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Can't relax? It's all in your mind: Research shows stopping a thought puts more strain on the brain

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(PhysOrg.com) -- Turns out, relaxing is exhausting—which could by why so many people struggle to unplug from work during vacation.

According to mathematicians at Case Western Reserve University, stopping a thought burns more energy than thinking-like stopping a truck on a downhill slope.

"Maybe this explains why it is so tiring to relax and think about nothing," says Daniela Calvetti, professor of mathematics and one of the authors of a new brain study published in an advanced online publication of the *Journal of Cerebral Blood Flow & Metabolism.*

Since opening up the brain for detailed monitoring isn't exactly practical, Calvetti teamed up with fellow mathematics professor Erkki Somersalo and Rossana Occhipinti, a postdoctoral researcher in physiology and biophysics, to create a computer model of brain metabolism.

Calvetti and Somersalo created a software package specifically designed to study the complex metabolic systems. The software-Metabolica-produces a numeric rendering of the pathways linking excitatory neurons that transmit thought or inhibitory neurons that put on the brakes with star-shaped brain cells called astrocytes. Astrocytes provide essential chemicals and functions to both kinds of neurons.

To stop a thought, the brain uses inhibitory neurons to prevent excitatory neurons from passing information-they block information by releasing gamma aminobutyric acid, commonly called GABA, which counteracts the effect of the neurotransmitter glutamate by excitatory neurons.

In other words, glutamate opens the synaptic gates and GABA holds them closed.

"The astrocytes, which are the Cinderellas of the brain, consume large amounts of oxygen mopping up and recycling the GABA and the glutamate, which is a neurotoxin," Somersalo says.

More oxygen requires more blood flow, although the connection between cerebral metabolism and hemodynamics is not fully understood yet.

All together, "It's a surprising expense to keep inhibition on," he says.

The researchers hope their work can provide some insight on brain diseases, which are often difficult to diagnose until advanced stages. Most brain maladies are linked to energy metabolism, and understanding

the norm may enable doctors to detect problems earlier.

The toll inhibition takes may be particularly relevant to neurodegenerative diseases. "And that is truly exciting," Calvetti says.

Provided by Case Western Reserve University