuroGenetics.

"Rather, our findings more specifically question the application of these same measures to reveal how the brains of different people function differently."

For their research, Hariri and his colleagues used a combination of a meta-analysis of prior research and new analyses of test/retest data to assess the reliability of many commonly used task-fMRI measures of brain activity.

Their results found that, on average, 56 prior test-retest studies did not produce the same readings for each individual from the first to the second test. This was true even when the tests were separated by only a short period of time.

"If a measure gives a different value every time it is administered, it can hardly be used to make predictions about a person," noted Hariri. "This is important because more and more such studies are being reported, often accompanied by sensationalistic headlines."

Hariri also noted that many large-scale studies that aim to measure brain activity to predict the future health of individuals have adopted task-fMRI measures that are not fit for the purpose because they are unreliable.

The Duke team's findings, which are derived from the largest and most comprehensive set of analyses to date, suggest not only that psychological scientists need to exercise caution in evaluating the broad applicability of task-fMRI findings, but also that researchers need to develop a more rigorous foundation for advancing task-fMRI measures to study brain-behavior correlations.

"Better research measures, particularly in the age of individualized medicine and precision neuroscience, are needed to achieve clinically useful results," Hariri concluded. His findings stress that researchers should accept current limitations while striving for more meaningful measurement tools.

# # #

Elliott, M.L. and Knodt, A.R. et al. (2020) What Is the Test-Retest Reliability of Common Task-Functional MRI Measures? New Empirical Evidence and a Meta-Analysis. *Psychological Science*, https://doi/10.1177/0956797620916786