Researchers examine the neuroscience of mental fatigue

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We all perhaps know the feeling of mental exhaustion, but what does it mean physiologically to have mental fatigue? A new study carried out using brain scans could help scientists uncover the neurobiological mechanisms underlying mental fatigue.

According to Bui Ha Duc and Xiaoping Li of the National University of Singapore writing in a forthcoming issue of the *International Journal Computer Applications in Technology*, mental fatigue has become commonplace as many people face increasing mental demands from stressful jobs, longer working hours with less time to relax and increasingly suffer sleep problems. Mental fatigue has received attention from those involved generally in health and well being as well as from the military and transport industry. After all, mental fatigue not only affects the health of individuals but can also have implications for road safety and international security.

The researchers used functional magnetic resonance imaging (fMRI) to monitor activity in the brains of ten student volunteers (male and female aged 19 to 25 years) deprived of sleep for 25 hours and given a simple task repeatedly through that period. They carried out scans at 9am, 2pm, 3am, 9am the following day. All volunteers had to have avoided alcohol and caffeine for the 24 hours prior to the experiment, were all physically and mentally fit prior to participation and none had any sleep problems.

The activation of the left thalamus increases with sleep deprivation, going in an exactly opposite trend to the inferior parietal that (following

the circadian rhythm) decreases in activation from 9 am to 3 am next day and then increases in activation. This finding fits with logic as the inferior parietal cortex integrates information from different sensory modalities. As all the information has to go through the thalamus and then is sent by the thalamus to the inferior parietal, when the inferior parietal decreases in activation, the thalamus must increase its activation to get the information sent through.

The team explains that a gradual increase in mental fatigue led to decreased activity in the volunteers' brains in specific regions: the anterior cingulate gyrus, right inferior frontal, left middle frontal and right superior temporal cortex. The anterior cingulate cortex has been described as an interface between motivation, cognition and action, and has been implicated in using reinforcement information to control behavior. The fMRI scans suggest that decreased activity in this part of the brain is therefore linked to those familiar feelings of mental fatigue including lethargy and slowness of thinking.

"The research provides a neurophysiologic basis for measuring the level of mental fatigue by EEG, as well as for the intervention by non-invasive neural stimulation to maintain wakefulness," the team says. "We have developed devices for both, which will be commercialized by our spinoff company, Newrocare Pte Ltd."

More information: Functional neuroimaging of circadian fatigue, *Int. J. Computer Applications in Technology*, 2012, 45, 156-162. www.inderscience.com/info/inar … icle.php?artid=50704

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