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Circadian Phase Shifts Effect of Social Jetlag on Cellular Metabolism and Circadian Genes in Wildtype Flies

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Introduction:

Drosophila have circadian clocks which regulate behavioral and physiological systems within the body. This “biological clock” is synchronized via temperature or light cycle to one’s environment. Small fluctuations in day length or temperature trigger a reset of circadian clocks each day. However, significant disruptions can cause a wide variety of health and stress issues such as changes in activity, metabolism, and jetlag in humans. Social jetlag occurs when an individual’s biological clock clashes with the timing of one’s sleep schedule determined by social factors and the day’s demands. This can be seen in many instances, one being the life of a college student. Misalignment can result in mental health issues, fatigue, and illness. Social jetlag is imitated by shifting the light-dark cycles of drosophila. We then study the effects of the shift using techniques like Polymerase Chain Reaction to follow the shifting genes and Seahorse bio flux assays to measure cell metabolism. These data will allow us to learn how shifting light variations might induce alterations in cell metabolism, efficiency, and the health of cells in the brain.

Significance:

Studying social jetlag in drosophila may provide us with a new perspective on human circadian rhythms, as the two species have similar circadian clocks. This information could provide insight into human metabolism, stress, and its adverse effects when circadian clocks are shifted irregularly. By studying Drosophila brain activity in tandem with gene expression, we can learn whether there is a correlation between the changes we see in both following the disruption to the circadian cycle.

References:

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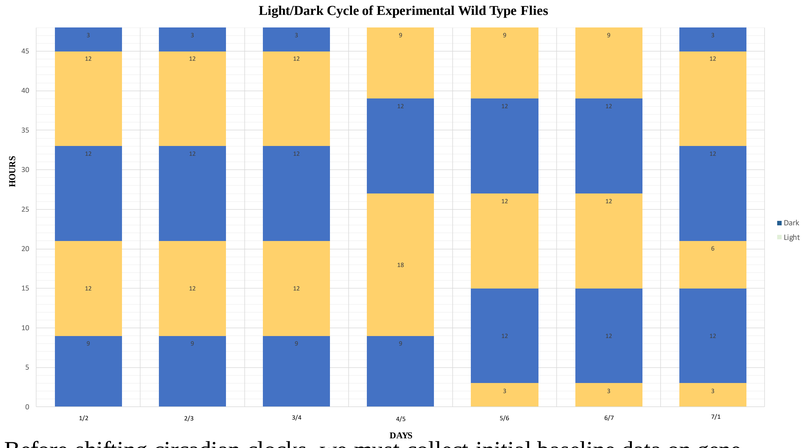
Peek, C. B., Ramsey, K. M., Levine, D. C., Marcheva, B., Perelis, M., & Bass, J. (2015). Circadian regulation of cellular physiology. *Methods in enzymology*, *552*, 165–184. https://doi.org/10.1016/bs.mie.2014.10.006

Methods:



Before shifting circadian clocks, we must collect initial baseline data on gene expression and cellular activity within the fly. We are still in the process of collecting this data. Once our baseline data is complete, Our experimental wildtype flies will shift their light/dark cycle by 6 hours (from 12 hours:12 hours, shifted to 18 hours:6 hours). These results will allow us to see if these circadian fluctuations influence cell metabolism, efficiency, and health of cells in the brain and how long the fly's internal clock will take to adjust to its disrupted light/dark cycle.

Seahorse Bioflux

The Seahorse Bioflux analyzer measures oxygen consumption (OCR) and the extracellular acidification (ECAR) rate of these living cells every 1 minute for seven cycles. Measuring these levels of cellular respiration will allow us to see how much activity each fly is conducting. This technology will also give insight into how tissues coordinate the utilization of food and metabolism and how the disruption of the circadian clock will affect this. The seahorse machine will measure the levels of cellular respiration in experimental and control wild-type drosophila at various points in their 24-hour light-dark cycle.

Polymerase Chain Reaction

Wildtype fly brains will be dissected and measured by the upregulation of mRNA of PER, TIM, and Clk genes that influence circadian clocks in their light/dark cycles in the fly. Once the fly RNA is purified, we synthesize cDNA. Once cDNA is synthesized, cDNA primers will be used in qPCR to measure the amount of gene expression within the DNA. The results from qPCR will allow us to build an initial baseline of gene expression in control flies and compare baseline data to the gene expression of our experimental flies with disrupted circadian clocks.

Seahorse Bioflux Data: