Biological clocks orchestrate behavioral rhythms by sending signals downstream

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Different groups of neurons program biological clocks to orchestrate our behaviors by sending messages in a unidirectional manner downstream, a team of biologists has found.

The study, which appears in the journal *Nature Neuroscience*, focused on clock neurons in the fruit fly Drosophila and sought to understand the larger role of biological clocks—also known as circadian rhythms.

"We've known for a long time how clock neurons keep time, but we haven't understood how rhythms in a fairly small number of clock neurons control the behavior of an entire animal," explains Justin Blau, the paper's senior author and a professor in NYU's Department of Biology and at NYU Abu Dhabi. "Our findings reveal a 'circadian circuit' in which signals go from one set of neurons to another in a unidirectional manner, and this circuit connects clock neurons to the central brain areas that regulate activity and sleep."

In their studies, the scientists found that the fly's clock neurons send signals to Leucokinin, or LK, neurons, which in turn send signals to Leucokinin Receptor, or LK-R, neurons.

Clock neurons have their own molecular clocks that allow them to signal at specific times of day. But how is this time information transmitted through the brain? Blau and his team found that the rhythmic signaling of clock neurons drives rhythms when the downstream LK and LK-R neurons signal—even though LK and LK-R neurons do not have molecular clocks themselves.

The researchers also found rhythms in the signaling of DH44-expressing neurons—another set of neurons previously shown to be downstream of clock neurons. So, the researchers concluded, transferring rhythms from clock neurons downstream seems to be a general mechanism for how time flows through the brain.

More information: "Circadian rhythms in neuronal activity propagate through output circuits," *Nature Neuroscience* (2016). DOI: 10.1038/nn.4263

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