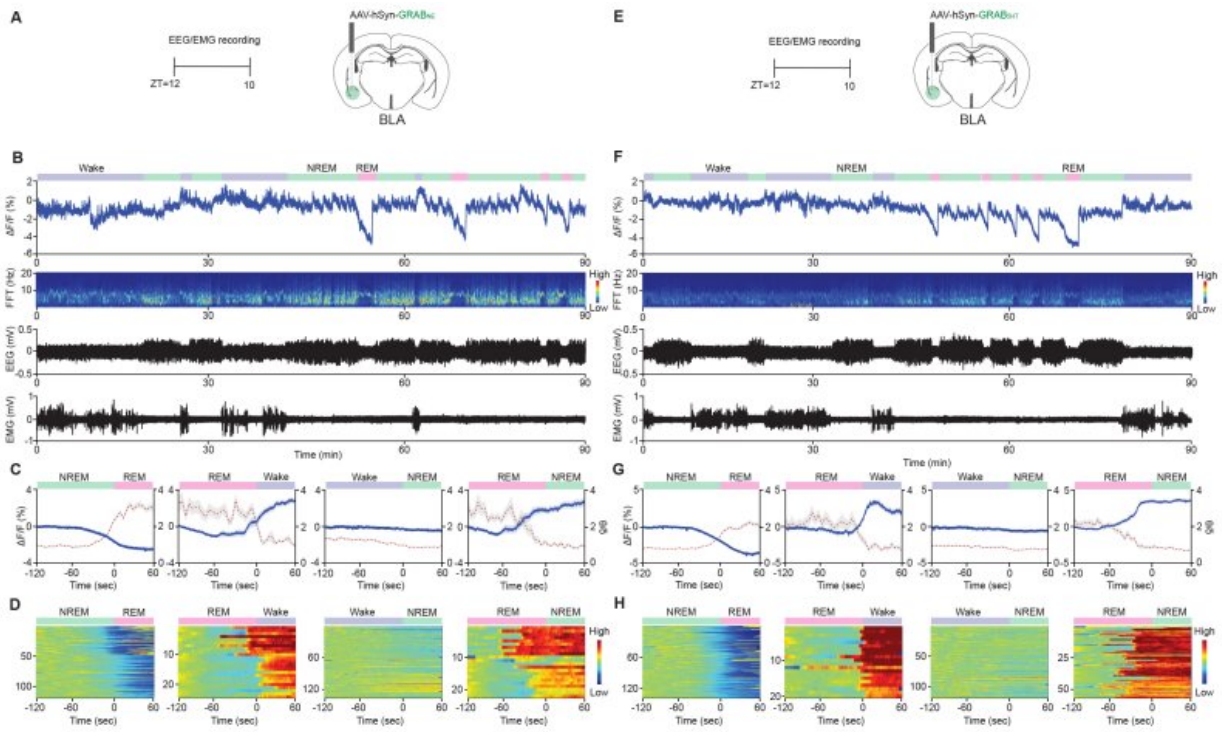
Dopamine found to be an initiator of REM sleep

March 7 2022, by Bob Yirka



NE and 5HT levels in BLA start to decrease before NREM to REM sleep transition. Levels of NA and 5HT in the BLA showed a completely different pattern from that of DA. They were decreased during NREM sleep and started to further decrease just shortly prior to transition to REM sleep, and maintained a low level during REM sleep. (A) and (E) Left, experimental design. Right, schematic drawings of fiber locations and AAV injection in BLA. (B) and (F) Top, representative trace of NE or 5HT level in BLA in C57BL/6J mouse. Blue, green and pink bars show wakefulness, NREM and REM sleep, respectively. Middle and Bottom, representative time-resolved power spectrum and waveform of EEG from cortical surface and EMG. (C) and (G) Temporal changes in NE or

5HT levels at each transition (blue) and theta/delta power (red dotted line) (average±S.E.). Time is relative to the transition of states. (D) and (H) Heatmap showing level of NE or 5HT at each transition (3 mice, recorded for 22 h, Only state transitions where the preceding state lasted more than 120 s and another state following it lasted more than 60 s were extracted and converted to data. Credit: *Science* (2022). DOI: 10.1126/science.abl6618

A team of researchers from the University of Tsukuba in Japan and Peking University School of Life Sciences, in China, has found an association between the production of dopamine in the basolateral amygdala and the initiation of REM sleep. In their paper published in the journal *Science*, the researchers describe their use of optogenetic manipulation in mice to better understand what happens in the brain during sleep cycles. Elda Arrigoni and Patrick Fuller with the Beth Israel Deaconess Medical Center and Harvard Medical School, and the University of California, Davis School of Medicine, Davis, respectively, have published a Perspective piece on the work by the team in the same journal edition.

Prior research has shown that people move between two types of sleep as they doze: non-rapid eye movement and rapid eye movement (REM). What has not been clear is the mechanism involved in switching between the two kinds of sleep. The researchers used optogenetic manipulation in mice to learn more about this process.

Optogenetic manipulation is a technique whereby mice are genetically altered in such a way as to have certain cells respond to the presence of light (using fiber photometry). In this instance, the mice were altered in a way that led to excitement of dopamine fibers in the basolateral amygdala while they were sleeping.

The work by the team involved first watching as cells in the basolateral amygdala were activated during different parts of the sleep cycle. In so doing, they found that production of dopamine in that region of the brain increased just prior to the brain moving into REM sleep. A similar change did not occur during non-REM cycles. This suggested to the researchers that increases in dopamine levels were associated with pushing the brain to move to a REM state. To test this, they artificially stimulated the production of dopamine in the same region while the mice were in a non-REM state and found that doing so pushed the brain to a REM state.

The researchers also found that inciting the production of dopamine in the same brain region could trigger cataplexy in narcoleptic mice. They conclude by suggesting that it appears possible that therapies designed to stimulate the production of dopamine in the basolateral amygdala might help people who have sleep problems.

More information: Emi Hasegawa et al, Rapid eye movement sleep is initiated by basolateral amygdala dopamine signaling in mice, *Science* (2022). DOI: 10.1126/science.abl6618

Elda Arrigoni et al, Addicted to dreaming, *Science* (2022). DOI: 10.1126/science.abo1987