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820 Jorie Blvd
Oak Brook, IL 60523
TEL 1-630-571-2670
FAX 1-630-571-7837
RSNA.org

NEWS

RSNA Press Release

Study Shows Link between Motor Function and Level of Brain Activity

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Media Contacts:

Maureen Morley
(630) 590-7754
mmorley@rsna.org

Heather Babiar
(630) 590-7738
hbabiar@rsna.org

OAK BROOK, Ill. - Individuals with quick reaction times are activating more areas of their brains, according to a study published in the January issue of the journal *Radiology*.

The study, from Johns Hopkins Hospital and the Johns Hopkins University, is one of the first to focus specifically on brain activity with respect to reaction time (the time between the onset of a stimulus and the motor response to it), a variable used widely in the behavioral sciences and neurosciences as a measure of cognitive and motor performance. The study found that individuals who performed a specific task exceptionally fast activated significantly more brain volume than those who performed the same task relatively slowly.

"A significant body of evidence indicates that reaction times increase with age," said study co-author David M. Yousem, M.D., director of neuroradiology and professor of radiology at Johns Hopkins Hospital. "The prolongation of reaction time accounts for the increase in car accidents, slips and falls in the elderly and infirm," Dr. Yousem said.

"Since slowing of motor functions has an undeniable effect on quality of life as people get older, it is important to understand the underlying mechanism of this phenomenon," Dr. Yousem said. "To do so, first we must understand normal brain function as it relates to reaction time."

Lead author Kader Karli Oguz, M.D., Dr. Yousem and colleagues used functional magnetic resonance imaging (fMRI) to map changes in brain activity in 12 healthy adults as they performed a simple task in which they pressed a button with their finger each time they saw a multicolored circle projected on a screen. Their reaction times were recorded and their brain activity measured. Like MRI, fMRI uses a powerful magnet and radio signals to create images of the brain. However, fMRI reveals changes in brain activity rather than just the anatomy. An increase in the firing of neurons in an active area of the brain requires an increase in the flow of oxygenated blood to that area. Functional MRI provides information about how the brain works by highlighting these shifts in oxygenated blood flow.

For the study, researchers measured the reaction times of 24 individuals. The six individuals with the fastest reaction times were placed in one group, and the six with the slowest

reaction times were placed in another. Average reaction times for the fast and slow groups were significantly different at 342 milliseconds and 475 milliseconds, respectively. The groups did not differ significantly in age (an average of 58 and 60 years) or gender composition.

Participants were asked to press a button as soon as they saw a multi-colored visual cue that appeared on a screen for a half-second at random 20- or 30-second intervals. The researchers analyzed the images for each participant to produce an individual map of brain activity, and then combined these individual maps to create a map for each group. The maps were used to determine activation volumes in the left and right visual, sensori-motor and supplemental motor cortices.

A subtraction image illustrating the differences in amount of brain activated between the two groups showed a substantial graphic difference in both the visual and motor cortices. "On both individual and group maps, the fast group activated a greater volume of the brain at all the relevant sites than did the slow group," Dr. Yousem said.

The findings support the theory that, in adults, better performance is correlated with more brain activation rather than less activation. "Some say that, as you get better at a task, you use less brain tissue to do the task. We come down on the side that more activation yields superior performance, at least in the age group we studied," Dr. Yousem said.

Since previous research has shown a decline in brain volume activation with age during motor tasks requiring an increase in oxygenated blood flow, the researchers eliminated the effects of age by keeping the ages of the two groups similar. Participants ranged in age from 38 to 72 years in the fast group and 31 to 85 years in the slow group.

"Dr. Karli Oguz's findings add one chapter to the 'greater book' that will ultimately help physicians detect neurodegenerative diseases such as Alzheimer's and Parkinson's and other neurological conditions long before they become clinically evident," Dr. Yousem said.

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Radiology is a monthly scientific journal devoted to clinical radiology and allied sciences. The journal is edited by Anthony V. Proto, M.D., School of Medicine, Virginia Commonwealth University, Richmond, Virginia. Radiology is owned and published by the Radiological Society of North America, Inc. (http://radiology.rsna.org)

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"Correlation of fMRI Activation Data with Simple Reaction Times." Collaborating with Dr. Yousem and Dr. Oguz on this study were Nina Mikelashvili, M.D., Vince D. Calhoun, Ph.D., Colin Wu, Ph.D., and Michael Kraut, M.D.