Paul Chiu (SN 28624112)
Science Journalism Article

How Light and Different Bedtimes May Affect Your Sleep

While you might not be great at keeping track of time, your body definitely is. Many of its processes, like hunger, are regulated by circadian rhythms (i.e. the fluctuation of levels experienced by various chemical factors throughout the day). Another process regulated by these rhythms is sleep. Decades of research have tried to understand how exactly sleep is regulated, but it is still not well-understood. However, there is one factor that is attractive to scientists: melatonin. Levels of melatonin in the body follow a circadian rhythm thanks to a circadian pacemaker, a part of the brain that control its secretion via the pineal gland. One part of melatonin's circadian rhythm is the dim light melatonin onset. This is when the rate of melatonin synthesis and secretion by the pineal gland increases two hours before one's usual bedtime, provided that the body is exposed to dim light. Scientists use the timings of dim light melatonin onset to figure out whether the circadian rhythm has been altered from its normal state, but what would be able to alter it? Some possible factors could be exposure to bright light or a different bedtime.

A study published in 1999 by researchers at the University of Groningen in the Netherlands sought to figure out whether bright light exposure (in lieu of dim light exposure) and/or sleep displacement could influence the circadian pacemaker and subsequently alter the timing of one's sleep cycle.

To study the effect of bright light, Dr. Marijke Gordijin and her colleagues monitored the melatonin levels, sleep, and temperatures of human subjects during four consecutive nights. These parameters were chosen as they all undergo a pacemaker-regulated circadian rhythm. The subjects stayed in the laboratory from 6pm to 9am the next day. In the first three nights, the authors allowed the subjects to sleep from 10pm to 6am. In addition, the authors exposed the subjects to either bright light before 10pm (before sleep) or after 6am (after sleep), with dim light exposure happening in the opposite period. The former group of subjects were classified as Evening Light, while the latter were classified as Morning Light. In the fourth night, the authors exposed the subjects only to dim light and allowed them to sleep from 12am to whenever they felt refreshed. The recorded body parameters were compared to initial records that were obtained when the subjects were only exposed to dim light throughout the four nights. The abnormally timed light exposures successfully phase shifted the subjects' circadian pacemakers, as denoted by the observation that the timings of the subjects' dim light melatonin onset, their circadian rhythms of body temperature during sleep, the times at which they were able to wake up feeling refreshed after the fourth night (used by the authors to represent sleep cycles), and the durations of their first episodes of rapid eye movement sleep (the times during sleep when one's eyes begin to move rapidly and one begins to dream) were all different when compared to their initial records. These parameters were also different between the Morning Light and Evening Light subjects; the timings of the parameters were earlier for the former than the latter. As these parameters all

changed together, the authors concluded that the changes were caused by the bright light exposure affecting the pacemaker and shifting the sleep cycle. This means that exposing oneself to bright light (perhaps from smartphone screens) as opposed to dim light too late at night or too early in the morning may end up shifting one's sleep cycle's timings.

To study whether sleep displacement (as opposed to abnormally timed bright light exposure) could alter the sleep cycle, the authors monitored the same three parameters during four consecutive nights. The subjects stayed in the lab from 6pm to 9am and the authors exposed them to dim light the entire time. For the first three days, the authors either allowed the subjects to sleep from 11pm to 7am, from 8pm to 4am, or from 4am to 10am. On the fourth night, the authors allowed them to sleep from 12pm to whenever they felt refreshed. This time, only the timings of dim light melatonin onset shifted. The circadian rhythms of body temperature, the times that the subjects woke up feeling refreshed after the fourth night, and the periods of rapid eye movement sleep were not significantly changed. With the lack of shifts in these parameters, the authors doubted whether sleep displacement shifted the timing of melatonin's circadian rhythm by influencing the circadian pacemaker.

Generally, this experiment suggests both abnormally-timed exposure to bright lights and sleep displacement can influence melatonin's circadian rhythm. However, the authors concluded that only the former can alter the rhythm by affecting the circadian pacemaker. Regardless, it seems that late-night texting and pulling out all-nighters may impact our sleep in some ways after all.

Gordijn, M.C.M., Beersma, D.G.M., Korta, H.J., Van Den Hoofdakker, R.H. (1999). Effects of light exposure and sleep displacement on dim light melatonin onset. *J. Sleep. Res*. **8**, 163-174.