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Of Rats and Men: A Discussion of the Relationship between Sleep, Environment, and Anxiety

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OF RATS AND MEN: A DISCUSSION OF THE RELATIONSHIP BETWEEN SLEEP, ENVIRONMENT, AND ANXIETY

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Chapter 1 - Introduction

Being asked to write a thesis is a daunting task. What topic could I explore that I am that passionate about and interested in? A year ago, I was asking myself that very question. I racked my brain, looking for inspiration from anyone, anything, and anywhere. One day, one of my friends was talking about writing a thesis on sleep, speaking in jest because he thought no one would take it seriously. However, I latched onto this idea. I thought about it more, and eventually, I thought to myself, "Why not?" I have always enjoyed the activity of sleeping in and of itself, particularly afternoon naps. One of my future goals is to possibly become a neurologist who specializes in sleep disorders, or even become a sleep medicine specialist. This would be the perfect chance to learn more about sleep, so I came to embrace this idea.

Whenever I get a good night's rest, I am more capable of thinking clearly. This is evident in how it affects my ability to learn and remember information, my attention span and alertness, my emotional stability, and my energy levels. I am also less anxious (that is something I will discuss later). During the three nights of a trip to conference and the one night before the trip, I obtained a combined 14 hours of sleep. Needless to say, the ramifications were not fun and lasted at least a week. This experience alongside my daily experiences with lack of sleep served as my inspiration. On a side note, it is also particularly ironic that I should be exploring sleep in such detail, when my very exploration is one of the reasons why I have and will be losing sleep.

Stemming from this fascination with sleep, I started looking at the environment surrounding me. Being a college student, sleep is not always easy to come by. Some

weeks, it is a luxury to get eight hours, if even six hours of sleep. Whenever I talk to my peers, I always hear about how little sleep they got or the sleep problems that they are suffering from. Hearing this made me realize how unhealthy this lack of sleep is for us. All this affirmed how not only does this issue interest me, but it also has a lot of relevance in the world around us.

A thesis on sleep is fascinating. Yet, it is far too broad and has the potential to become uninteresting if left too big as I realized repeatedly early on. It was then that my advisor, Dr. Mark Basham, suggested that I find a way to physically test and quantify my question. Many findings about human health and behavior have originated from studies with rats, so there was no reason (aside from approval and funding) why I could not attempt this, too. I started to think of my topic in more scientific terms, Instead of simply narrowing down, I started trying to find other variables to put sleep into conversation with.

Sleep has a relationship with many factors, one of which is the environment in which we live in. My question soon became, what is the relationship between sleep and the environment, particularly socioeconomic status (SES)? As I will explain later, SES is not synonymous with environment. However, due to its encompassing nature, much of what can inferred from SES can be translated into the environment that surrounds you. When I thought about how to translate this into rats, my advisor shared with me an example about a past student who had studied rats and the environments that they lived in. A student decided to investigate how an enriched environment, that is, an environment with more room, social interaction, and stimuli, would affect the rats. From here, I went

to the literature and found that there does exist a relationship between sleep and the environment.

I initially did not think about having a third variable. However, there was one problem: if sleep and type of environment were both independent variables in my experiment, what would be the dependent variable? After some discussion, testing the levels of anxiety stuck with me. I am not talking about a generalized anxiety disorder, but rather, the various levels of anxiety that we feel everyday, As I mentioned above, whenever I do not get enough sleep, I feel anxious. Anxiety unhinges me, for it is something about the racing, pulsating sensation that results from anticipating the future that makes me unable to focus or be productive if it gets too severe. Inspired by my own experiences with anxiety, I decided to pursue a better understanding of this relationship. On a more practical note, anxiety is also easily quantified in rats by using a simple test, so it was the perfect variable to explore.

These variables are interesting to me, but they are also relevant to our society. College students, professionals, and even younger children now are not getting the sleep that they need. For most adults, it is recommended that 7-9 hours of sleep be obtained per night (Hirshkowitz et al., 2015). However, there is increasing evidence that they are not obtaining enough sleep. At least 1 in 3 American adults are not sleeping well on a regular basis (Liu et al., 2016). About 45 percent of Americans also say that a lack of sleep or poor sleep have impaired or hindered their daily activities once in the past seven days (National Sleep Foundation, 2014). In my own life, many of my friends obtain, on average, 6-7 hours of sleep a night. Even then, that sleep is not necessarily quality,

uninterrupted sleep. This lack of quality sleep leads to a variety of negative effects occurring. Some of these effects include impaired cognition, issues with metabolism, and affected mood among others. The importance of these and other negative occurrences will be discussed in further detail in Chapter 2.

SES is closely linked to health and life outcomes (Oakes, n.d). Therefore, to live a healthy life, it helps to improve in SES, but to improve in SES, it also helps to increase in health. Sleep, one important facet of health, is relevant in this relationship. I have been blessed with a life where I do not necessarily have to worry about the immediate future regarding my needs. The environment surrounding me may become stressful from time to time, but I do not have to live in a constant state of hardships. Knowing this, I can only wonder what people of a low SES may go through when considering the stressful, tough environment that surrounds them. In this context, it is interesting to consider what sleep and anxiety can contribute/how they can exacerbate the negative effects of the environment.

Not forgetting anxiety, it is something that we experience on a day-to-day basis at varying levels. However, some days, anxiety could go from being a nuisance to being debilitating. When encountering more stressful situations, feelings of anxiety become more prominent. Environment plays a prevalent role in anxiety. Depending on the environment you live in, there are stressors that could easily contribute to anxiety. Sleep and anxiety, both related in the sense of health, could wreak havoc if the impairment of one also leads to the impairment of the other. If we could better understand amount/quality of sleep as well SES lending to quality of the environment, this could

help us in understanding anxiety, how it comes about, and how we could better alleviate it.

Above, I have justified why these variables are worth intellectual curiosity. However, when all of these questions come together, it is more than just a question about sleep, SES, and anxiety; it is a question about health and quality of life, as well as one that lends to larger sense of justice. Relatively speaking, for a decent proportion of the people in my life (as far as I know), as well as for myself, sleep, anxiety, and environment are not things that we have to worry about in a grave manner. For example, I do suffer from a lack of sleep, I do feel a lot of anxiety at times, and my environment can be tough and stressful from time to time. However, I take for granted the fact that I have the ability to easily remove myself from these situations, whether it be temporarily or permanently. There are other people, such a child who is born into a low SES neighborhood that cannot help some of the things that they experience in regards to these variables. In part, my thesis is inspired by my concern for others, the ones who cannot take these variables for granted due to the situation that they live in. The research in this thesis is intellectually relevant, as well as it is personally relevant to all of us because we experience the implications of sleep, SES, and anxiety. However, the child that is mentioned here is an example of what this research has to say about social responsibility. I will return to this child, along with other less fortunate individuals, later in my thesis to bring attention to the social implications of sleep, SES, and anxiety.

There are many things out there that give meaning to our lives. However, I will go as far as to say that good sleep is an important part of what it means to be human. If sleep

is so important, then so are the things that imperil it, such as environment and anxiety. Therefore, it is important to me to investigate this manner in a more analytical and scientific manner, while also bridging connections from the answers of this investigation to the larger human struggles.

Chapter 2 - Variables

Sleep

Sleep is one of the most important activities that we partake in on a daily basis. We need to sleep so that we can rest and have energy for the next day. Sometimes, sleep is needed to save energy. For example, mice have very fast metabolisms. Therefore, most of their day is spent foraging, feeding, and grooming. Mice sleep when they have finished all these tasks and have nothing left to do, but also, so that they can conserve energy (Horne, 2007). In fact, sleep is so needed that we will go to great lengths to obtain some sleep. One example would be of dolphins. Dolphins have to continue swimming and surfacing for air every few minutes in order to breathe. However, they must sleep. Therefore, they engage in microsleep, meaning that half of the brain is sleeping, while the other half is maintaining these essential processes (Horne, 2007). Grounding the importance of sleep in humans, I have heard many stories of people desperately searching for times and places to sleep. People I know will bring blankets and pillows into their car to have a 15-minute nap. I, myself, have once sought out a little nook in the library to nap in between classes. All living organisms crave sleep, as it is critical in saving and developing energy and crucial in efficient functioning.

The brainwave activity when humans are awake is different than when they are asleep. There are two different types of sleep, rapid eye movement (REM) and non-rapid eye movement (NREM). These types alternate with each other throughout a sleep cycle, which should last approximately 90-100 minutes. (Lockley & Foster, 2012). Therefore, in order to get an adequate amount of sleep, we must go through four to five full cycles a

night, of which the five distinct stages of this cycle are: 1) NREM 1, 2) NREM 2, 3) NREM 3, 4) NREM 4, and 5) REM. NREM 3 and 4 compose slow-wave sleep (SWS), and REM is also known as paradoxical sleep (PS).

Sleep is a complex process, so there are ample opportunities for sleep being shortened or interrupted. As mentioned before in Chapter 1, there are particular recommendations for sleep amount depending on the age group. However, due to a variety of reasons, the world we live in does not make it quite as easy to obtain this amount of sleep. We work and study more, run errands, participate in clubs and organizations, spend time socializing, focus on sharpening our hobbies, etc. all in the hopes of making our lives more well-rounded. However, this comes at cost of getting an adequate amount of sleep. sleep disruption, can occur not only due to commonplace interferences, but also due to sleep disorders and medical conditions. Waking up and going to sleep at different times every day also throw off our bodies, making it harder to sleep uninterruptedly. We wake up multiple times throughout the night. When this happens, we are disrupting our sleep cycles, which make it harder to obtain the correct amount of sleep needed as well the benefits that each stage of sleep can provide.

Experiencing disrupted sleep leads to a variety of physical problems. For example, sleep is key in energy metabolism. When humans get less sleep, more energy is spent. However, there is also an increase in energy intake because dietary restraint decreases. This plays a big factor in being overweight or developing obesity (Markwald et al., 2013). In both objective and self-reported measures, people who have a shorter sleep duration are often more prone to adverse cardiometabolic outcomes, such as

hypertension and diabetes mellitus (Grandner, Chakravorty, Perlis, Oliver, & Gurubhagavatula, 2014). This is not to mention the fatigue and sluggishness that we have all experienced due to not obtaining a good night's rest. In terms of pain, routinely having insufficient quality or quantity of sleep may not only lead to earlier onset of pain, but also an intensification of the pain (Haack & Mullington, 2005).

There are also some key negative effects of sleep disruption on mental and emotional activity. With less sleep, there is also a decline of alertness and cognitive functioning, caused in part by a decrease of activity in the cortico-thalamic network that regulates attention and more complex cognitive functioning, as well as a decrease in metabolic activity of the basal ganglia and limbic regions (Thomas et al., 2000; Wu, Gillin, Buchsbaum, & Hershey, 1991). Optimistic outlook and psychosocial functioning are also hindered due to lack of sleep (Haack & Mullington, 2005). Also, there is a stronger chance of experiencing a negative affect, in other words, being in a bad mood when your sleep is impaired. Having lower accuracy and speeds on a vigilance task due to less sleep also indicates an affected attention span and awareness level (Taub & Berger, 1973). Lack of sleep also acts negatively upon autonomic function, neuroendocrine stress networks, and response to stress. Therefore, this potentially causes an individual to be more stressed or feel more stress (Meerlo, Sgoifo, & Suchecki, 2008). These deleterious effects due to not obtaining adequate or quality sleep have the ability to harm our overall health, therefore, we should be aware of how important it is to sleep well and sleep a lot.

In the introduction, I briefly mentioned the issue of sleep as relevant to a child born into a low SES. We may not immediately imagine sleep as having an important impact on a person's prospects in life, but as demonstrated above, it has clear ramifications. On the other hand, most people would agree that SES impacts said prospects. In the next section, I explore research on SES as an environmental factor as an introduction to its important relationship to sleep.

Socioeconomic Status (Environment)

What is SES? According to the American Psychological Association (APA) (n.d.), Socioeconomic status (SES) is, generally speaking, a measure of education, income, and occupation for an individual or group. This is then carried over to defining the social standing or class of said individual/group. When looking at the factors of education, income, and occupation, it seems clear what the connection is between these variables. While each of these variables has an interaction with each of the other variables, it is commonly believed that higher education, higher income, and better occupation all lead to a higher class of life, in other words, a higher "social standing." SES is not an environment in itself, but the characteristics of the different classes of SES are reflected in the type of environment that you find yourself living in. SES is one's ability to access resources, such as financial, social, human capital, neighborhood, and educational (NCES, 2012). Your background of work and education is important in SES, but so is your ability to obtain "resources," which are the things that you need to be sustainable. Oakes and Rossi (2003) also have a similar viewpoint, but they make this construct more tangible by naming "resources" to be concepts such as healthcare, leisure time, friendship connections, and power.

While I will not be doing a comprehensive investigation into the multiple levels of SES, I will be examining some of the differences brought out by low SES versus high SES. With the inequalities in wealth and quality of life, the differences between levels of SES are exacerbated, and mobility is difficult to achieve. Based on the variables discussed above, some of the correlates are lower education, poorer health, poverty, and a

minority race (APA, n.d.). For example, in terms of health, low levels of SES are associated with worse overall health, whether it be in adolescence or as an adult, when compared to advantaged individuals (Adler & Ostrove, 1999).

Now that we are armed with a working definition of SES, it is important to draw a connection between SES and environment. Many of the factors that is associated with a certain SES tend to define the surrounding environment. Low SES is correlated to social and environmental factors that are related to chronic stress burden (Baum, Garofalo, & Yali, 1999). These factors include discrimination, crime, and crowding among other conditions. As stated before, SES on its own is not equivalent to environment. However, the negative correlations of SES, such as poverty, low income, less education, and poor health are also associated with a less than desirable environment. When you think of crowding, crime, and noise pollution, these are situations that you would tend to avoid because they cause many issues ranging from added stress to adverse health. However, people in a low SES are less likely to escape these situations because they do not have the means to do so. Therefore, this low SES and negative environment continue to feed into one another.

As a general simplification for the purpose of this study, people of a low SES are also those who live in a less desirable environment with more negative aspects and correlates. Now, with the connection between SES and environment established, we can move forward with a look between SES and sleep, as well as SES and anxiety. What is the correlation between amount/quality of sleep and level of SES? Is the relationship between level of SES and level of anxiety causal? If, again, we keep in mind the child

with a low SES and potential sleep issues, we can see that answers to these questions will have profound implications for her life. Before we do that, there is one more key component to define: anxiety.

Anxiety

Anxiety is a feeling that most humans will encounter daily. In small, controlled doses, anxiety can be positive and healthy, keeping us grounded and focused on the future. However, in larger doses, anxiety can be impairing, even debilitating if it gets too severe.

What exactly is anxiety? The anxiety that I will be discussing, as I mentioned before, is not necessarily the one that is present in psychological disorders such as generalized anxiety disorder or obsessive-compulsive disorder. Although the anxiety I am talking about can be present in these disorders, it is more generalized and applicable to the entirety of the population. The most technical definition of anxiety comes from the *Diagnostic and Statistical Manual of Mental Disorders* (DSM). Anxiety is future-oriented. When we anticipate a future event, multiple scenarios run through our minds about how something could turn out. This future event could be a good event, but more often, it is typically something that we may perceive to be dangerous or unfortunate. Our minds and bodies take on the stress that results from this anticipation. There are dysphoric feelings of unease or dissatisfaction, as well as a somatic feeling of heaviness and tightness (American Psychiatric Association, 2013).

Anxiety is also interlinked with worry. A study conducted on 128 university students and working adults ages 18-59 found the following results: 38% of participants stated they had spells of worry at least once a day and 19.4% said they had spells once every two to three days. 9% of participants had spells lasting two or more hours, 11% lasting one to two hours, 18% had lasting between 10 and 60 minutes, 38% lasting from

one to ten minutes, and 24% lasting only a minute or less (Tallis, Davey, & Capuzzo, 1994). As we can see here, many people worry in different frequencies and durations. Worrying less and shorter periods of time is most likely not dangerous and indicates some level of anxiety, but a healthy amount. However, when the worrying becomes very frequent and lasts a couple of hours, this has implications of a debilitating anxiety that could affect overall quality of life.

One explanation of anxiety comes from cognitivism. Cognitivism claims that anxiety occurs when you appraise a situation and your senses pick up on something that could be potentially worrisome. If our brains perceive the threat to be something that we might not be able to handle, then anxiety rears itself (Freeman & Freeman, 2012). The severity and occurrences of our anxieties are then shaped by our schematic beliefs, which are made up of our habitual thought processes, our preconceptions, our ideals, our rationale, etc. (Beck & Emery, 1985). Essentially, our anxieties are shaped by how we think, which is affected greatly by the environment you are exposed to and what you are taught.

Another explanation of anxiety derives from neurobiology. While we have increased much knowledge about anxiety in terms of neurobiology, we still have a long way to go before we can pinpoint the exact mechanism. For now, we have some strong theories about how this occurs in our brains. Key structures and regions involved in a circuit are the prefrontal cortex, the hippocampus, the amygdala, and the insula (Damasio et al. 2000). Anxiety occurs when our amygdala, which can cause unconscious feelings of anxiety, is working too much and makes quick appraisals (LeDoux, 1998). This can act

by itself or in tandem with our prefrontal cortex, where executive functioning and higher thought process occur, not working well enough. If our prefrontal cortex does not process the sensory information relating to anxiety, then our amygdala will continue to make these anxiety-causing appraisals. Overall, there are many structures in the brain that are active in causing anxiety, and they function together in a complicated system.

Some of the effects of anxiety listed above include feelings of dissatisfaction, unease, and worry and tightening and weighing down of the body. Feelings of fear and terror can also accompany this. There are also other physical manifestations such as paleness of skin, sweating, dilation of pupils, heavy pounding of the heart, tension in muscles, rapid breathing, tendency to be startled, and so on (Marks, 1978). Many of these acute changes occur due to a release of corticotrophin-releasing hormone (CRH), a stress releasing hormone that is activated in times of stress and duration. Gamma aminobutyric acid (GABA), however, is able to placate our anxiety (Freeman & Freeman, 2012). These acute changes will not have lasting effects if given time to recover, but if you experience anxiety for too long of a period, these effects become unhealthy. Depression, restlessness, loss of appetite, avoidance of stressful situations, and most relevantly, negative impact on sleep, are some of the effects of long-term anxiety (Marks, 1978).

Aside from the technical language, another similar and possibly more relatable perspective summarizes that anxiety makes us feel as if we trapped in a tight corner. Even though there are no apparent signs of danger, we still feel threatened (Marks, 1978). When you are backed up in a tight corner, you feel as if there is no escape, and the things that you are anxious about come at you from every side. These anxieties might not even

be conscious to you, but you definitely feel the effects, from the sweaty palms and the heart pounding of your chest feeling to the racing thoughts and swirling emotions. If left too long in this state, you do not know what you will do. Anxiety, a very powerful emotion, has a multitude of causes and effects, and it is very relevant to each of us in our daily lives. With this definition in mind, we proceed onwards to establishing the relationship between these variables.

Chapter 3 - Relationships

Sleep & SES (Environment)

As fortunate as I have been in my life, things were not always that way for my family. Both of my parents, immigrants who fled the Vietnam War and its aftermath, started over in America. Refugees with little to no money, large families, and few resources, they were immediately considered to be in a low SES. When you live in a crowded environment, work night shifts or even two part-time jobs, worry about yours and your family's future, and reminisce about your past struggles and terrors, how are you supposed to obtain enough sleep, much less obtain quality sleep? If you cannot sleep, then how do you remain healthy and able enough to go to work and take care of your family (not to mention combat long-term health consequences), or how do you have the mental stamina and emotional ability to deal with your less-than-ideal situation? Both of my parents and some of my aunts, uncles, and cousins have dealt with these problems to varying degrees. Some still face these problems to this day, years and years after they have settled in America.

SES has a strong effect on health. People with a high SES tend to have more education, which is associated with a higher income, which is associated with better physical health (Moore, Adler, Williams, & Jackson, 2002). People in a low SES are more at risk for negative health issues such as mental disorders, cardiovascular problems, and infectious diseases because they are less likely to have access to education about some of these health issues, or they do not have the means to prevent or treat them (Moore, Adler, Williams, & Jackson, 2002).

While people with a low SES are more susceptible to these problems than those people with a high SES, sleep quantity mediates some of the effects of mental and physical health, and furthermore, sleep quality plays a role in alleviating the negative effects of income on mental and physical health (Moore et al., 2002). Sleep, while important to all humans, is even more important to those with a low SES when considering how their circumstances and lifestyles put them at higher risk for certain diseases and disorders, such as cardiovascular problems and mental disorders as mentioned above. If we better understand sleep quality and quantity for someone who has a low SES, then we have a better chance at improving their quality of life through better health.

A large number of people with a low SES live in urban neighborhoods (although, many live in rural areas). Two studies, although almost 30 years apart, show similar results about sleep for people with a low SES who live in an urban environment. Out of 1645 individuals in an urban Florida county, over one-third of the participants in a survey have trouble with sleep. The greatest population that struggles with sleep are those with a low SES, particularly older non-single females. Young females at a low SES also have the most problems with nightmares (Karacan et al., 1976). Some of these troubles might be in part because of the lifestyles attributed to someone with a lower SES living in this type of environment.

The conditions of a low SES neighborhood are not ideal for obtaining ample, peaceful sleep. A later study makes more speculations as towards why problems with sleeping are present in those with a low SES living in an urban environment. In 371

adults living in urban, low-income housing in New York, many have low sleep quality, sleep disturbances, and prolonged sleep latency. The reasons for this include crowding in homes, neighborhood chaos and disorder, and problems with the building e.g. unpleasant smells, litter, dark and dirty stairwells, etc. (Chambers, Pichardo, & Rosenbaum, 2014). Hearing loud neighbors, experiencing stress in a tense and violent environment, living with too many people, and feeling unsafe due to issues with the physical building are just some examples of why sleep problems are so common in urban, low SES environments. The relationship that is depicted between SES and sleep here is that a low SES environment adversely affects sleep.

Aside from the physical environment component of SES, there are also other elements of SES, which define a larger environment, that interact with sleep. Some components of SES that have a strong relationship with sleep issues are low income, low educational status, unemployment, and living in public housing (Arber, Bote, & Meadows, 2009). Among these, being unemployed while also having a low education level correlate with having more sleep problems. These disadvantages cause more sleep problems potentially through intermediary mechanisms such as increased stress, poor health, and environmental circumstances (Arber et al., 2009). The presence of components of low SES does not necessarily indicate a causational relationship with sleep, but it does demonstrate a correlational relationship between the two variables. The tangible and more figurative elements of SES correlate with quality and quantity of sleep.

After looking at the relationship between SES and sleep in adults, we now shift our focus to examining the effects of this relationship in children. The effects are mainly

seen in academic performance and achievement, a central domain for a child. When a child experiences some kind of emotional insecurity, commonly routed in family issues, it is associated with decreased quality and quantity of sleep. However, in children with low SES, these sleep problems are more likely to negatively affect academic achievement (El-Sheikh, Buckhalt, Keller, Cummings, & Acebo, 2007). Sleep is critical to cognitive processes essential to academic achievement. When sleep is compromised in children of a low SES, as mentioned above, they struggle academically, which could serve to broaden the achievement gap between children of a lower SES and those of a higher SES (Buckhalt, 2011). This is a clear example of the correlational relationship between sleep and SES. While it can be hard to pinpoint whether inadequate sleep causes a low SES, or a low SES leads to poor sleep, it is seen in children that this relationship, when gone awry, can have negative consequences. If children in a low SES struggle in school due to lack of quality sleep, then they are more likely to remain in a cycle of low SES. In this cycle, they will continue to struggle with sleep and health overall, with receiving an adequate education, with living in a safe, positive environment, and so on. This all feeds back to one another, leading to the effects of poor sleep and low SES to exacerbate the situation.

A low SES can lead to living in an environment that is less likely to facilitate a decent amount of quality sleep. The demands of the circumstances and a chaotic and hectic physical living environment are among some of the factors that lead to disrupted sleep. On the other side, less quality sleep can increase the risk of poor health and low academic achievement as, some of the many elements that may lead to a low SES. In the

next sections, we will introduce anxiety as an additional variable to these two factors, further discussing how sleep and SES shape anxiety.

Anxiety & Sleep

During my finals week of Fall 2016, I first-hand experienced the interaction between anxiety and sleep, and the effects of that interaction having gone slightly awry. Between all the finals, papers, and projects due, as well as other life commitments to take care of, naturally, my anxiety levels were a little bit higher than an average week. When I was anxious, it was not easy to relax. At night, I was tired, but because my mind was racing with thoughts, I found it a little harder than usual to fall asleep and stay asleep throughout the entire night. Since I could not sleep and experienced sleep restriction, I was naturally more anxious. However, I surely experienced a little more stress at the thought of getting less sleep and not having enough energy to get through my day efficiently. I am not alone in this struggle by any means, as many of my peers experiencing finals week, as well as people living their lives all over the world experience this interaction daily. It is hard to tell whether the lack of quality of sleep is what causes a higher level of anxiety, or if it is the higher level of anxiety that makes it harder for us to obtain some quality sleep. Based on the evidence compiled from research studies, there is certainly a relationship between the two, with support for both sides of the argument.

Issues with anxiety and sleep are not something only seen in patients with clinical problems; rather, they are also seen in a general, nonclinical population. there is a high interrelatedness between anxiety and sleep complaints (Spoormaker & Bout, 2005). While there are a large variety of sleep complaints, insomnia and narcolepsy are the most connected to anxiety complaints, particularly worrying and rumination (Spoormaker &

Bout, 2005). This not only indicates that there is indeed a relationship present between presence of anxiety and quality of sleep, but there are even specific complaints linked to one another. They present the idea of addressing both sleep and anxiety complaints, when necessary. By considering both types of complaints, there opens up potential new treatment/coping strategies that will help alleviate at least one, if not, both of the problems.

Anxiety has a negative effect on sleep. Anxiety has been identified as an etiological factor in not being to sleep (Haynes, Follingstad, & McGowan, 1974). in general, anxious participants have a shorter duration of sleep as well as a lower quality of sleep than normal participants (Rosa, Bonney, & Kramer, 1983). They spend less time in stage 4 sleep and REM sleep. There is also a decreased latency to REM sleep. Less stage 4 sleep, decreased latency to REM sleep, and higher numbers of awakenings all correlate with higher levels of anxiety (Rosa et al., 1983).

So far, we have looked at the correlation between quality and quantity of sleep and levels of anxiety. However, there exists an important causal relationship between sleep and anxiety. Sleep-deprived people report an overall more negative affect than well-rested people (Talbot, McGlinchey, Kaplan, 2010). More specifically, they also have greater anxiety and worry more about potential catastrophes. The effects are not simply limited to adults as early adolescents, ages 10-13, are more anxious and feel more threatened by their main worries than their well-rested peers when they suffer from lack of sleep (Talbot et al., 2010).

We will next turn to the relationship between SES and anxiety. This pivot will allow us to see how important a healthy level of anxiety is for human flourishing, but also, how vulnerable this balance is to the external factor of SES. It will also give us a context for considering the broader social implications of SES and anxiety, in tandem with sleep.

Anxiety & SES (Environment)

Over the years, I have had some conversations with and have heard the stories of those living in a low SES. A common theme to these conversations and stories? Worry. An even more subtle theme? Anxiety. Of note are the stories I have heard from some of my extended family. One of my uncles and his family live in a low SES setting. My uncle, being the sole breadwinner, has worked a job on the weekday and another job on the weekend at one point. There was even an overlap between the two jobs when on Friday, he would finish his first job and then go immediately to his second job, getting no sleep for at least 24 hours. My uncle and his wife were constantly anxious. Living paycheck to paycheck, they were concerned about my uncle losing his job(s). They were worried about their children having a good education and living in a safe environment. Eventually, I could see the toll it had their emotional and mental well-being, and even to an extent, my uncle's physical health. Fortunately, they are doing better now. However, this is not the case for all families living in a low SES and experiencing the effects of continuous anxiety.

SES is one of the most important predictors in mental health, with a low SES indicating lower mental health than someone with a high SES (Warheit, Holzer, & Arey, 1975). A relationship between SES and anxiety exists where with increasing age, there is the widening of socioeconomic inequalities in anxiety. At the various stages of life, the incidence and persistence of anxiety differs based on different factors related to SES (Green & Benzeval, 2013). For younger adults (19-37 years old) with low SES and low education, not only will they be more likely to experience anxiety when compared to

other young people with high SES and high education, but this anxiety can lead to depression. For middle-aged adults (41-57 years old) and older adults (56-76 years old), education and social class are both factors in that those groups with low education and a low social class are more likely to experience incidence and persistence of anxiety (Green & Benzeval, 2013). An increase of incidence and persistence of anxiety due to SES inequalities as someone ages indicates that interventions in regards to SES inequalities should target people of this age, but it should also target people earlier in life in order to reduce the levels of anxiety.

While the prevalence and incidence of anxiety does increase with age, SES is still a risk factor for anxiety in young people, particularly those between 10-15 years of age. In fact, the prevalence of anxiety in youth with low SES is 2.49 times higher than youth with high SES (Lemstra et al., 2008). Having low quality education, not being able to access financial, social and educational resources, living in a disruptive neighborhood, and so on, are potential explanations as towards why low SES youth have higher anxiety than their high SES peers. Preventing as much negative anxiety as possible in youth is important, not only for their present health, but also for their future well-being. This anxiety could impact emotional development, as well as future educational and occupational progress (Lemstra et al., 2008). If educational and occupational progress is impaired, that also keeps the youth in a lower SES. Reiterating what was mentioned above, interventions to combat low SES inequalities at a stage early in life, potentially around 10-15 years of age, will help with future outcomes regarding anxiety and mental health, overall.

It is possible to minimize the negative effects of low SES and high anxiety. College students, right in between adolescents and adults, display effects of the relationship between SES and anxiety. Hopelessness is an example of a mediating factor within the relationship between SES and anxiety (Salami & Walker, 2014). The higher the level of hopelessness, the more likely the relationship between SES and anxiety will negatively impact the student. Inversely, having hope not only alleviates the impacts of high anxiety and low SES, but it fully mediates this relationship (Salami & Walker, 2014). There is still much more to discuss regarding solutions, but the idea of hope can be a mediator in itself, or it can lead to other potential mediators.

In the next chapter, I will discuss the experiment I conducted to test the relationships amongst three variables: sleep, anxiety and environment. Before moving on, I will flag key questions to keep in mind that are related to the practical implications of this research: 1) how will our findings in the experiment reflect what goes on in the real world, and what should we make of them? 2) how ought we to consider those less fortunate than us, such as the child with a less fortunate upbringing or the refugees of today and yesterday? and 3) what values can we pull from that help us transform the points brought up in this thesis from being words on paper to identifiable issues in the world?

Chapter 4 - Experiment

In previous chapters, I discussed the qualitative relationships of these variables in humans. Now, I will shift to discussing these relationships in a quantifiable manner. A way to quantify these findings on a smaller scale is through research with rats. Rats bear similarities to humans in terms of physiology and anatomy, including sleep patterns, so we are able to apply findings found in rats to humans (Toth & Bhargava, 2013).

Sleep disturbances increase anxiety in rats (MacLean & Datta, 2007). In rats with sleep deprivation, corticosterone (CORT) levels, a hormone that is present with the increase of anxiety, are increased as compared to rats with normal sleep (Tartar et al., 2009). There are also increased levels of adrenocorticotropic hormone (ACTH), another hormone present with the increase of anxiety (Suchecki, Tiba, & Tufik, 2002).

Rats that live in an enriched environment, i.e. a cage with enrichments items such as toys, larger space, and social interaction/group living, are likely to have longer sleep duration as well as more quiet sleep time than rats in normal environments or isolated environments (Abou-Ismali, Burman, Nicol, & Mendl, 2010; Mirmiran, Van Den Dungen, & Uylings, 1982). They experience a higher percentage of paradoxical/REM sleep and slow wave sleep, as well, leading to a higher quality of sleep (Tagney, 1973; Kiyono, Leo, & Shibagaki, 1981). The environment also interacts with the level of anxiety in a rat. Rats that live in an enriched environment have lower baseline levels of ACTH and CORT than rats that do not live in an enriched environment (Belz, Kennell, Czambel, Rubin, & Rhodes, 2003). Environmental enrichment reduces not only anxiety

levels, but also activity in brain regions that play a role in the response to anxiety in rats (Sampedro-Piquero, Zancada-Menendez, Begega, & Arias, 2013).

There has not yet been a study that examines the three variables of sleep, environment, and anxiety together. The primary aim of this study is to further understand the relationship between these three variables in male, Sprague-Dawley rats. I will manipulate two independent variables: type of environment and type of sleep. The first variable, type of environment, will have two levels of manipulation: 1) normal laboratory cage, and 2) enriched cage. The second variable, type of sleep, will also have two levels: 1) normal sleep, and 2) disrupted sleep. The dependent variable will be anxiety levels. I hypothesize that rats who live in an enriched environment and have proper, non-disruptive sleep will exhibit lower levels of anxiety compared to rats that live in a standard, lab environment and experience disruptive sleep.

Method

In order to test this hypothesis, I performed an experiment that was approved by the Institutional Animal Care and Use Committee (IACUC) and funded by the University Research and Scholarship Council (URSC) and the Regis University Department of Psychology and Neuroscience. The subjects were 20 male, Sprague-Dawley rats. The pups were received as littermates at weaning age (18-21 days) from Charles-River Laboratory.

From the beginning to end of the experiment, the rats received free access to food and water. The control group for sleep had a regular 12-hour light/dark cycle, and the group for sleep disruption had a reversed 12-hour light/dark cycle. Since there were two

independent variables each with two different levels, this was a 2x2 between-subjects study.

Table 1

Placement of rats into different conditions

Environment Condition	Sleep Condition	
	Normal Sleep	Disrupted Sleep
Normal Environment	5 rats	5 rats
Enriched Environment	5 rats	5 rats

Ten of the rats were assigned randomly to the enriched environment group**.** The enriched environment was composed of cages that are ones that were designed by another Regis student and have been used prior to this study. These cages were larger than a standard rat cage due to the fact that they were formerly birdcages. The large size of the cage allowed for multiple rats, five rats in this study, to reside in the same cage. The cages had a variety of different toys and equipment that allowed for the rats to have constant stimulation. The toys were rotated once a week so that the rats had new stimulation. The other 10 rats were living in the control, standard environment. The rats adjusted to their environment over 31 days. During the duration of these 31 days, I weighed them at least twice a week and checked on them daily to ensure that they were

growing properly. At the end of the 31 days, I began the sleep disruption portion of the experiment.

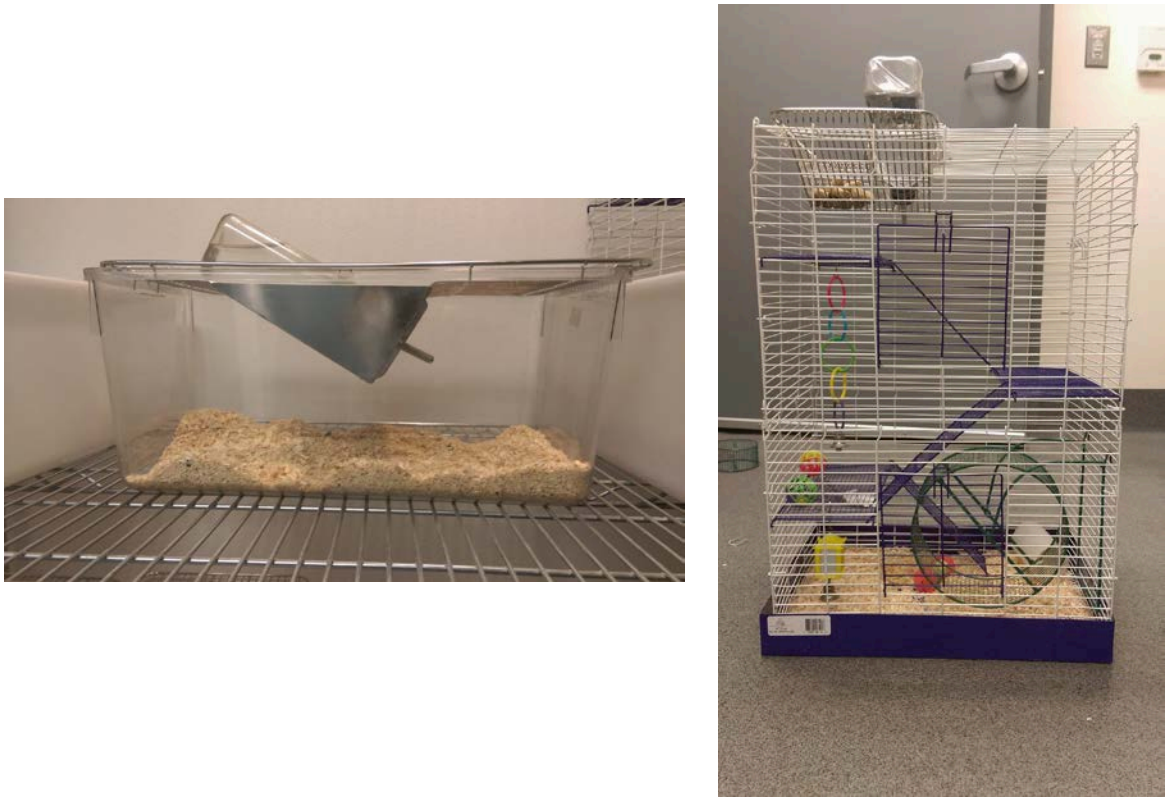

Figure 1. Normal rat cage (left), enriched rat cage (right).

To conduct sleep disruption, I used a forced treadmill exercise. Through this method, the rats were placed on a treadmill that forced them to keep moving in order to stay on the treadmill. I used a treadmill system that has three lanes, meaning that I had three rats on the treadmill at a given time. On the first day of the experiment, during their light cycle, I placed the rats in the sleep disruption group on the treadmills. The speed of the treadmill was set at a pace of 60 meters per minute. There was also a shock stimulus present at the end of each lane of the treadmill to keep the subjects moving on the treadmill. The intensity of the shock was set at 0.5 out of a 10-point scale, and the

repetition was set at a 3 out of a 10-point scale. They were placed on the treadmill for 10 minutes, and then taken off for 50 minutes. Then, the next three rats were placed on the treadmill for 10 minutes, and then taken off for 50 minutes. This was repeated for the next two groups of two rats. This was repeated for six hours (Hrncic et al., 2016; McKenna et al., 2007). On the second day of test, the rats in the control group for sleep, or the group that is getting a normal amount of sleep, was also placed on the treadmill. They experienced the same amount and pattern of exercise, but during their dark cycle so as to control for the exercise variable.

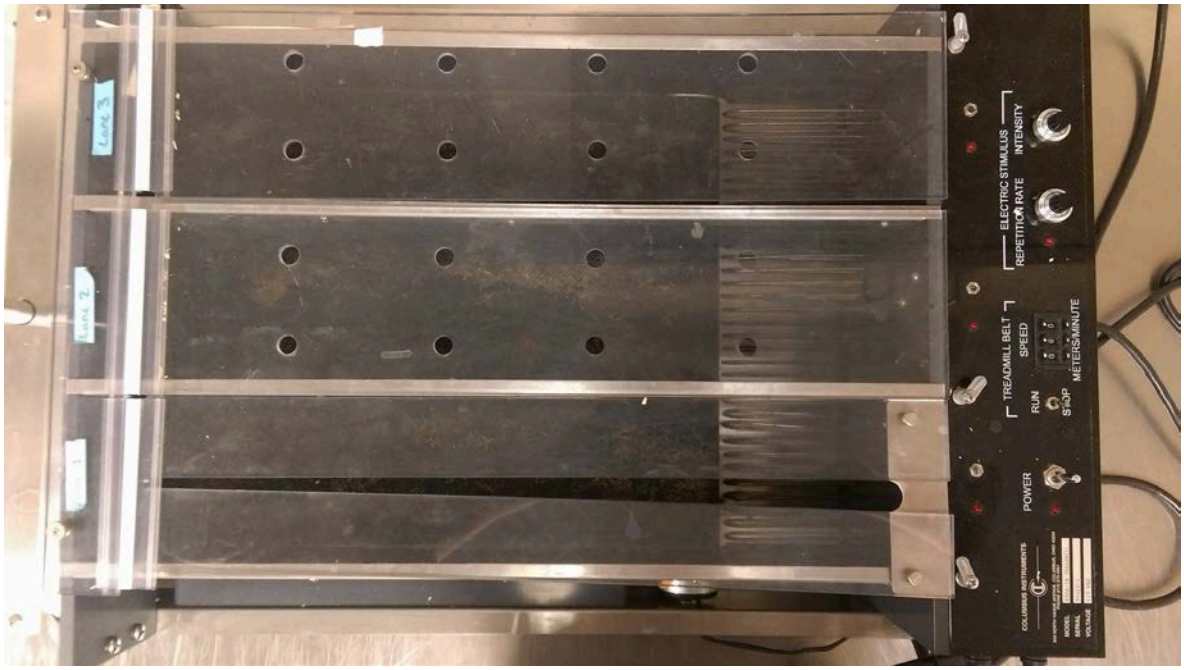

Figure 2. Rat treadmill.

Following the treatment, the rats experienced a three-hour recovery period. After this period, I used an elevated plus maze, a validated test, to quantify the anxiety of the subjects. The more time the subjects spend in the open arms of the maze, the less anxious

the subjects are (Doremus, Varlinskaya, & Spear, 2006). Also, I measured the number of times they crossed into the open arms, closed arms, and center. There was one maze, so I tested each rat for a ten-minute period.

Figure 3. Elevated plus maze.

Results

The means and standard deviations of the groups are presented in Table 2. For type of sleep, there was a significant main effect of type of sleep on seconds spent in open arms, $F_{(3,20)} = 7.421$, $p = .015$, seconds spent in closed arms, $F_{(3,20)} = 7.439$, $p = .015$, and number of entries into open arms, $F_{(3,20)} = 7.611$, $p = .014$. There was not a significant main effect of type of sleep on time spent in the center, $F_{(3,20)} < 1$, number of

entry points into closed arm, $F_{(3,20)} < 1$, and number of entry points into the center $F_{(3,20)} = 2.409$, $p = 0.140$.

For type of environment, there was a significant main effect of type of environment on seconds spent in closed arms, $F_{(3, 20)} = 12.632$, $p = .003$, and seconds spent in the center $F_{(3, 20)} = 10.069$, $p = .006$. There was not a main significant effect of type of environment on seconds spent in open arms, $F_{(3, 20)} = 1.910$, $p = .186$, number of entries into open arms, $F_{(3, 20)} = 3.267$, $p = .090$, number of entries into closed arms, $F_{(3,20)} < 1$, and number of entries into center $F_{(3,20)} < 1$. The interaction between type of sleep and type of environment was not significant on any dependent variable, $F_{(3, 20)} < 1$.

Table 2

Mean (with Standard Deviation) of Time Spent in Different Areas and Number of Entry Points into Different Areas under Different Conditions of Sleep and Environment

Type of Measurement	Normal Sleep, Normal Environment (n = 5)	Normal Sleep, Enriched Environment (n = 5)	Disrupted Sleep, Normal Environment (n = 5)	Disrupted Sleep, Enriched Environment (n = 5)
Seconds Spent in Open Arm	78.00 (38.24)	86.00 (64.20)	13.20 (13.37)	54.20 (22.91)
Seconds Spent in Closed Arm	418.80 (47.97)	340.60 (39.99)	495.60 (44.72)	398.40 (79.23)
Seconds Spent in Center	103.20 (22.24)	174.60 (50.38)	91.20 (40.57)	147.40 (58.36)
Entries into Open Arm	4.80 (2.17)	6.00 (3.74)	1.20 (1.30)	3.80 (1.30)
Entries into Closed Arm	11.00 (4.90)	12.60 (4.04)	12.00 (4.30)	10.60 (3.05)
Entries into Center	16.40 (6.77)	19.00 (6.40)	13.40 (4.28)	14.40 (3.85)

Chapter 5- Discussion & Conclusion

Interpretation of Experiment

Rats with normal sleep showed less anxiety by spending more time in the open arms, spending less time in the closed arms, and entering the open arms more than rats with disrupted sleep. Rats that lived in an enriched environment also showed less anxiety by spending less time in closed arms and the center of the maze as opposed to rats that lived in a standard environment. I interpret the latter part of the explanation as the rats being too anxious to move too much in any direction due to being unfamiliar with the surroundings, therefore, remaining in the center. Finally, there was not an interaction between sleep and environment, indicating that the effects of sleep state do not depend on the environment and the effects of environment do not depend on sleep state.

Aside from the results of the test, I also observed other potential signs of anxiety. The rats with their sleep disrupted were more fearful of and nervous around me than the rats with normal sleep. The former would run away when I approached them and squirm when I held them. The same was seen in rats who had lived in the normal environment for 30 days as opposed to the enriched environment.

Limitations of Experiment

In this experiment, I was only able to disrupt the sleep of the rats for one sleep cycle. However, stronger results than my current results may occur from conducting repeated sleep disruption over a course of time. If I could repeatedly disrupt sleep over a period of a few days, the difference between the rats that experienced disrupted sleep versus the rats that experienced normal sleep would be greater. Potentially, the rats with

the repeated nights of disrupted sleep will spend even less time in open arms than they did in this experiment.

It would be interesting to develop an experiment where there are not only two levels of environment, normal and enriched, but also a level that may be worse than normal (but not to the point of animal cruelty.) While my experiment demonstrated what an enriched environment could do for anxiety (decrease it), could a worse than normal environment, i.e. a negative/impoverished environment, increase anxiety more than the normal environment did in this experiment? This has the possibility of producing significance for the time the rats spent in open arms, which would produce a compelling case for environment affecting level of anxiety.

Aside from a behavioral measure, it would be useful to examine the presence of chemicals related to anxiety, CORT and ACTH, in the rats' brains using immunohistochemistry. If significant differences in levels of anxiety were found, we could then use drugs to test their effects on lessening anxiety due to sleep states and environment conditions. Overall, these methods could have produced significant results and added extra layers of information into my investigation. These methods could not be conducted in this experiment due to various constraints such as time, manpower, and money.

Application

Taking this back to the real world and applying the research from chapters 2 and 3, can the results that occur in rats be translated into and reflect what might happen in humans? The answer is yes, the statistics and observations from the rat model lend support to what has been posed throughout this thesis. Sleep has a causational relationship with anxiety. One night of sleep disruption in rats could be equivalent to the one night of sleep disruption in humans. If humans are like the rats, then we will surely become more anxious and exhibit behavior indicative of this. Moreover, if anxiety is already present after one night of sleep disruption, having repeated nights of disruption will cause anxiety to become a threat. Environment also has a causational relationship with anxiety. As with sleep, living in a low-quality environment for 30 days will not have long-term effects on us like it did with the rats, as our life cycles are longer than rats, so 30 days cannot carry over for face value. However, what this does mean is that living in a low SES environment over an extended period of time will eventually lead to humans becoming more anxious. If the rat model is indeed an accurate model for humans, this is worrisome because acute anxiety will cause humans to display more nervous, evasive, and fearful behavior than in normal conditions. Long-term anxiety, however, will lead to dangerous mental and physical health issues, such as those mentioned in chapter 2.

One part of my original points initially did not seem to hold throughout the experiment. The interaction between sleep and environment did not have significance, meaning that the effects of sleep on anxiety are not affected by the type of environment, and effects of environment on anxiety are not affected by the type of sleep. This turned

out to be a good thing. If an interaction between two variables was significant, then a certain result will happen only if the two variables interact in a particular manner. For example, in the normal sleep condition, the level of anxiety would be the same across normal and enriched environment. However, in the disrupted sleep condition, the level of anxiety would be higher in the normal environment than the enriched environment. This would not be what was desired since the goal was to support that sleep and environment affect each other regardless of levels of each variable. Without an interaction, this is supporting the correlation of sleep and environment across all conditions without exceptions.

The results from this experiment are interesting and stand on their own right. The various analyses and definitions from throughout this thesis are also deserving of intellectual curiosity. However, why does any of this matter? Why should you or I care about sleep, environment/SES, and anxiety, much less the relationship between the three? And of course, the touchstone question of the Honors Program at Regis: How ought we to live? To further discuss these points, I will utilize some of the key values that I have become familiar with throughout the past few years of attending Regis. The values that I am referring to are the six Key Values in Jesuit Higher Education, specifically, “unity of heart and mind,” “contemplatives in action,” and “men and women for and with others.” Together, these three values form the basis for transforming the results of my thesis into something that has social and practical bearings.

There are many unfortunate times where your actions do not have unity of heart and mind. In cases like this, an idea that has great intellectual worth is not done for the

good of the people, and an idea that is full of compassion and morality may not be well thought out in terms of philosophy or execution. Unity of heart and mind is what occurs when a person is educated and engaged. What you think and what you feel shapes your mission and informs your actions (Regis University, 2017). With my thesis, I hoped to tackle both of these sides. In my investigation of sleep, SES, and anxiety, I scoured through a lot of research to find intellectual and scientific support to help explain the relationships between these variables followed by what I determined as my hypothesis. Furthermore, science and math were the main backing for my entire experiment, from carrying out the procedure to analyzing the results. Through all this, I aimed to establish my topic as having intellectual credibility as backed by research. I wanted to educate myself and you, the audience.

However, that is not enough. I had to have a reason for why this engaged my heart, and why it should it engage yours, from a personal level to a societal level. We all have experienced issues with at least one of the variables of sleep, environment/SES, and anxiety at some point. Those problems affected our lives to varying degrees, ranging from mildly discomforting to painful disruption. I have shared various stories about how they have affected me. I want you to think about your own experience. Have you ever had a few nights of disturbed sleep leading to some crankiness and even anxiety? Or have you had a perfect storm of the three combined, when you are living in a low SES, cannot sleep well, and have disabling anxiety? Whatever your situation is, I believe that my thesis topic speaks to the heart about our own personal struggles. Yet, it also engages our hearts because it evokes a sense of empathy. There truly are children living in a low

SES who cannot obtain adequate sleep and experience unhealthy levels of stress. There really are refugees all over the world, past and present, my parents and extended family included, who are struggling to resettle, dealing with pressures from every angle. These pressures come from trying to remain healthy, which goes hand in hand with sleeping well, and improving level of SES, thereby living in a safe, conducive environment. These pressures cause refugees to be placed in a situation of high anxiety, which no doubt has negative consequences. All in all, this topic, is not merely an intellectual one; it is one that demands attention to personal and social justice struggles. If we can align the logic behind this topic with the passion giving cause to it, we achieve unity of heart and mind.

Proceeding from this, we must think about being contemplatives in action, which is composed of two parts. We must spend time in reflection and develop our thoughts and philosophy, especially in regards to social issues. However, they cannot remain just that; rather, we must execute action in addressing those issues (Regis University, 2017). Becoming educated and engaged in this topic is a huge step in the right direction. For me, that means that I understand the logic and facts behind the nuances of the relationship between sleep, environment/SES, and anxiety. I also know that this topic speaks to my heart, and I want to make it so that it speaks to other people's minds and hearts. I have spent considerable time in reflection and have given ample thought to the topic. Therefore, I have been a contemplative. Now, I must somehow act, whether it be directly myself or indirectly by inspiring and motivating others. Honestly, I do not have the "end all, be all" solution to the problems that this topic presents at this moment. Yet, if I tackle it piece by piece, there is a chance I can make some kind of difference. For example, I

can start off by taking care of myself. I can obtain adequate, quality sleep, I can (fortunately) place myself in a non-stress inducing environment, and I can take steps to alleviate my own anxiety.

On a slightly larger level, I can look out for my family and friends. I have given many examples throughout my thesis about my family and friends who have had problems with some of negative consequences these relationships bring to light. I can do something about this by addressing my loved ones when they need help. For example, if my friend is severely lacking sleep, I will strongly encourage them to sleep or help them out with tasks that will eventually lead them to obtaining sleep. If my uncle in a low SES needs to attend to some errands, I will gladly babysit his children. If my cousin is struggling through unhealthy levels of anxiety and its side effects, I will take her out to relax and talk or help with homework. Moving even further from this, I can take action about this issue on a societal level. Sure, I may not be able to address all three variables at once in a given circumstance, but I can do my best to address them all. For example, I intend on becoming a physician. With the responsibility I will have, I will also be armed with my knowledge from this thesis. I can be more alert to the presence of these interactions between the variables affecting my patient's health. I can refer to or give them the appropriate resources. Maybe, I will even expand upon this thesis one day and do further research about these variables.

Being a contemplative in action on a societal level intersects with being men and women for and with others. In being for and with others, we advocate for and stand in solidarity for those that are less fortunate (Regis University, 2017). I am in a fortunate

position when it comes to sleep, environment/SES, and anxiety, but I know that many are not. In order to be with others, I must respectfully empathize with them, even if and especially if they are not my family or friends. I need to try to understand their struggles, even though it will be hard for me to do because I can never fully step in their shoes. If we are fortunate enough as to not suffer some of the trials our brothers and sisters go through, we should still care and empathize.

Just as important, we need to be for others, which means being a contemplative in action on a societal level. This involves being an advocate for the voices of those who live in a low SES, those whose lives are being impacted because of inadequate quality sleep, and those who deal with crippling anxiety. The socioeconomic inequality in our nation and all around the world is great. I do not have enough knowledge to firmly suggest what should be done to alleviate this, but a big goal, with effort particularly from the government, must necessitate paying attention to the separation gap that lies between the richest of the rich and the poorest of the poor and fixing this gap. There also needs to be more awareness of the dangers of sleep disruption, sleep fragmentation, and all issues related to sleep. The notion that sleep is secondary to other important duties and tasks is dangerous. This belief and/or opinion must be dispelled, and it can come from different avenues, such as doctors, teachers, scientists, etc. Of course, last but not least, there is a social stigma against mental illnesses as well as mental signs of unrest. If you have a headache or a stomachache, people will likely sympathize. Less likely, people will sympathize if you say that you are suffering from higher than normal levels of anxiety. It is okay to admit that you are dealing with daily anxiety, and it is okay to seek reprieve

before it evolves into something with long-term consequences. There must be a widespread change in this stigma, but it involves the public being informed. This is already changing with social media campaigns from activist groups spreading the message against the stigma, as well as a rise of mental health professionals seeking to share the same message.

All of these issues requires a sustained effort from more than just activist groups, the government, mental health professionals, etc. They require our spreading the message to those around us in any way we can. They require us contacting and urging professionals to take care of these issues. If we can work on each issue on its own, there is a smaller chance of all three variables colliding together and wreaking havoc on the lives of others. In this way, we are being contemplatives in action by being men and women for and with others.

Conclusion

I do realize that this is not the end, as I have invested too much work into the relationship between sleep, SES (environment), and anxiety to simply forget about it. Where I go next with this, whether it be a continuation or derivation, remains to be seen. However, with me, I will bring forth the different findings and lessons that have come from this thesis and the process of writing this thesis. The most obvious finding is that between the relationships of the variables. Sleep and SES are correlated, sleep and environment each have a causal relationship on anxiety, as disrupted sleep and a low SES/low quality environment cause higher levels of anxiety as opposed to a human, or a rat, with normal sleep and a high SES/enriched environment. A lesson that comes from this is that the lab and real-world often reflect what goes on in the other, despite the lab being a vacuum and the real-world having so many intricacies. It is crucial to be able to get as concise and accurate of explanations for an occurrence as possible to achieve internal validity, but it is important that these results have external validity and can generalize to real-life situations. Another important lesson comes from the many dimensions of an issue that you choose to investigate. Of course, you must prove the intellectual merit of something that you think is important. This issue must be researchable. However, to be an issue of worth, there must be social and/or practical implications at stake. Therefore, we must be able to act upon the findings of that issue. In the end, there are countless issues that are worth our time. It is up to us to decide where our efforts, dedication, actions, and thoughts will lie. For me, I picked the relationship between sleep, environment/SES, and anxiety, as these appealed to me on various levels.

With the conclusion of this thesis, I am taken back to the journey of this past year. When I picked a thesis, I had hoped that I would be lucky enough to remain fascinated and inspired by it so that I would not become burnt out. As time went on, there were moments why I questioned doing a thesis. However, looking back, this journey has imparted me with not only a technical sense of my selected topic, but also, with a stronger understanding of myself as a scholar in relation to the world. I have come to learn that if I pick something to investigate that I am curious in and maybe even passionate about, that the hard work will be taken care of naturally (with a bit, or a lot, of effort), and that the meaning the work will give to me, and ideally, to a larger community, will all be worth it. Now, perhaps I will go sleep for awhile or maybe take care of any anxiety. Regardless of what I do, the lessons that I have learned here and the knowledge that I have gathered will continue to shape my journey and the meaning of what it means to be human.

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