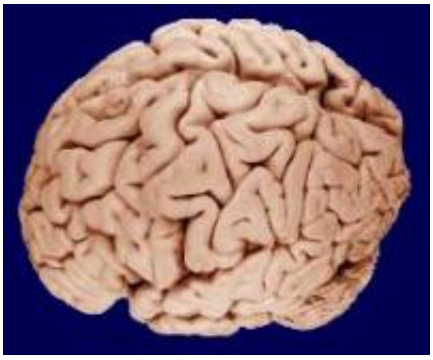
Learning keeps brain healthy: study

March 2 2010



Credit: University of Wisconsin and Michigan State Comparative Mammalian Brain Collections and the National Museum of Health and Medicine

UC Irvine neurobiologists are providing the first visual evidence that learning promotes brain health - and, therefore, that mental stimulation could limit the debilitating effects of aging on memory and the mind.

Using a novel visualization technique they devised to study memory, a research team led by Lulu Chen and Christine Gall found that everyday forms of learning animate neuron receptors that help keep brain cells functioning at optimum levels.

These receptors are activated by a protein called brain-derived neurotrophic factor, which facilitates the growth and differentiation of the connections, or synapses, responsible for communication among neurons. BDNF is key in the formation of memories.

"The findings confirm a critical relationship between learning and brain growth and point to ways we can amplify that relationship through possible future treatments," says Chen, a graduate researcher in anatomy & neurobiology.

Study results appear in the early online edition of the *Proceedings of the National Academy of Sciences* for the week of March 1.

In addition to discovering that brain activity sets off BDNF signaling at the sites where neurons develop synapses, researchers determined that this process is linked to learning-related brain rhythms, called theta rhythms, vital to the encoding of new memories.

Theta rhythms occurring in the hippocampus involve numerous neurons firing synchronously at a rate of three to eight times per second. These rhythms have been associated with long-term potentiation, a cellular mechanism underlying learning and memory.

In rodent studies, the team found that both unsupervised learning and artificial application of theta rhythms triggered BDNF signaling at synapse creation sites.

"This relationship has implications for maintaining good brain health," says Gall, a professor of anatomy & neurobiology. "There is evidence that theta rhythms weaken as we age, and our discoveries suggest that this can result in memory impairment. On the other hand, they suggest that staying mentally active as we age can keep neuronal BDNF signaling at a constant rate, which may limit memory and cognitive decline."

Researchers are now exploring whether learning-induced growth signals decrease with age and, if so, whether this can be reversed with a new family of experimental drugs.