The Efficiency of Modern Blue Light Inhibiting Technology- Grant Proposal

ICons 1 Independent Case Study

Amazon Anti Eye Strain Glasses

Quay Blue Light Glasses

Warby Parker Glasses

Team B

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I. Project Summary

We hope to examine the extent to which blue light radiation with 412-426 nm wavelengths is associated with one's circadian rhythm, and how these effects are limited by various brands of blue light blocking technology. Different groups of participants will use electrode based sleep trackers to monitor when they fall asleep, how long they sleep, and how much of that time is spent in rapid eye movement. Doing so will allow the general public to better understand how well blue light glasses help filter out blue light radiation in relation to one's circadian rhythm, while providing valuable information to companies who have a responsibility to improve their blue light inhibiting technology.

II. Background

There is a lot of research of the effects of blue light - both positive and negative. Even so, there are few studies that have covered the effects of blue light filters ranging from blue light filters for phones and computers to blue light filter glasses and the extent to which they can benefit one's health.

An article published by Harvard Health indicated that while limited amounts of blue light can boost attention, reaction time and mood, it can also suppress melatonin secretion, which is linked to shortened sleep time and a shifted circadian rhythm ("Blue Light Has a Dark Side"). The article stated that chronic sleep deprivation has been associated with depression, diabetes, and cardiovascular problems, leading to the pursuit of blue light filtering technology. David C. Holzman's scholarly article, "What's in a Color? The Unique Human Health Effects of Blue Light", also claimed that various tumular diseases can be associated with an overexposure to blue light, while reiterating the claim that blue light exposure can result in sleep deprivation. Holzman claimed that the rapid eye movement period was delayed during sleep, which decreased the overall sleep quality (Holzman).

Research pertaining to health effects of blue light exposure indicate that effective blue light blocking technology should be made readily available to the general public (Zhao). Even so, the effectiveness of existing technology is still being evaluated through various studies, and more research is necessary for determining the best method for regulating blue light ("Do Blue Light Blocking Glasses Actually Work?"). One study titled "Apps Can Cut Blue Light From Devices, But Do They Help You Sleep?" involved 21 people who were given blue light filter

glasses, blocking photoreceptors that tell our body that it is daytime since blue light prevents these cells in the eye from triggering the release of a sleep hormone (Hamilton). After two weeks, participants' melatonin levels had increased by 58% and they reported better sleep overall. The results indicated that apps which filter blue light are not as good as glasses, so it was highly recommended that the consumer purchase blue light filtering glasses (Hamilton).

By comparing products at different price points and studying a socioeconomically diverse group of test subjects one can examine how accessible effective technology is for all individuals and work towards increasing its availability. With the prior knowledge and evidence that blue light has more negative than positive effects, we want to look at different types of blue light glasses and which ones would be the best and more efficient choice, thus providing vital information for the general consumer and for the companies who produce these products..

III. Methods

Parameters for the experiment

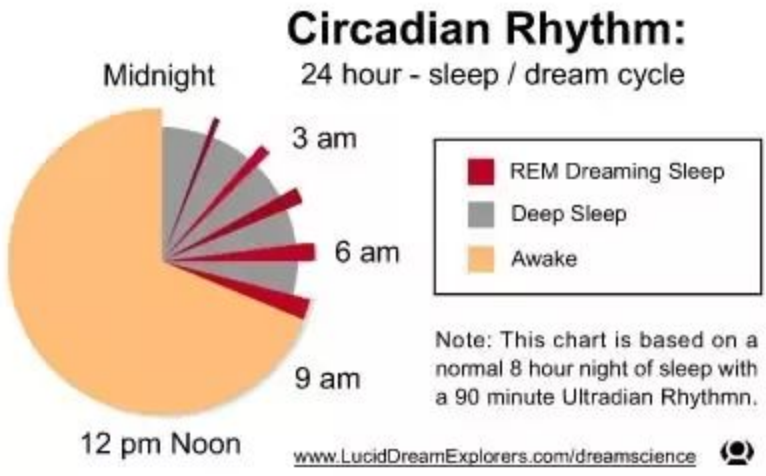
- We (along with some hired researchers) would pick and observe a group of 100 randomly selected participants between the ages of 18-44 (the average age range of smartphone users) for two weeks
- They will be split up into four separate different group with a control group and three different types of blue light glasses at different price points:
    - No exposure to any blue light (control group)
    - Amazon blue light glasses ($15)
    - Quay blue light glasses ($55)
    - Warby Parker blue light glasses ($95)
- Each person before we start the study is going to have to fill out a questionnaire based on basic demographic information such as age and gender, and also more lifestyle questions such as how many hours of sleep that they get on a regular day and what time they go to sleep regularly. This profile would also be helpful in terms of error analysis since going to sleep at 1 a.m in the morning is going to mess with one's sleep cycle with or without the use of blue light, so we want to limit the amount of external factors such as poor sleep time.
- Each group would only have 7 hours a day of smartphone access a day which will be monitored with an app downloaded onto their phone such as the app Screen Time which tracks screen time and can block out time which they can not use their phone.

- During the study, we would track how they sleep over the next few weeks: circadian rhythm and hours of sleep they get. Specifically, how long are they in REM sleep versus NREM? These factors can be quantitatively monitored using electrode based sleep trackers, such as the Fitbit, which can differentiate light sleep from rapid eye movement and are relatively affordable (Lee). The accessibility and relative accuracy of these trackers would allow a wide array of participants to measure the amount of time they spend sleeping, and how much time is spent in rapid eye movement.
- We would have subjects keep track of their moods and how they function throughout the day. We would also want to track patterns such as if the participants take naps. If so, how often and how long? How does this differ to their sleeping patterns recorded before the study began?
- At the end of the study, we will collect all the excel sheets and make sure everything is filled out correctly and begin to do the data analysis.
- Data that supports our hypothesis would demonstrate a correlation between decreased quality of sleep with increased exposure to blue light. To quantitatively measure quality of sleep, 20-25% of the sleep cycle being REM sleep is considered healthy for the average sleep cycle (Colten). Throughout the night the individual transitions between the various stages of sleep (Coltent). An individual with exposure to blue light would likely experience fewer cycles, therefore decreasing sleep quality.
- Our goal is to find which blue light glasses are going to be the most effective, if they are effective at all in helping with sleep, and also see if the price of the glasses matter (if we find that blue light glasses improve sleep at all).

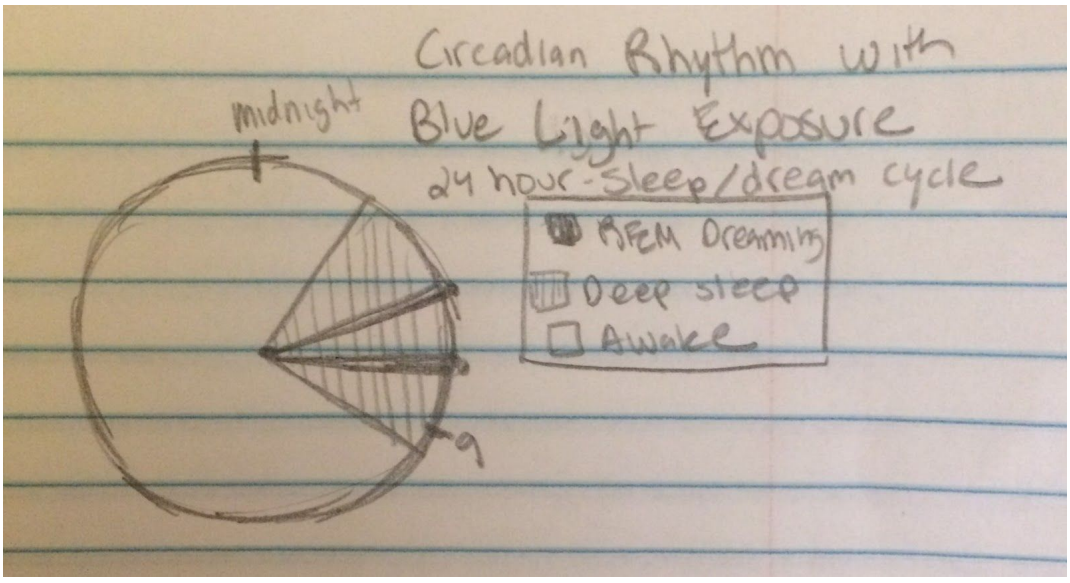
IV. Anticipated Results

Normal Sleep Pattern:

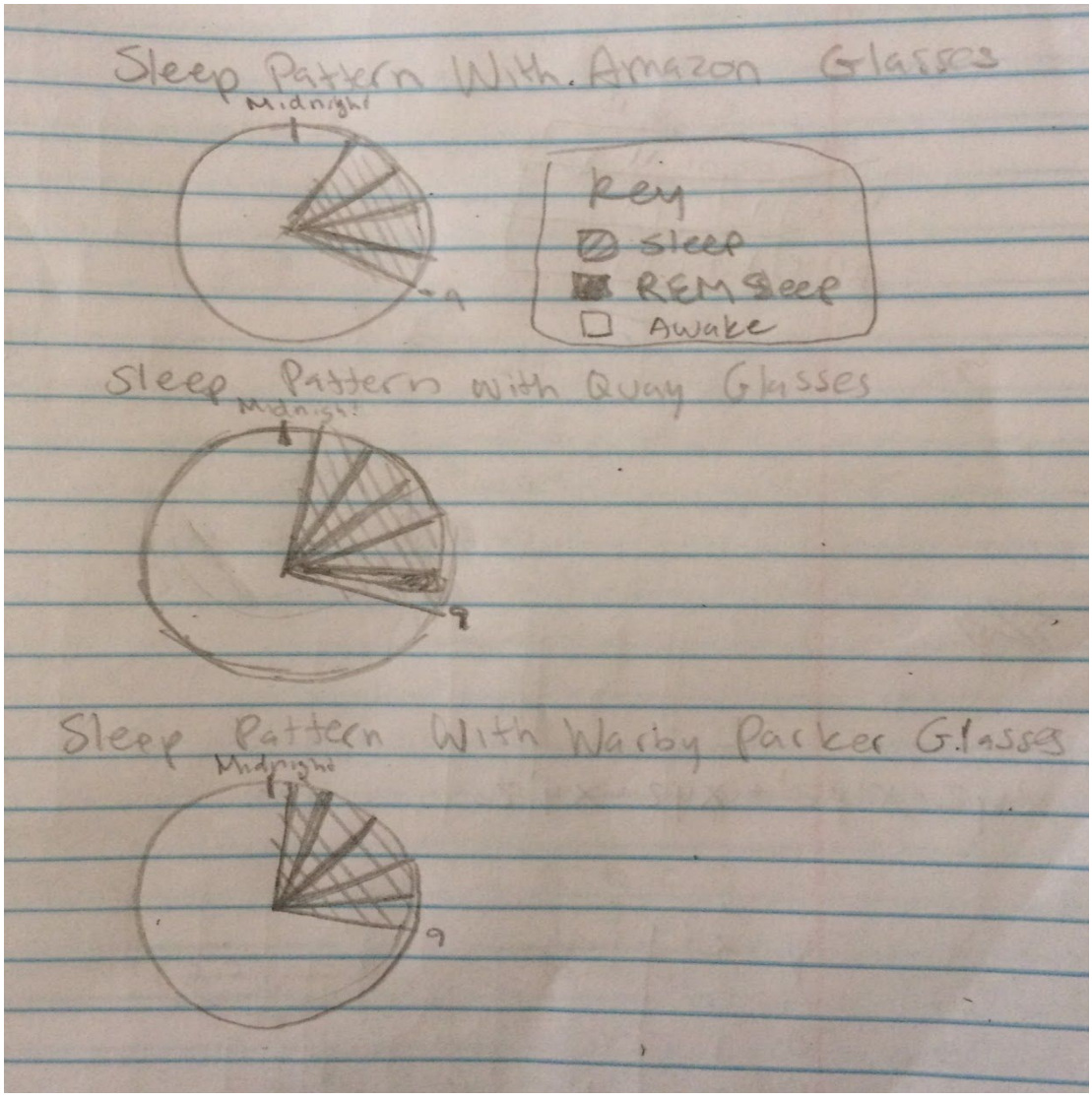
https://qph.fs.quoracdn.net/main-qimg-cd4cd0f8dd150feac3115c3f5fb5c5ed.webp



Visualizes the different stages of sleep, specifically REM and deep sleep. The graph shows an ideal circadian rhythm of a 24 hour cycle.



The graph demonstrates how blue light exposure could impact one's circadian rhythm, most noticeably reducing the frequency of REM sleep and deep sleep.



The graph depicts the different hypothetical circadian rhythms of people in the study, varying on the brand of glasses.

Based on the available research, it is predicted that exposure to blue light would theoretically disrupt the average individual's sleep patterns, causing them to require more time to fall asleep. For the graphs, the first one shows the control group and what we expect, the second graph shows the Amazon glasses, the third graph shows the Quay glasses, and the fourth graph shows the Warby Parker graphs. We anticipate that Quay glasses are going to perform the best, then the Warbly Parker, and then the Amazon glasses performing the worst. This is based on preliminary research based on reviews. If an individual is exposed to blue light directly before falling asleep then their circadian rhythm would theoretically increase the amount of time required to fall asleep after lying down. This delay in the start of sleep would also force the individual to wake up slightly later, and may decrease their net hours of sleep. Additionally, research has indicated that the individual would enter the rapid eye movement, or REM, state at a later time and experience fewer cycles of REM, decreasing the overall quality of their sleep during the night (Holzman). Although the extent to which sleep would be delayed and level of decrease in rapid eye movement during sleep is unknown, existing research indicates that there will be a negative change in both factors of sleep. This theory would be tested by determining the average time that individuals in each grouping fall asleep, wake up, and experience REM. These average values would be mapped on pie charts, and the sleeping patterns over the course of 24 hours for each group would be compared in order to determine which groups experience the most refreshing overall sleep.

V. Timeline

Here is a timeline of the process from inception to data interpretation:

Week 1	● Hire three other researchers ● Start to finalize questions and methods of recording sleep data with lab
Week 2	● Finish up the plans for the conduction of the study ● Start to recruit 100 people for the survey
Week 3-4	● Inform participants on what they are doing and distribute the rules and regulation of how the study will be done ● Conduct the study
Week 5	● Start creating charts and graphs from the data collection ● Start to prepare charts and graphs for the presentation
Week 6	● Start to interpret the data and the outcomes from our results ● See if our research question was answered to the best of our abilities
Week 7	● Get all materials and preparation done ● Get ready to present and publish study

VI. Materials and Budget

Materials	**Resources**	**Budget**
• Google forms for the participants to fill out questionnaire	• Team members will be responsible for analyzing and interpreting data	• We would compensate each participant around $100 for a two week study so that would be $10,000 for compensation
• For data collection: participants will be given a FitBit Versa 2 that tracks sleep throughout the night		• Do $25 an hour for three other researches to help collect data • Each researcher will log an average of 10 hours a week - so about 20 hours in total give or take
• Download the app Screen Time which will measure screen time and block out period of time where you can't use your phone		• Each Fitbit Versa 2 is about $150 • 100 Fitbits is about $15,000

Total Cost: Roughly $13,000 give or take a few expenses and dependent on hourly rates

VII. Key Personnel

All group members are responsible for data collection and interpretation. Us and a group of three other researchers would recruit individuals from various socioeconomic standings who are all exposed to screens daily. We are the best group to carry out this experiment because we all come from STEM backgrounds, more specifically, math, engineering, and computer science. We have all dealt with the analysis of data both in the classroom and through projects and experiments.

The group would then be responsible for communicating the results of this data with the public in order to increase awareness of the health effects of blue light exposure. This would also be accomplished through social media campaigns, in order to contact a broad and diverse array of individuals and increase awareness with the overall public. The wide array of communities that this group is able to draw data from and communicate to, as well as the background knowledge of computer technology that factors into our data analysis, makes us uniquely suited for conducting this experiment.

VIII. Relevance of Proposed Study and Broader Impacts

The results of this social experiment would be essential for seeing if blue light glasses truly helped the population and to see the effects of different types of blue light glasses brands at three different price points. Other studies have already demonstrated the long term health impacts of chronic sleep deprivation, therefore by drawing a connection between blue light exposure and sleep deprivation one can develop an argument for expanding preventative technology (such as blue light glasses) against blue light wavelengths. The results of this survey could expose that degree to which different companies have effectively implemented blue light blocking technology into their products.

The results of this study could provide valuable information about how much further this protective technology must develop in order to be both accessible to the general population and effective in protecting their eyes. By analyzing the behavior of a diverse array of participants, as well as the effect that these actions have on their sleep, one can better understand and communicate the degree to which limiting blue light exposure can improve human health. This information could be taken into account during future technological development in order to expand and improve on existing glasses for blue light prevention. The future responsibilities of different companies in further developing their glasses would be quantifiably measured through this social experiment.

Who may benefit from the outcomes of our work? The consumer would benefit from the outcomes of our work and companies would be given valuable information about how their

products compare to other blue light blocking glasses. Everyone throughout their daily lives encounter blue light in one form or another whether it is looking at your phone or doing work on a computer. Most people do not know how blue light may affect them, and the results from our study can help consumers understand more the impacts it has on their health and help influence their future decisions when purchasing protective eyewear. Blue light seems like an insignificant part to our day, but it is much more than that since we live in a society where technology is all around us. Blue light glasses are not regulated by the FDA because they are not seen as a medical device (Ellis). Even so, this experiment could motivate companies to enhance their technology, this protected citizens from harmful radiation. Additionally the FDA could be motivated to recognize the glasses as a medical device, allowing more people to be able to afford them through their insurance companies.

Not only do consumers benefit from the outcomes of our work, but so do companies producing blue light glasses and tech companies. The companies who produce blue light glasses can use the data we collected to make their glasses more effective at blocking out as much as blue light as possible and making them more cost friendly for all consumers to be able to have access for buying them. When making new technology, they can see if it is possible to eliminate the wavelengths of blue light radiating from the screen without sacrificing the quality of the pictures displayed.

How is our work meaningful to the general public? Our work may be meaningful to the general public because almost everyone has some access to a phone, laptop, or other devices. Our work will bring up the issues it can have on people's health, specifically sleep. Sleep is a

very important part of our daily lives and if we better understand what affects our sleep, we can improve our day to day living because how you sleep affects how the rest of your day will go.

How will we communicate our findings to a broad audience? The best way we can communicate our findings to a broad audience is to publish our findings and publicly speak about this topic through a presentation we create with the data we have collected. We can spread it through social media and podcasts and also set up talks at workplaces where computers work in dominant and schools where a lot of kids use their phones on a daily basis. Additionally, we can contact major eyewear companies directly to communicate the significance of our findings in order to directly impact their future products' capacity to block blue light.

IX. References

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