

The role of dopamine in sleep regulation

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A group of Spanish researchers has discovered a new function of the neurotransmitter dopamine in controlling sleep regulation. Dopamine acts in the pineal gland, which is central to dictating the 'circadian rhythm' in humans—the series of biological processes that enables brain activity to adapt to the time of the day (that is, light and dark cycles). The researchers, from the CIBERNED (Centro de Investigación Biomédica en Red de Enfermedades Neurodegenerativas), dependant on the Spanish Ministry of Economy and Competitiveness through the Carlos III Health Institute, and from the Faculty of Biology of the University of Barcelona, publish their findings 19 June in the open-access journal *PLoS Biology*.

All animals respond to cycles of light and dark with various patterns in sleeping, feeding, body temperature alterations, and other biological functions. The pineal gland translates the light signals received by the retina into a language understandable to the rest of the body, for example through the synthesis of the hormone melatonin, which is produced and released at night and which helps to regulate the body's metabolic activity during sleep.

Another hormone, norepinephrine, is involved in regulating this synthesis and release of melatonin in the pineal gland. The functions of norepinephrine are carried out via binding to its receptors in the membranes of cells. It was long believed that these norepinephrine receptors all acted independently of other proteins, but in the new study, researchers have discovered that this is not the case. In fact, the receptors collaborate with other [dopamine](#) receptors forming

'heteromers'.

When dopamine then interacts with its receptors, it inhibits the effects of norepinephrine—which means a decrease in the production and release of melatonin. Interestingly, the researchers found that these dopamine receptors only appear in the pineal gland towards the end of the night, as the dark period closes. Therefore, the researchers conclude, the formation of these heteromers is an effective mechanism to stop melatonin production when the day begins and to 'wake up' the brain.

"These results are interesting as they demonstrate a mechanism in which dopamine, normally increased at times of stimulation, can directly inhibit production and release of a molecule, melatonin, that induces drowsiness and prepares the body for sleep," explained Dr McCormick.

The discovery of this new function of dopamine could be extremely useful when designing new treatments to help mitigate circadian rhythm disturbances, such as those related to jet lag, those found among people who work at night, and in cases of [sleep](#) disorders in general which, according to the World Health Organisation, affect 40% of the world's population. Circadian rhythm disturbances can also produce alterations in body mass index, and can lead to behavioural disorders that affect 1 in 4 people at least once in their lifetime, in which melatonin levels are related.

More information: González S, Moreno-Delgado D, Moreno E, Pérez-Capote K, Franco R, et al. (2012) Circadian-Related Heteromerization of Adrenergic and Dopamine D4 Receptors Modulates Melatonin Synthesis and Release in the Pineal Gland. *PLoS Biol* 10(6): e1001347. [doi:10.1371/journal.pbio.1001347](https://doi.org/10.1371/journal.pbio.1001347)

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