Differences in jet lag severity could be rooted in how circadian clock sets itself

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It's no secret that long-distance, west-to-east air travel – Seattle to Paris, for example – can raise havoc with a person's sleep and waking patterns, and that the effects are substantially less pronounced when traveling in the opposite direction.

Now researchers, including a University of Washington biologist, have found hints that differing molecular processes in an area of the brain known as the suprachiasmatic nucleus might play a significant role in those jet lag differences.

Human circadian clocks operate on a period about 20 minutes longer than one day and so must be synchronized to the light-dark cycle of the solar day, delaying or advancing their time in response to light.

Someone whose clock runs faster than a solar day must delay it on a daily basis, and someone whose clock runs slower than a solar day must advance it. These daily adjustments happen naturally, and without our noticing, but the process is disrupted by sudden large shifts in the light-dark cycle because of a radically new geographic location.

Researchers previously learned that delaying the circadian clock happens through different pathways in the suprachiasmatic nucleus than advancing the clock does. The new research shows that, at a molecular level, the mechanisms responsible for resetting the expression of the "clock genes" are drastically different.

"We have known for decades that, in humans and other organisms, advances are always much harder to achieve than delays. For example, compare jet lag going to Europe with that coming back," said Horacio de la Iglesia, a UW associate professor of biology.

"One of the reasons may be that these two forms of resetting the clock involve different molecular mechanisms at the clock level," he said.

de la Iglesia and William Schwartz of the University of Massachusetts Medical School are corresponding authors of a paper detailing the research, published online recently (Oct. 3) in the *Proceedings of the National Academy of Sciences*. Co-authors are Mahboubeh Tavakoli-Nezhad, Christopher Lambert and David Weaver, also of the University of Massachusetts Medical School.

The researchers exposed hamsters to two light-dark cycles, one of 23.33 hours and the other at 24.67 hours, to test the mechanisms that advance and delay the circadian clock. A one-hour light pulse in the shorter cycle acted as dawn, but in the longer cycle it acted as dusk. The scientists confirmed that the pulse of light at dawn advanced the animals' circadian clocks, while the light at dusk delayed the clocks.

The results suggest that different molecular mechanisms in the suprachiasmatic nucleus are at work when the circadian clocks are advanced than when the clocks are delayed, de la Iglesia said.

That could provide clues for understanding how circadian clocks work in nocturnal animals in natural conditions, and it could help in understanding potential remedies for jet lag.

More information: An abstract of the paper is available at www.pnas.org/content/early/201 … /1107848108.abstract

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