INTERNATIONAL BRAIN RESEARCH ORGANIZATION
8th IBRO World Congress of Neuroscience
14-18 July – Florence, Italy
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PRESS RELEASE

EMBARGOED UNTIL MONDAY 18 JULY, 00.01

SLEEP LOSS CATCHES UP WITH THE BRAIN

Losing sleep might seem a trivial matter in modern life, because we may not feel an impact on our performance the next day. But new research in the Netherlands indicates that the impact of sleep loss may appear later on, because the brain compensates with other, less flexible areas. Speaking today (18 July) at the IBRO World Congress of Neuroscience in Florence, Dr Peter Meerlo described research in mice uncovering how sleep deprivation eventually affects spatial learning and memory.

Sleep is acknowledged by scientists as crucial for learning and memory. Sleep loss especially affects a brain area called the hippocampus, which is particularly important for memory of places and locations. Constantly adapting memories to changing conditions is essential for managing regular changes in surroundings, such as navigating from a new workplace to home, explained Dr Meerlo. "So testing whether sleep deprivation induces a shift in the brain's strategy for place navigation, we found that it did." His team determined that the brain can temporarily compensate for sleep loss effects by changing to alternative learning mechanisms in other areas.

The University of Groningen research team trained mice in spatial tasks using environmental cues, on mazes assessing memory formation (learning food location) and flexibility (learning that food location changed). After daily training, mice were sleep deprived for five hours — a phase believed critical for memory consolidation. Initially, researchers observed no obvious sleep loss effects. But after some time, especially during reversal training (adaption to new information), the mice's performance diminished significantly.

The researchers believed that the sleep-deprived mice were initially compensating by switching from the hippocampus, normally active in spatial memory formation, to using the striatum, an area less susceptible to sleep loss, but less able to adapt memories. Examining brain tissue confirmed the behavioural observations. Researchers found changes in the brain chemical cascade triggered by maze training. Increase of an important protein — phosphorylated CREB, which activates genes key in learning and memory — shifted from the hippocampus to the dorsal striatum.

"Our findings confirm that sleep deprivation affects the hippocampus and spatial learning," said Dr Meerlo. "They also indicate that mice may temporarily compensate for sleep deprivation's negative effects by shifting from a spatial-based hippocampal system to a response-based learning strategy of the striatal memory system." He explained that the striatal system is more about internally driven responses that do not depend on environmental cues. "It's a 'routine mode' of memory, like going on autopilot to your old home even after you've moved."

"We still don't understand why some areas of the brain are more sensitive to sleep loss than others" he told delegates. "But our study showed you don't need to lose a lot of sleep for it to impair memory. The time when you lose the sleep is also important. If it's during memory consolidation periods, brief sleep loss may be enough to cause memory deficits."

Dr Meerlo believes the findings could be important for ongoing sleep and memory research in both animals and humans. "Because sleep loss effects are not immediately apparent, it may seem like there is no effect. But the brain is temporarily bypassing areas it usually uses, so impacts may show up much later on. In the long run, sleep loss is working against you."

END

Abstract Reference 1210: *Consequences of mild sleep disruption: changes in regional brain activity and learning strategy*
Symposia S18: *The role of sleep in learning and memory formation: from molecular mechanisms to cognitive function*

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NOTES TO EDITORS
IBRO, the International Brain Research Organization, is the global neuroscience federation dedicated to the promotion of neuroscience and communication between brain researchers around the world with special emphasis on assisting young investigators in the developing world. Incorporated in 1961, IBRO now counts 84 member societies in 61 countries around the globe with a membership of over 75,000 neuroscientists. Celebrating its 50th anniversary in 2011, the International Brain Research Organization (IBRO) – along with the Italian Society of Neuroscience (SINS) – invites the world's neuroscientists to Florence, Italy, for the 8th IBRO World Congress. www.ibro.org

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Publications
Sleep deprivation impairs contextual fear conditioning and attenuates subsequent behavioural, endocrine and neuronal responses. R Hagewoud, L Bultsma, R Paulien Barf, J Koolhaas, P Meerlo. *J. Sleep Res*. 2011, 20; 259–266.

Coping with Sleep Deprivation: Shifts in Regional Brain Activity and Learning Strategy. R Hagewoud, R Havekes, P Tiba, A Novati, K Hogenelst, P Weinreder, E Van der Zee, P Meerlo. *SLEEP.* 2010, Vol. 33, No. 11; 1465-1473.