Biol 792 Project

Cassandra Hui

**Data Modification for Analyzing Circadian Activity**

Much of our lab’s research is focused around studying circadian rhythms, oscillations in activity and other physiological functions in approximately 24-hour cycles. More recently, we have been studying the effects of artificial light at night. Artificial light at night decreases organismal health, disrupts hormones, and enhanced nighttime activity (Alaasam et al., 2021). However, the neurological pathways leading to these effects are unknown and preliminary data suggests no direct mediation through the core circadian pacemaker. We are attempting to unravel these pathways through staining for immediate early gene expression. Immediate early genes, such as cFos and avian ZENK, alter gene expression in activated neurons when organisms are exposed to novel stimuli.

Thirteen birds were entrained to a light dark period of 12 hours each for four weeks. Birds were randomized into three groups, control night, control day, and artificial light at night. Control day activity was included because previous research demonstrated that birds are active at night even with dim light (Alaasam et al., 2021), therefore we accounted for awake and active neuronal activity. Birds were perfused two hours after night light exposure or at a comparative time for controls. Brains were sliced and imaged for cFos and ZENK staining. Additionally, perches registering a hop collected activity data daily, showing number of hops per minute by hour from each bird.

The daily files use columns for minutes and rows for hours. The first 24 rows represent the first bird, the next 24 the second bird, and so on, with an empty line in between. The output then is a list of files for each experimental day, a useless setup. We need to examine individual activity over the last week of entrainment, to confirm normal rhythmicity.

To resolve this, I wrote three data sorting scripts. The first one takes every file, by date, and sums the minutes to give an output of activity per hour. This is accomplished through reading in each line, registering the item as a number, adding to a list, and printing the sum. This open script operates on any files provided in the Unix command line.

The second script slices the birds into separate files generating one bird per day, through the pandas package. This script also converts each file specified in the Unix command line by constructing a data frame of every 24 rows. The panadas package eliminates the data frame aspect, writing out activity data alone and incorporating the cage number in each output file name.

The final script add the dates for individual birds together, producing one file of activity over the week. The script reads each file entered line by line and prints to the second argument specified in the Unix command. Therefore, future file names are flexible. These numbers then insert into a figure displaying circadian activity over time. With some subtle changes, these codes could function differently in the future. If we skip the first scrip the minute data remains intact. The date is also coded into the first and third scripts if it proves useful.

In summary, the activity data collected from this, and future experiments is now manageable. As science is always changing, having three scripts allows for flexible data sorting. Adjustments in one script can produce different output files. This is a successful code to analyze individual hourly activity over a specified time period.

Alaasam, V. J., Liu, X., Niu, Y., Habibian, J. S., Pieraut, S., Ferguson, B. S., . . . Ouyang, J. Q. (2021). Effects of dim artificial light at night on locomotor activity, cardiovascular physiology, and circadian clock genes in a diurnal songbird. *Environmental Pollution*, *282*, Article 117036. <https://doi.org/10.1016/j.envpol.2021.117036>