Sleep Tracking Assignment

GenEd1038: Sleep
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1 Introduction

1.1 Interest in GenEd 1038: Sleep

Throughout the course of my life, I have experienced many phases in which I have been fascinated by the concept of sleep. As a child, I often replayed good dreams in my mind during the day, while nightmares would inevitably haunt me for weeks. As a high school student, I started wondering if sleep was necessary and went through a few phases of (non-scientific) experimentation with my sleep. Now, as a college student, I desire to know more about the science behind sleep and how I can sleep better and improve my daytime well-being through sleep. This naturally sparked an eagerness to participate in the Gened1038: Sleep.

1.2 High School, Sleep Tracking

In high school, with the exception of my sophomore year, my engagement with sleep was relatively consistent. As a freshman in high school, my sleep schedule was quite steady: my average time of sleep was probably around 11pm, and my average time of waking up was around 6:30am for weekdays and 8:00am for weekends. However, as a sophomore, I desired more hours in the day in order to pursue academic goals and thus experimented with polyphasic sleeping. This led to sleep schedules that varied widely, ranging from uninterrupted 8 hour blocks of sleep to 5 naps throughout the day lasting around half an hour each. As a junior and senior, I realized that polyphasic sleeping made me less productive during the day, so I reverted to my old sleep schedule and again slept roughly between 11pm to 6:30am every night. I sporadically used the app Sleep Cycle on my phone to track my sleep. Sleep Cycle utilized the phone's built-in microphone during the night to track the wakefulness of my sleep and then woke me up during a period of lighter sleep. I no longer track my sleep using this app, but I remember it being mildly helpful in the past.

As alluded to above, there were a few major factors influencing my sleep in high school, some of them which can be viewed as strategies that I used to protect my sleep (i.e. keep my sleep schedule relatively consistent). My high school started at 7:20am sharp, and because of traffic I

had to leave the home by 6:40am latest. This set up a hard cutoff time by which I would have to be awake by, and the adrenaline rush that came from seeing the alarm clock at 6:35am was almost always more than enough to wake me up. In a sense, the consistency of school start times forced my wake times to be consistent.

Another factor that influenced my sleep was academic work. I knew in high school that I would be more effective throughout the day if I did not stay up late at night doing homework, so I often did a lot of work during the day, trying to get as much homework done as possible during school itself. This allowed me to obtain an adequate amount of sleep each night and avoid many late nights.

1.3 College, COVID-19 Pandemic

In college, my sleep schedule increased in variability. No longer did I have the consistent, dependable start time of 7:20am every day in college. Instead, I had a different schedule of classes, extracurriculars, and social activities every day. Some of the activities ran late into the evening, while others started early in the morning, requiring me to adjust my sleep schedule nightly in order to accommodate for my variable schedule. There were nights when I stayed up until 4am working on assignments or talking with friends, and there were mornings in which I had to get up by 6am to attend to some activities. Overall, this decreased my quality and consistency of sleep as compared .

During the peak of the pandemic, my sleep schedule was a little more consistent than at college (pre-pandemic), but it was less consistent than in high school. I stayed at home for much of the pandemic, and my parents were working from home. My parents have a relatively consistent sleep schedule because their work times are very consistent, and I benefited from that. However, variable virtual college events still dictated my earliest and latest activities, so it wasn't quite as consistent as in high school.

Now, back on campus (though still in the midst of the pandemic), I am being much more mindful of my sleep, and I try to sleep more consistently. This class has helped me to internalize the importance of sleep. I desire to keep improving my sleep this semester and in future semesters.

2 Data Collection Methods

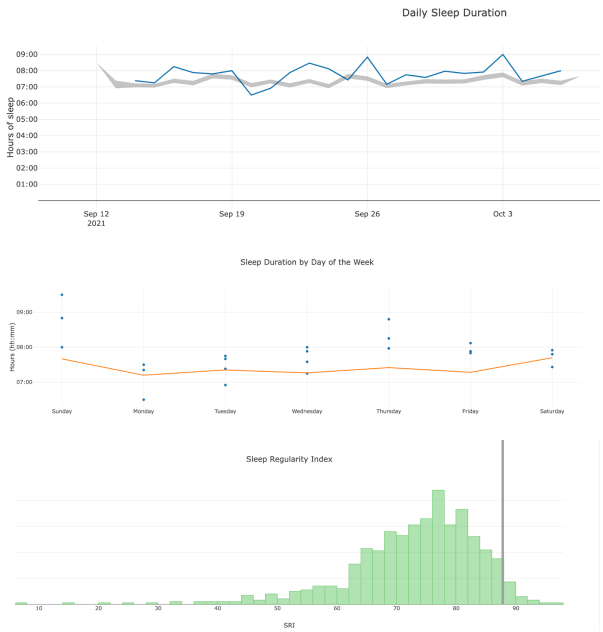
I collected my sleep data daily in the morning via the online diary. Every morning, I completed the online diary for that morning and for the evening before. I did not complete the evening diaries right before I slept because I wanted to minimize screen time at night. I do not believe that I am missing any days in my data.

I filled out every category of the online diaries to the best of my abilities, as I was and still am genuinely curious about my sleep and how my mood, my exercise habits, and my activities during the day are related to my sleep. I hope to use the correlations discovered in this data to improve my future sleep and well-being.

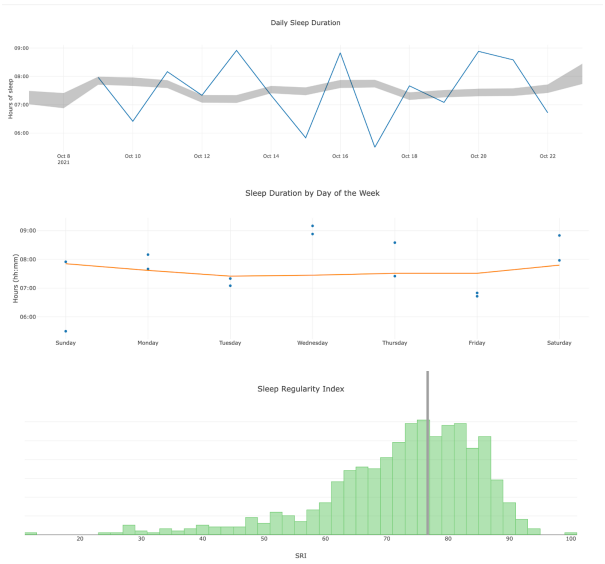
Besides self-reporting in the online diary, I did not use any other apps to track my sleep.

3 Results

3.1 Summary Reports



(a) Summary Report Figures from the First Three Weeks



(b) Summary Report Figures from the Last Two Weeks

Figure 1: Summary Report Figures

Quantity of Interest	My Average (hours:minutes)	My Standard Deviation (minutes)	Class Average (hours:minutes)	Class Standard Deviation (minutes)
Average Main Sleep Episode	07:47	33	07:07	104
Average Time in Bed for Main Sleep Episode	08:01	36	07:29	106
Total Sleep, Including Naps	07:50	N/A	07:20	108
Sleep Regularity Index	87.84		73	

Table 1: Summary Statistics for First Three Weeks

Quantity of Interest	My Average (hours:minutes)	My Standard Deviation (minutes)	Class Average (hours:minutes)	Class Standard Deviation (minutes)
Average Main Sleep Episode	07:31	65	07:20	108
Average Time in Bed for Main Sleep Episode	07:53	56	07:39	109
Total Sleep, Including Naps	07:43	N/A	07:31	112
Sleep Regularity Index	76.7		73	

Table 2: Summary Statistics for Last Two Weeks

As we can see from Table 1 and Table 2, on average, I had more sleep and a better sleep regularity when compared to the class average. However, the magnitude of the difference significantly decreased from the first three weeks of reporting to the second two weeks of reporting. In the first three weeks of reporting, my average main sleep episode was larger than the class average by 40 minutes. I slept 7 hours 47 minutes in my main sleep episode compared to the class average of 7 hours 7 minutes. However, in the last two weeks of reporting, my average main sleep episode was larger than the class average by 11 minutes. In this time period, my average main sleep episode was 7 hours 31 minutes, compared to the class average main sleep episode of 7 hours 20 minutes.

Moreover, my sleep regularity also decreased by 11.14 points over the past two weeks. My sleep regularity indices are both above the class average's (My first three weeks' sleep regularity exceeds the class average's by 14.84, and my last two weeks' sleep regularity regularity exceeds the class average's by 3.7), but the last two weeks are significantly less above than the first three weeks.

3.2 Question 1: Is the amount I sleep affected by the ending time of my latest extracurricular, academic, or exercise activity?

Intuitively, I thought that a later ending time of my latest activity would result in less total sleep.

3.2.1 Methods and Findings

I used Excel and calculated my total sleep during the day using the following formula:

$$\text{Total Sleep} = \text{Wake onset} - \text{Sleep onset} - \text{Awakenings} - \text{Sleep latency} + \text{Naps} \tag{1}$$

Then, I calculated the latest activity end time as:

$$\text{Latest Activity End Time} = \max_{a \in \text{activities}} (\text{start time of } a + \text{length of } a) \tag{2}$$

Note that I offset the data points so that I was analyzing the the latest activity end time and then my total sleep *for that following night.*

I found that there were a few data points that were missing any activities, so I removed them from the dataset. Then, I analyzed this data via scatter plotting Latest Activity End Time on the x-axis and Total Sleep on the y-axis, obtaining the following graph:

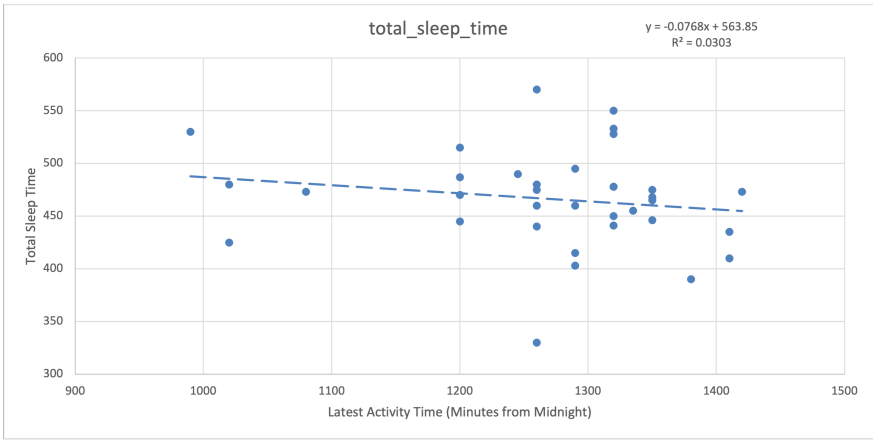


Figure 2: End Time of Latest Activity and Total Sleep

However, I noticed that the four data points on the left may be misleading, since they suggest that the latest activity I participate in is very early on in the day. However, I remembered that I only documented scheduled activities, but activities such as dinners with friends would likely occur afterwards, so these data points would not really represent my latest activities. After removing these data points, I obtained the following graph:

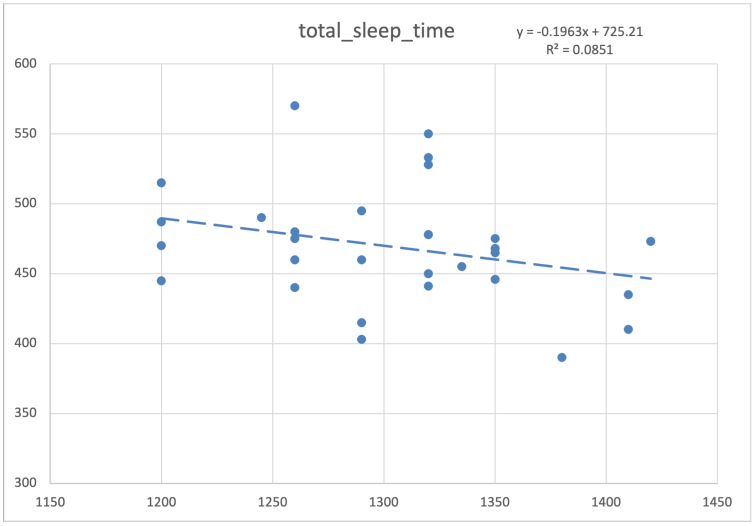


Figure 3: End Time of Latest Activity and Total Sleep

3.2.2 Interpretations

As we can see from the two graphs, there is a negative correlation between the end time of my latest activity and my sleep the following night. In other words, generally, the later the end time of my last scheduled activity, the less sleep I get the next night. This result is expected, since if an activity runs late into the night I am likely to be actively thinking and processing and unable to sleep until later, so my sleep will likely be shorter. There is also a stronger correlation in the scatter plot without the 4 points with very early start times, as expected (since those four points do not accurately represent my latest activity end time).

3.3 Question 2: Is the amount I sleep affected by whether or not I exercised?

Intuitively, I thought that exercising should either increase my sleep time or increase its consistency.

3.3.1 Methods and Findings

I used Excel and Python and calculated my total sleep during the day using Equation (1). Then I separated the data into two categories: those in which I exercised, and those in which I did not. I then plotted relative frequency histograms for total sleep the following night for each of the two categories (exercised and did not exercise) and also obtained the average total sleep for each category. This resulted in the following:

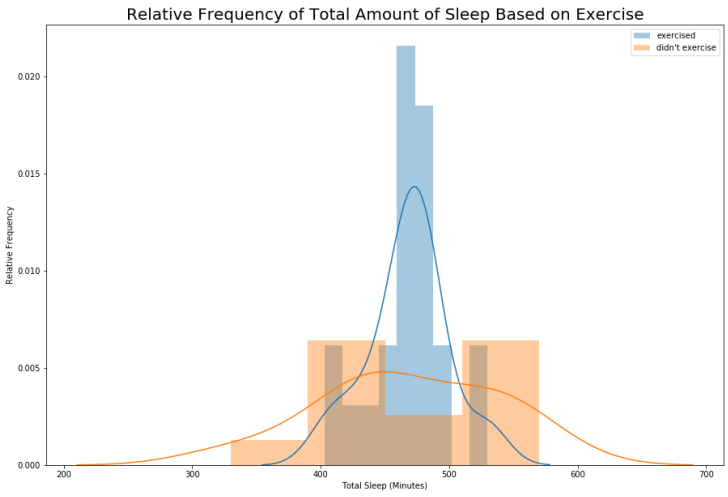


Figure 4: Exercise and Total Sleep

Category	Average Total Sleep	Total Sleep Standard Deviation
Exercised	07:48	30.16
Did Not Exercise	07:48	66.65

3.3.2 Interpretations

The averages for exercising and not exercising are actually the same, which was quite surprising! However, the standard deviation is much larger for when I don't sleep and when I do sleep. This suggests that exercising is correlated with having a consistent sleep schedule. The plot is supportive of this, as we see a very wide spread of total sleep times for the didn't exercise category, and a much narrower spread for the did exercise category.

3.4 Question 3: Does my Total Sleep Time affect my Sleep Latency the Next Night?

Intuitively, I thought that sleeping more one night would result in me being able to fall asleep less the next night, so my sleep latency should increase.

3.4.1 Methods and Findings

I used Excel and Python and calculated my total sleep during the day using Equation (1). Then I plotted a scatter plot of total sleep on the x-axis and sleep latency the next night on the y-axis. I then fit a linear regression model to the data and plotted the trendline. This resulted in the following:

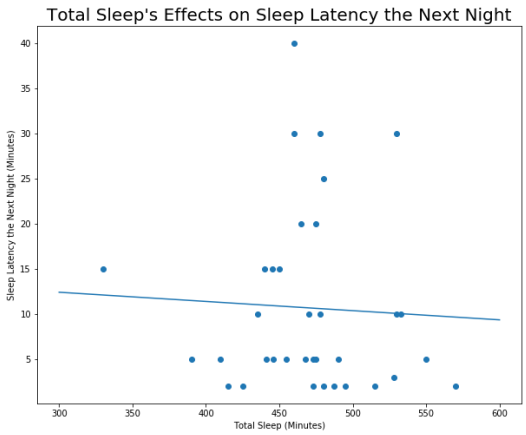


Figure 5: Sleep Latency and Total Sleep

3.4.2 Interpretations

From the graph, we see that there is a not a significant relationship between sleep latency and total sleep. I also believe that this data is particular hard to perform inference and analysis on, since there are times when I don't remember how long it took me to fall asleep. Thus, many data points are very noisy estimates of the true data. Assuming the data is accurate, total sleep and sleep latency the next night do not have a direct relationship.

4 Discussion of Sleep Challenge

I did not complete the sleep challenge. In fact, I slept less on average than in the first three weeks of data collection. My main sleep episodes were less by 16 minutes, and my total sleep was less by 7 minutes. The challenges that led to this result were the increased number of deadlines, activities, and work to do during the middle of the semester in contrast to the beginning. For example, the middle of the semester generally contains midterm exams and papers, while the beginning of the semester does not. This forced me to give up sleep in order to complete these assignments and finish my tasks under stressful deadlines.

My sleep regularity index also decreased by 11.14 points. Late nights became a little more common with the aforementioned deadlines. Moreover, there was this short period in the two weeks when my sleep was slowly drifting later, so I attempted to change my sleep schedule back to its normal state. However, this attempt was too drastic (i.e. shifting from 8am wake up to 6am wake up), and I ended up not being consistent. I suspect this also decreased my sleep regularity index.

5 Conclusion

Based on my results, I believe that the major factors that decrease my quality of sleep at night are not managing my academic deadlines wisely (Section 4), having too many activities that end late into the night (Section 3.2), and not exercising (Section 3.3).

I intend to try to change my daytime lifestyles so as to increase my quality of sleep, via creating even more routine exercise schedules, refusing to schedule activities past a certain time, and attempting to amortize my academic work across many days instead of staying up late to complete assignments.

I plan on tracking my sleep via journaling, as I believe that this will be the most free form way of expressing factors that I believe will have had an effect on my sleep. However, I do intend to keep some form of regular structure in the journal (e.g. keeping track of the time of sleep and the time of waking up).