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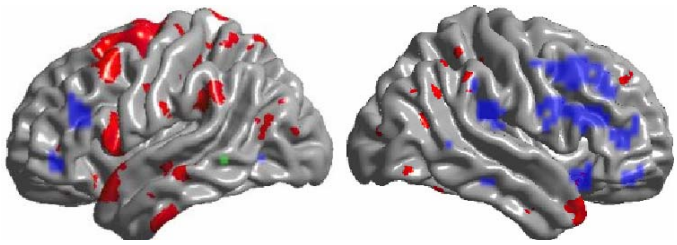
# Brain Imaging Shows Playing Tetris Leads to Both Brain Efficiency and Thicker Cortex

*Study is one of the first to investigate the effects of practice in the brain using two imaging techniques*

Albuquerque, NM. – August, September 1, 2009 – Researchers at the Mind Research Network today announced the findings of a scientific study that used brain imaging and Tetris to investigate whether practice makes the brain efficient because it increases gray matter. Over a three-month period, adolescent girls practiced Tetris, a computer game requiring a combination of cognitive skills. The girls who practiced showed greater brain efficiency, consistent with earlier studies. Compared to controls, the girls that practiced also had a thicker cortex, but not in the same brain areas where efficiency occurred [see photo].



[Caption: Relative to controls, red areas show where practice led to a thicker cortex; blue areas show more efficient brain function after practice; right image is right hemisphere; left image is the left hemisphere]

"One of the most surprising findings of brain research in the last five years was that juggling practice increased gray matter in the motor areas of the brain," said Dr. Rex Jung, a co-investigator on the Tetris study and a clinical neuropsychologist. "We did our Tetris study to see if mental practice increased cortical thickness, a sign of more gray matter. If it did, it could be an explanation for why previous studies have shown that mental practice increases brain efficiency. More gray matter in an area could mean that the area would not need to work as hard during Tetris play."

"We showed that practice on a challenging visuospatial task has an impact on the structure of the cortex, which is in keeping with a growing body of scientific evidence showing that the brain can change with stimulation and is in striking contrast with the pervasive and only-recently outmoded belief that our brain's structure is fixed," said Dr. Sherif Karama, a co-investigator at the Montreal Neurological Institute.

This study, published in the open-access journal *BMC Research Notes*, is one of the first to investigate the effects of practice in the brain using two imaging techniques. The girls completed both structural and functional MRI scans before and after the three-month practice period, as did girls in the control group who did not play Tetris. A structural MRI was used to assess cortical thickness, and a functional MRI was used to assess efficient activity.

"We were excited to see cortical thickness differences between the girls that practiced Tetris and those that did not," said Dr. Richard Haier, a co-investigator in the study and lead author of a 1992[1] study that found

[1] Richard J. Haier, et al., "Regional glucose metabolic changes after learning a complex visuospatial/motor task: a positron emission tomographic study," *Brain Research*, (1992), 134-143

practicing Tetris led to greater brain efficiency. “But, it was surprising that these changes were not where we saw more efficiency. How a thicker cortex and increased brain efficiency are related remains a mystery.”

The areas of the brain that showed relatively thicker cortex were the Brodmann Area (BA) 6 in the left frontal lobe and BA 22 and BA 38 in the left temporal lobe. Scientists believe BA 6 plays a role in the planning of complex, coordinated movements. BA 22 and BA 38 are believed to be the part of the brain active in multisensory integration—or our brain’s coordination of visual, tactile, auditory, and internal physiological information.

Functional MRI (fMRI) showed greater efficiency after practice mostly in the right frontal and parietal lobes including BAs 32, 6, 8, 9, 46 and BA 40. These areas are associated with critical thinking, reasoning, and language and processing.

According to the researchers, Tetris was a useful tool for brain research. “Tetris, for the brain, is quite complex,” said Haier. “It requires many cognitive processes like attention, hand/eye co-ordination, memory and visual spatial problem solving all working together very quickly. It’s not surprising that we see changes throughout the brain.”

A number of previous scientific studies also have used Tetris. [2, 3, 4, 5, 6]

The researchers chose to use adolescents in this study because it is more likely to see changes in developing brains. Girls were chosen because boys tend to have considerably more computer game experience and, therefore, may not show detectable brain change after game practice. All 26 girls in the study had limited computer game experience.

“We hope to continue this work with larger, more diverse samples to investigate whether the brain changes we measured revert back when subjects stop playing Tetris,” said Dr. Jung. “Similarly, we are interested if the skills learned in Tetris, and the associated brain changes, transfer to other cognitive areas such as working memory, processing speed, or spatial reasoning.”

**About this study:**

The study, “MRI assessment of cortical thickness and functional activity changes in adolescent girls following three months of practice on a visual-spatial task,” will be published by *Biomedical Central (BMC) Research Notes* on Tuesday, September 1. *BMC Research Notes* is a peer-reviewed, open access online journal. Before being published, the study was reviewed by two experts in the research field, and all original research articles published by *BMC* are made freely and permanently accessible online immediately upon publication. Authors publishing with *BMC* retain the copyright to their work, licensing it under the Creative Commons Attribution License. This license allows articles to be freely downloaded from the *BMC* website, and also allows articles to be re-used and re-distributed without restriction, as long as the original work is correctly cited. You can read the study in its entirety here: http://www.biomedcentral.com/bmcresnotes/

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[2] Lynn Okagaki, et al., “Effects of Video Game Playing on Measures of Spatial Performance: Gender Effects in Late Adolescence,” *Journal of Applied Developmental Psychology*, 15 (1994), 33-58

[3] Robert Stickgold, et al., “Replaying the Game: Hypnagogic Images in Normals and Amnesics,” *Science*, 209 no. 5490 (2000), 350–353

[4] Paul Franks, et al., “Cardiovascular Response of Trained Preadolescent Boys to Mental Challenge,” *Medicine & Science in Sports & Exercise* (2003), 1429-1435

[5] Paul P. Maglio, et al., “Evidence for the role of self-priming in epistemic action: Expertise and the effective use of memory,” *Acta Psychologica*, 127 (2008), 72–88

[6] Emily A. Holmes, et al., “Can Playing the Computer Game ‘Tetris’ Reduce the Build-Up of Flashbacks for Trauma? A Proposal from Cognitive Science,” *PLoS ONE*, 4(1): e4153. doi:10.1371/journal.pone.0004153 (2009)

This study was funded by Blue Planet Software, Inc., the sole agent for the Tetris Company, where Dr. Richard Haier is currently a consultant.

For more information on Dr. Haier's past research and published studies, please visit his website: http://web.mac.com/rjhaier/iWeb/Haier/Welcome.html

**About the Mind Research Network:**

The Mind Research Network (MRN) is an independent 501(c)3 non-profit organization dedicated to advancing the diagnosis and treatment of mental illness and brain injury. Headquartered in Albuquerque, New Mexico, MRN consists of an interdisciplinary association of scientists located at universities, national laboratories and research centers around the world and is focused on imaging technology and its emergence as an integral element of neuroscience investigation.

**About the Montreal Neurological Institute:**

The Montreal Neurological Institute and Hospital (MNI) is an academic medical centre dedicated to neuroscience. It fosters multidisciplinary teams of basic and clinical scientists that generate fundamental information about the nervous system and apply that knowledge to understanding and treating neurological diseases. It has 11 research units closely integrated with clinical activities and is engaged in the full spectrum of contemporary neuroscience research and patient care.

**About BMC Research Notes:**

BMC Research Notes (http://www.biomedcentral.com/bmcresnotes/) is an open access journal publishing scientifically sound research across all fields of biology and medicine, enabling authors to publish updates to previous research, software tools and databases, data sets, small-scale clinical studies, and reports of confirmatory or 'negative' results. Additionally the journal welcomes descriptions of incremental improvements to methods as well as short correspondence items and hypotheses.