

A LITERATURE REVIEW ANALYZING THE RELATIONSHIP
BETWEEN CELL PHONE USAGE AND SLEEP QUALITY

A Thesis

Presented to

The Faculty of the College of Education and Behavior Sciences

Houston Baptist University

In Partial Fulfillment

Of the Requirements for the Degree of

Master of Arts in Psychology

By

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May 10, 2021

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ABSTRACT

Smart phones and portable mobile devices are the new normal in the United States. Much of the research thus far has focused on the effects of screen-use on children and adolescents: lower attention spans, difficulty concentrating, and academic performance to name a few. Research would be remiss to exclude adults from this conversation. Society has yet to fully understand the long-term effects of personalized mobile devices on the human brain. This review aims to analyze the relationship between smartphone use and sleep quality in adult subjects. Individuals that use these handheld computers are sacrificing free thought and critical thinking. The aspects of social media are a gift to some and for others it is a tool that disrupts precious sleeping time.

KEY WORDS: Cell phone, Smartphone, Mobile phone, Sleep, Sleep quality, Sleep quantity, Phone Addiction

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CHAPTER I

Introduction

Rationale

Smart phones and portable mobile devices are one of the fastest-emerging innovations in the United States these past two decades. There have been over 1.5 billion mobile phones sold in the past year alone, which is an enormous demand. Mobile phones and smartphones have easily invaded everyday life and continue to do so for millions all around the world. Much of the research thus far has focused on the effects of screen-use on children and adolescents: lower attention spans, difficulty concentrating, and academic performance to name a few. Research would be remiss to exclude young adults and parents from this conversation. The invention of the smartphone was just over a decade ago now, so the general population has yet to fully understand the long-term effects of personalized mobile devices on the human brain. In another facet of everyday life for humans is the concept of sleep. The general guideline on sleep for most individuals is roughly seven hours of sleep per night. Some individuals are overlooking their natural sleep schedule because there has been an uptick in sleeping problems and disorders. The connection between these two somewhat unrelated topics might be the pathway to understanding something truly inherent about the human mind. This review of scientific literature aims to explore existing information between the relationship of smartphone usage and sleep quality in young adult subjects. Individuals may be sacrificing their brain power for the convenience of a handheld computer. This small object held by a multitude of individuals, invading their brain's processes, could be considered a force of destruction. The lingering thoughts of needing to text or check the latest post on social media is pervading human cognition. The overuse of mobile phones could be detrimental to sleeping conditions. Alternatively, individuals might be shooting

themselves in the foot when it comes to taking their phones to bed with them. The studies within this review try to piece together enough information for the reader to make their decisions about the relationship between their sleep and mobile phone usage.

Statement of Purpose

This review aims to inform parents and young adults about existing evidence of the relationship between increased mobile phone use, lower sleep quality, and sleep duration. These factors have not been studied exhaustively as a relationship and there is a need for more data on the subject. The variables mentioned can have a direct affect on the overall mental well-being and attentional awareness of individuals.

Significance of Study

The population has been introduced to the invention of the mobile phone. Through its wide availability of communication, people are now more connected than ever. The Internet community and social media has been shown to have certain effects on the brain and behaviors of individuals. Sleep has, theoretically, always been needed by humans and the effects of sleep deprivation might be able to be eclipsed, or at least lessened, by the information provided. This study seeks to bring a light to the way that mobile phones affect the behaviors of sleep to young adults and parents.

Operational Definitions

Smartphone: the cellular device owned by the individual that is for personal use only. Does not include tablets, computers, etc. This is done in an attempt to consolidate only one aspect of technology. The researcher believes that this device is the most average used device for most of the population.

Screen Use/Time: using or looking at an electronic screen. This includes all phones, tablets, computers, and televisions for any purpose—professional, educational, and personal. This definition combines mobile phones and other technological screen related options together to aid in its generalization. Though this definition is rarely used, it was thought helpful to add.

Sleep Quality: the amount of well-restedness individuals feel after sleeping. One of the main factors discussed in the paper. Most of the time, this term is self diagnosed and subjective to the individual.

Sleep Quantity: the amount of actual sleep an individual had. A lesser, but still used, factor within the paper. Like sleep quality, it is usually self diagnosed by the individual.

Sleep Deprivation: insufficient or inadequate amount of sleep. A factor describing the lack of sleep in individuals. Sleep deprivation can be deemed, for the purpose of this paper, less than 6 hours of sleep.

Social Media: the applications that are installed by the user of a mobile device that allow them to connect with others (i.e. Instagram, Twitter, Facebook). The mobile phone used by an individual will typically have more than one of these applications. Consequently, social media's prevalence in young culture has allowed them all to congregate and mix together with each other. This is a big subsection of the mobile phone use category and one that the researcher believes is at the heart of the problem in the relationship between sleep and mobile phones.

REM Sleep: rapid eye movement while sleeping. This half of the sleeping cycle is when the individual's brain is widely active. The brain during this point is attempting to repeat encounters of situations and provide a safe experience for the neurons to fire and grow stronger. The body during this cycle also undergoes varied states and is unable to regulate functions like body temperature.

NREM: non-rapid eye movement while sleeping. This half of the sleeping cycle is when the individual is at a deep resting point. The brain is minimally active and the body comes to a resting state.

Theoretical Framework

The quantifiable amount of time individuals use their mobile phones during the day and night has a direct negative effect on their sleeping behaviors. The relationship between these two factors require more exhaustive studying to be more fully understood, especially in the techno-world most of the population lives in. How the body and brain is affected by the use of the mobile phone is significant. The behaviors that may be altered during increased mobile phone usage include REM sleep, NREM sleep, well-restedness, as well as duration of sleep.

Hypotheses

H₀₁: Increased mobile phone use decreases sleep quality

H₀₂: Increased sleep quality and cell phone use have an affect on each other

H₀₃: Using a mobile phone before sleeping decreases sleep quality

CHAPTER II

Review of Literature

Sleep: A Benefitting Cycle

Maintaining a healthy body is quite difficult. There are a multitude of ideas individuals have to keep in mind from day to day. For instance, individuals have to consider eating as healthy as possible for the body, making sure exercise is part of the daily routine, and one that has not received too much attention over the years—good quality sleep. Defining such a subjective action is no easy task; however, to say that sleep is just a matter of rest for the next day would be incorrect. Sleeping is, in reality, a time when the brain is active. Surprisingly, there are a large number of neurons firing even during sleep, which is referred to as “paradoxical sleep” (Siegal, 2011). Though seemingly backwards, this is what is needed for the brain and body. Though researchers do not yet fully understand the sleep processes, they have made a few distinct hypotheses about them.

REM is defined as rapid eye movement, during which the eyes move rapidly REM sleep does not only affect the state of the brain but also the parts of the brain that can manipulate the functions of the body. For instance, the heart rate and temperature regulation become volatile, similar to how both of these functions work when the individual is awake (Siegal, 2003). Typically, when thinking of sleep, it is seen more as a resting state and not REM sleep. Here the dreams of the sleeper are the most lucid because the brain is almost as active as if the sleeper is awake.

Moving on to non-REM or NREM, the body slows down and gets to a *comfortable* state. Muscles may contract and relax here—the startling jerks and waking up state can be found in this part of NREM. Brain waves slow immensely and the body is seemingly in a state of rest. The

human body switches between the REM and NREM stages. Though it is not yet known exactly why this happens, researchers believe it is a way for the body to repair the brain, prepare the brain for memory and learning, and relax the body.

Siegel (2003) explains that the NREM cycle gives the brain and body time to relax, repair, and reinvigorate itself. Without this recovery period, the brain would never be given a chance to experience downtime. Siegal (2003) goes on to say, “interrupted release of neurotransmitters called monoamines during REM sleep may allow the brain’s receptors for those chemicals to recover and regain full sensitivity, which helps with regulation of mood and learning” (pg. 94). Considering that there is a specific neurotransmitter that directly helps neurons rebuild themselves during these cycles, the neurotransmitter is proof for the necessity of sleep. Making sure that the brain is fully prepared is the most favorable way to start the day. Not allowing the brain to get to that point sets up for a difficult day ahead. The third idea about sleep Siegal had is the overwhelming neuronal activity of REM sleep in early life allows the brain to develop into adulthood. Further developing the mind is a great way to look at the functions of REM sleep. Though the idea of what REM sleep truly does for the brain is still uncertain, suggesting that it is a developmental process and a continual growth, even while sleeping, is most interesting.

Sleep has been seen throughout history as a time to restore an individual to restedness. It has been theorized to be the main component of the functions of sleep, but still much remains unknown about the true necessity of sleep. Assefa (2015) wrote;

“A major argument in favor of the restorative function of sleep is the observation that hormones released during sleep have a predominant anabolic function, such as growth hormone, as opposed to hormones associated with wakefulness, which

tend to have a catabolic effect, such as cortisol, which is suppressed during sleep, with the amplitude of the circadian cortisol decline dampened by sleep restriction” (pg. 158).

With this being known, researchers can conclude that at least some part of the sleep process is restorative. Whether or not that is the whole of the process is another thing. Not only do theorists think sleep is a time for growth, but also for rejuvenation of energy. The body of the sleeper, like stated above, goes into a cycle of REM and NREM. Re-establishing the idea of a state of restfulness through the NREM cycle gives ways for theorists to find function in this part of the sleep process.

Another area of interest is the way that sleep helps in learning. According to Assefa (2015), even with limiting the confounding factors such as the timing of motor skills training, testing and retesting, and sleep, as well as additive practice, sleep aids and enhances motor learning. Interestingly enough, naps also contribute to the functions of motor learning. It was found that naps have the ability to improve motor learning. Suffice to say that sleeping is quite beneficial, even if it would be for the simple task of motor learning (the way in which we learn to move our bodies). Especially for younger individuals, while they are growing up and learning how to use their body in the ways that is asked of them, i.e. sports or performing, motor learning is crucial. Memory is also impacted by sleep. This is a curious case for the everyday researcher to look into, something that can amplify and aid in the process and abilities of restfulness, motor skills, learning, and in memory.

The dynamic relationship between sleep and learning is one of the most bizarre yet extraordinary facets of the human body. Encoding, storage, and retrieval play a huge part in the brain’s learning process. Encoding is the term used to describe what it means to take on new

stimuli for your brain to dissect. The brain essentially writes down what it is trying to learn and begins to apply it through the vast array of neurons. Though one may not be perfect at a new task, this encoding process is necessary to move on to the stage of storage. Sleep chimes in and affects the encoding process as well, acting as a rehearsal time for neurons to fire once again. Sleep and learning have a symbiotic relationship. They both affect the other in a multitude of ways. The encoding process needs to be “slept over” for the brain to theoretically practice those neurons firing while asleep. This can be seen in learning a new skill such as a combination of piano keys or even visually tracking an object on the move. The same neurons that are active during learning these skills are the same ones that are active while in the REM sleep status (Chee, 2008). Thanks to what Chee discovered here, research can conclude that sleeping is necessary for optimal learning. Concerning the learning process, storage and retrieval are part of memory and attention for the individual. These functions have gotten some attention already, but will be discussed even more in the other topics.

Concluding the topical introduction into the benefits of sleep is a restatement of the main points from above. The importance of sleep is still not yet fully known; however, theorists have found small tidbits within various areas of sleep that help them to reinforce theories in a well-put-together and proven manner. First, the body goes between two cycles of sleep: the REM and NREM cycles. These two are close to opposites of each other. Within the REM cycle, the body’s internal functions begin to go a bit haywire, the brain has increased activity, and the eyes move rapidly. Though not scientifically proven, this could be seen as a time for the brain to test internal connectivity and reinforce used neurons to help them grow. In the NREM cycle, the body slows down to a state of rest. This more controlled time is when the body can truly relax. The balance between these two states causes a large amount of confusion; however, benefits

from them can be seen in some effect. The body does release anabolic hormones that aid in growth and repair during sleep. This allows the body to maintain a sort of reinvigorated state after the sleeping process. Not only is the body more reinvigorated, but the brain has a boost to its functioning as well. Learning and memory both receive help from sleep, which, in most cases, is one of the most beneficial things about the entire sleeping process.

Affectors of Sleep

Gaining a full understanding on how sleep can be affected by the actions of individuals and their environment is something of interest. These sleeping patterns are affected by how people choose to schedule their day. There are many things that contribute to differing schedules. For instance, some people may like to take naps in the middle of the day, while others can only sleep during the nighttime. One factor that contributes to varying sleeping patterns is natural and artificial light. Because humans have adapted to a work/rest cycle, work is typically completed during the day and the night is used as a resting time. The daylight allows the eyes to be able to fully intake informational stimulus, which is contrasted by the dark of nighttime when insufficient light lessens the ability to perceive as much. Thus, daylight maximizes the ability to do work. Additionally, there are more hours during the day as opposed to night. This would explain why humans have not developed night vision or, at least, more clear vision during the night. Generally, the consensus of nighttime is for the purpose of sleeping. However, this does not change the fact that many individuals still like to trade sleep for other activities. Ferrara (2001) explained that a considerable number of people do not think that sleep is time efficient. It is seen as a waste of hours that could be done doing something else. In the ever-revolving world, precious sleeping hours are thought as a misstep and can be used for another activity. So not only does the day and night cycle affect the human body, but also the desires and sometimes stressors

alter the sleep cycle. According to what was found by Ferrara, there has been a reduction in the length of sleep in humans by 20% over the last century for all ages. This could be why there have been a large amount of sleep-related disorders like insomnia, sleep apnea, and night terrors on the rise.

Sleep deprivation caused by work demands or social-related stressors is also notable, as employees and friend groups have been overly accessible due to the use of cellular devices and the internet. This phenomena was apparent before as a large portion of stressors; however, current technology amplified it even more. Not only does overwhelming stress affect one's normal ability, it can also disturb the natural sleep cycle. Lee's (2013) study about college women shows this disturbing bit of information: all of the women involved did not have pre-existing sleep or depressive disorders; however, they were sleep deprived, stressed, physically tired, unenergetic during the day, and showed depressive symptoms. This suggested that stress accountable from daily life was connected to poorer health-related well-being and poor sleepers were significantly more exposed to similar adverse health effects. The relationship between stress and sleep obviously has a considerable effect on the human body. How these two variables affect each other in such drastic ways allots for more unique studies similar to this one. The fact that stress disrupts regular sleeping habits, which contributes to the overall health of individuals, is alarming.

Not all of the factors that can affect sleep come from a negative connotation. Exercise is one of those things that does truly enhance the individual's ability to sleep, as well as mood. Analysis shows that exercise has an effect on heart rate variability. Regular exercise increases vagal modulation (involved in heart processes) which attempts to balance out the resting condition of the individual. Vagal modulation could show enhancement of parasympathetic body

control, which in turn, could improve sleep patterns and mood (Uchida, 2012). This is quite interesting for the simple fact that individuals do have a say in what allows them to sleep better. Now this is not the cure-all method for everybody, but with many other studies about the positive effects of exercise, one can assume this reaches into the realm of sleep in some way. Furthermore, when the body does have a strenuous time trying to regulate itself during a workout or exercising, it begins to become stronger. The resting heart rate becomes slower due to pumping more blood in less beats. This resting heart rate can be seen in that of NREM sleep, allowing the body to relax even more than those that do not regularly exercise.

Deficits in Sleep

Though the realm of what sleep can and does do for the human body remains, for the most part, in the unknown, variables congregate together to form the possible benefits of sleep. However, looking at the possibilities and what can happen without the proper sleep have proven to be quite detrimental to the regulatory functions of the human body. Sleep deprivation is one of the main terms that will come up time and time again in this next topic. Sleep deprivation can be found in a few forms as well such as in the suffering insomniac, the stress-filled worrier, and even the unenthusiastic wage worker. Krause (2017) denoted that sleep deprivation can show signs of altered behaviors. Most of these behaviors run down the line of risk taking, sensation seeking, and impulsivity. The idea as to why sleep deprivation can account for motivations like this are baffling. Not only does sleep deprivation affect behaviors, but lack of sleep can affect and impair working memory, attention, dopamine functioning, stimulus responses, and emotions. When one does not sleep, it appears as though they are being set up for failure in quite a few sociable and behavior skills. From earlier in this review, there has been a decrease in the average of overall sleep for the past century (Ferrara, 2001). This should be alarming. If most people are

not able to be at their full capacity for these subjects it could cause an endemic of inept learning ability for the country. Making sure that individuals at least attempt to get a good night of sleep most nights would set them up for a wealth of opportunity.

Attention and memory are a great place to start. Krause (2017) explained the deficits well. Performance begins to decrease on attentional tasks with the more time an individual is awake. This decline was explained by sleep pressure. These performance issues were called “lapses” or “microsleeps” wherein the failure of a task was seen as an omission. Attention also becomes volatile and inconsistent which doubles as unstable task performance. As seen with what Krause found, there is a massive amount of attention deficit. This is more than likely why learning is so hard to accomplish after sleep deprivation. Connecting the dots even more, this can also explain the loss in memory capability, which is another facet of learning. Attention, memory, and learning are so closely related, it is no wonder that sleep truly and markedly affects them all.

Sleep deprivation goes on to disrupt not just attention, learning, and memory—it begins affecting the brain’s chemical levels and brings them to a state of imbalance. Dopamine, which is in control of the reward system in the brain, has less of an effect on the brain and is reduced while sleep deprived. This allows for a shift in the brain’s reward system in which the individual begins to favor approaching a risk-reward behavior as opposed to remaining unbiased (Krause et al. 2017). This approach to somewhat unhealthy behavior shows that being sleep deprived while doing everyday activities, such as driving, can be a large risk for the affected person and others. Not only is the reward system in the brain in a state of malfunction, other parts of the brain return to a more primal state. The individual with sleep deprivation has an increase in positive response for pleasurable images, as well as desirable food stimuli (Krause et al. 2017). This increased

response makes the individual more impulsive as well. Curtailing the normal ability to remain in control, the impulsivity takes away the brain's attention and results in more risky behaviors.

In a study relating to the positive and negative effects of sleeping or being sleep deprived, Talbot (2010) found when individuals were sleep deprived, they reported more anxiety as an outcome of "catastrophizing." Interestingly, they also reported an increase in the chance of catastrophes coming to reality as compared to when the individuals were fully rested. Simply stating that an individual becomes more anxious under the effects of sleep deprivation may seem like an understandable conclusion from the above text. Anxiety easily has an interesting effect on the body. So then it begins to exist as a sort of cycle—sleep deprivation can lead to anxiety and the anxiety may cause a lack of sleep due to stressing over everyday events.

To restate, the elusive boundaries of sleep and its still enigmatic functions, learning, memory, and sleep all have a uniquely connected relationship. It was noted by many others in the past centuries that sleep has an effect on the associative links the brain makes. It aids in strengthening them and allows them to grow by establishing and re-establishing neural pathways that process individual memories (Walker, 2008). Though the link between learning, memory, and sleep is not completely concise as of yet, there are still theories that may shed some light on the balance of the three. The cycles of sleep, known as the REM and NREM, constitute an inverse between an active sequence and a passive one. The active of the two might be seen as a tester sequence to hone in the abilities of the neurons in the brain. This can be seen in the activity and nuances of dreams that individuals have. The neurons are most active during this time and allow these connections to stay strong. On the other hand, the NREM cycle is the resting state for the brain and bodily functions. This is the deep sleeping portion and is the true rest time for the

neurons in the brain. This is the least active stage in sleep, giving the brain and body time to return to homeostasis and recuperate lost energy.

Interestingly enough, there was a study that indicated those with disturbed sleep and short sleep were found to be at a higher level of risk for cardiovascular disease mortality. Jung (2010) explained in depth that the energetic cost of staying awake through the night is similar to the energy gained from eating two slices of bread. Without sleep, humans need to increase their energy intake to be closer to homeostasis. Jung's study went into depth about the actual caloric intake and energy expenditure humans need and use during sleep and wakeful periods. What they are attempting to convey is that with less energy received from sleep, the more some individuals have to intake to make up for the lack of sleep. In part, this can connect sleeping with high caloric intake or obesity. This may explain the rise in American obesity, considering the lack of sleep Americans have been enduring over the last several decades. The world never stops. Supporting this finding is Grandner (2011), who stated that;

“Short or long sleep duration are associated with a number of cardiometabolic outcomes, including obesity, diabetes, hypertension, hypercholesterolaemia, myocardial infarction and stroke. These findings have been examined relative to sleep quality in the past, as several studies have found associations between disturbed sleep at night and negative health outcomes.” (pg. 430)

This study goes even further to say that sleeping later than needed is even bad for the health of some individuals. Aiming for the seven hours of sleep per night mark appears to be the best for health.

One interesting study decided to take a look at the relationship between sleep duration and quality as predictors of adolescent alcohol and cannabis use. Results from this study

suggested that shorter duration and lower quality of sleep are risk factors for alcohol and cannabis use (Mike, 2016). As it turns out, this makes an even greater case for making sure to get a good night's sleep. Though this is not a complete correlation, these two independent choices do have some say within each other. Still, this finding is quite a worrying result. If, in fact, these two were directly related and future studies were able to prove this, there might be a review of priority for most individuals as abusing these substances can ruin some lives. Allowing everyone to make the most informed decision about these subjects can be one of the most important things people may learn.

Considering that anxiety might be a factor along with the other detrimental effects of sleep deprivation, one should consider all of the risks before sacrificing on sleep. If getting enough sleep allows individuals to be at their best, should this be a top priority for most? Complications surrounding the most efficient sleep and daytime schedule such as work, activities, or hobbies that individuals have might be an explaining factor. For instance, those who place higher priority on going out with friends than trying to get a good night's sleep may find the results to be less than what they wanted. Of course, based on most of the studies, it does need to be more than just one night. Multiple nights of short sleep or sleep deprivation can cause a large number of these detrimental effects.

Advances in Technology

The mobile phone has become quite the phenomena in the last few decades. In June of 2007, the first iPhone was invented. This brought about a change to the world. In 2021, there is barely anyone who does not have a smartphone. Advancements in technology have allowed these devices to grow into something almost all people have incorporated into their everyday life. These devices are made so irresistible. There may be a plot attached to smartphones that preys on

an individual's mind. Directly diving into these questions are a few studies that have tried to answer the questions postulated. Research indicates the swift emplacement of mobile phones in everyday lives can have a positive, as well as a negative, effect on psychological well being. Henry (2012) suggested that desires for the use of technology were mainly social such as meeting new people and friends or interacting with old ones. These positive social desires correlated with more positive scores on psychosocial well-being and a strengthened sense of community. When the desires came for the use of technology in a non-social motivation is when the scores began to drop on psychosocial well-being and the sense of community. This summary shows the direct correlation of behaviors that are associated with positive or negative psychosocial wellbeing. Only when technology is used directly for interacting with a community do people begin to feel better about themselves and others. Henry continues on about their findings: those that searched technology or social media for the sole reason to find social support for personal problems or issues were at a disposition to score higher on negative traits (loneliness, depression, shyness, and social anxiety measures) and score lower on positive traits (social skill, self confidence, and self-efficacy). Henry's findings once again reveal the common theme that the motivation behind the use of technology or social media is the defining factor between a healthy self-esteem or the downward spiral into loneliness and depression. Though this study does not specifically endorse the use of mobile phones, conclusions can be made that align with similar thought processes toward the benefits of the whole of technology. It appears that there is a strange connection between the use of technology and social circles. Whenever the use of technology, specifically a mobile phone, is used to chat, call, or arrange meetings with known friends or communities, there is a positive benefit for the individual. Inversely, when technology is used for the motivation of solitude, there is a decrease in psychosocial well being.

All these studies combined set the stage for opening the discussion concerning mobile phone use and how it can affect a person's ability to enjoy a healthy, good night of restful sleep.

The ability to invest in others socially is an important part of everyday human life. As social beings, humans create social networks in order to be active, engage in hobbies, or simply enjoy life. Fortunately, with new technology, there is even more of a possibility to connect. Mobile phone applications allow many individuals to come together on websites like Facebook, to be social whenever they want to be. The increase in mobile phone usage due to the desire to be social has skyrocketed over the past years. These new devices, though helpful at times, may be impacting the general population more than once thought. Just about everyone has a smartphone nowadays. This object, that research has not gotten the amount of time it needs for, is practically and demonstrably beginning to break down some processes of the brain. For instance, social media and performance: Brooks (2015) alluded that social media usage led to negative performance scores. Attentional control and multitasking computer self-efficacy did not have an effect on this relationship. To break that down, Brooks found some students and professionals argue they are multitasking while, in reality, multitasking does not change the fact that social media has a negative effect on performance. Considering that social media is always available to an individual who has a mobile phone, should this lack in performance be disquieting? Brooks goes on to suggest personal social media usage led to negative effects on efficiency and well-being. Social media usage is associated with lower task performance, increased stress, and lower happiness. Learning all that one can about the phone and what it can affect in the human body and brain should be imperative.

Mobile phones have become much more than just a simple tool. The booming allure of social networking applications have overshadowed the original intent of the mobile phone. These

additive features have become so aligned with what a mobile phone is today and are considered essential. Social networking apps are some of the worst offenders. Programmed algorithms learn how people act and react and they are designed to capture an individual to stay on their app. An addiction is what some may call this phenomena. Salehan's (2013) study found using social networking applications like Facebook and Instagram is associated with mobile phone addiction. This finding is parallel with the theory of optimal flow which ultimately says that use and enjoyment of technology may lead to addiction. Addictive behaviors are uncontrollable at points. Most individuals cannot fathom breaking an addiction they do not even realize they have. This may be the secret most companies that run these social media apps do not want the population to discover.

Sleep and the Screen

Studying the effects of cell phone usage on sleep quality is not a new research topic. Several studies have found an indirect correlation between increased cell phone usage and diminished sleep quality. Demirci et al. (2015) found that sleep quality was lower in university students when cell phone use was taken into account. The same study also found correlations between diminished sleep and increased anxiety and depression, where cell phone use may be a mitigating factor. Sahmet al. (2013) went a step further by measuring how cell phone use can become addictive to the point of negatively impacting sleep among university students, where addiction was defined by more than 5 hours of cell phone use per day. Average daily smartphone usage has been steadily rising over the past 10 years, a trend that will likely continue as smartphone capabilities become more advanced and devices more widely available. Following the previous studies on cell phone use and sleep, the trend of increased cell phone use may have detrimental effects on sleep patterns, sleep quality, and, consequently, overall mental health.

A study conducted by Exelmens (2016) proved that an individual's mobile phone has become their own bedside media. Most of their 844 respondents stated they brought their phones with them to bed. They also found that usage of their phones before bed and after lights out was a predictor of negative sleep outcomes. These findings promote that bringing a phone to the bedside is harmful to the overall sleep and well being of the population. The entangling nature of the mobile phone causes an individual's mind to stay wrapped up and active, not allowing the necessary time for sleep to run its course. When an individual stays up all night browsing the internet or social media, they take away from their sleeping hours. Not getting enough sleep or having disturbances through the night results in poor sleep quality. The sleep one lacks during the night sets them up for failure as they do not allow their body to prepare itself for learning, keeping attention, encoding in memory, and simply wakefulness. By using a mobile phone far into the night, individuals stunt the sleeping process that is so necessary for their bodies and brains to grow.

Mobile phone usage and its effects are part of a larger conversation on the impact of screen use on the human brain, where a screen includes smartphones, personal mobile devices, computers, and television. Christensen et al. (2016) studied the relationship between screen time on mobile devices and sleep quality and concluded above average screen time use led to decreased overall sleep quality. They found this relationship strengthened with reported screen time during pre-bedtime hours. Already, research indicates mobile phone use is pervading into the everyday lives of individuals. Regardless of what they were doing on their device, screen use itself may be related to less restful sleep. Overusing a mobile phone, as discussed earlier, is detrimental and shows signs leading to addiction. This addiction allows the phone to take away not only time, but energy and sleep. To infer a connection, think of a smartphone as Las Vegas.

The casinos in Las Vegas are there to make people comfortable. The more time that one spends there, the more likely they are to lose money. There are no clocks, most casinos make sure there is no natural light, and waitresses are always ready to distract with drinks. Now, the inferences are not immediately noticeable until examining what applications on smartphones tend to do while using them. Some gaming apps or social media apps do not fully display the time or it is blocked. The light from the smartphone will begin to trick your brain with the light it produces, which in turns keeps the user awake. Receiving small dopamine highs will distract the body as well, arranging the desires of the individual to keep playing or using their phone.

Children that have grown up with a phone in their hands since a young age are already glued to their phones. Smith et al. (2020) studied the relationship between screen use and sleep quality specifically in the adolescent population. They found that 86% of subjects responded “yes” to being on their smartphone in bed either browsing social media sites (88%) or texting (77%). Respondents perceived themselves to be watching screens too often but felt smartphones, especially, were too important to maintain relationships with peers to reduce overall screen time. The ability of being social with others is a necessity in human life. Mobile phones are taking away from the real world connectivity that humans so desperately crave. Thomée (2011) went a step further and included sleep quality, symptoms of depression, and stress levels in their comparison to screen usage in adolescent subjects. They found higher screen use linked to increased reporting of depressive symptoms for both males and females. Screen use may not just impact sleep itself, but contribute to other areas of mental and physical health.

Fewer studies focused on the adult population and how their screen use impacts sleep quality and overall functioning. If screen use impacts the sleep quality, attention span, and cognitive functioning of children and adolescents, adults may very well experience the same

negative effects. Rosen (2016) found college students to be involved in a “sleep debt” that negatively impacts their performance and health. Here, Rosen asserts that college students are now beginning to lose sleep. Connecting the dots even further, young adults that have continued screen use begin to be dependent upon their mobile phones as a means to lessen their anxiety.

Rosen (2016) stated;

“Two paths to sleep problems emanated from anxiety/dependence, one of which predicted increased daily smartphone use leading to sleep problems and the other of which predicted increased nighttime phone awakenings, which also led to sleep problems. The link between anxiety/dependence and multitasking was validated, but this did not lead to sleep problems.” (pg. 53).

The research now comes full circle as screen use and dependence on one’s mobile phone appears to affect the sleep of these students. Why is there such a need to use one’s mobile phone? Is it simply a way to have leisure or is it something more? Why is this device such a hindrance to the human brain and body, yet almost everyone on the planet has one? The research has clearly indicated that use and overuse of the mobile phone is bad for the sleep patterns of individuals, which is not good for learning, memory, attention, energy, etc.

Effects of COVID-19 Quarantine

Mobile phone and smartphone usage is already on the rise. However, the worldwide COVID-19 pandemic has rapidly changed the way many countries work, learn, and spend their time. More time is being spent at home due to quarantine and social distancing mandates. Screen-based technology use is increasing exponentially as employers and school districts rely on Zoom meetings, Google Hangouts, and other similar mediums to conduct business and execute online learning platforms. The current situation must be acknowledged when examining

current smartphone usage and sleep quality. Denworth (2020) explained that the COVID-19 pandemic has led to an increase in symptoms of depression, anxiety, post-traumatic stress disorders, and loneliness. Some people are experiencing financial difficulties and physical health symptoms. Increased stress on the average person may influence both mobile phone usage and sleep quality. Mobile phone usage is increasing as people attempt to stay connected with others digitally. Segrin and Burke (2015) found that high levels of stress and increased senses of perceived loneliness were indirectly correlated to sleep quality. Participants who experienced increased stress and/or higher feelings of loneliness reported lower sleep quality. The COVID-19 pandemic and subsequent quarantine procedures has quickly, and perhaps permanently, altered daily life activities and normality for most countries. At a time of increased stress and social isolation, smartphone use and sleep quality may have drastically changed out of necessity. Therefore, this study will have interesting implications when compared to previous studies on smartphone usage and sleep quality because the subjects' societal context has changed.

CHAPTER III

Methodology

Participants

Participants that would be required for this study would be around 75 to 100. If possible, more participants would help with the overall sample size of the study. Most, if not all of the participants would come from the student community at Houston Baptist University. These students would be around the age of 18 to 25. Demographically, the Houston Baptist University students are most similar to the demographic of Houston, TX. The students within the study could be from any major, any classification, any type of degree, male and female, and any religious preference. Not only would this be easier for the researcher to gather, but it would also aid in the diversity of the sample. The broadening of data collection would allow for a more generalized version of the United States, though, Houston Baptist University students may not be exactly like the American population. The number of participants at 75 to 100 should be enough to see at least some assurance of statistical power. The sample size collected would allow for a close estimation of the findings and application to greater populations.

Instruments

The instruments that will be used for the study are a Google Forms survey that can be sent out via a link or by use of a QR code to complete the survey. Consequently, due to the lack of contact that individuals can have with each other currently, the easiest way for the survey to be completed is on a mobile device. The Mobile Usage Scale (Konok, 2016) and the Sleep Quality Questionnaire (Kato, 2014) would be sent to the subjects using a Google Form. The researcher chose this method of administration due to current quarantine measures as a result of the COVID-19 outbreak. The researcher would use a sample of convenience: subjects known to the

researchers and participants from Houston Baptist University to streamline communication and the administration of the survey. The first part of the survey would be the informed consent and confidentiality information. Afterwards the participants would complete the survey. In addition to the Mobile Usage Scale (MUS), Sleep Quality Questionnaire (SQQ), and additive questions, the individual's demographic information regarding the age and gender of participants was recorded. Ages of participants should range from 18 to 25. Participants would be given three choices to indicate gender: male, female, or other. Completed surveys are automatically recorded in Google Forms anonymously, as email addresses and names will not be collected.

The additive questions stated earlier would cover the topics within the literature review about the use of a mobile phone (concerning applications, daily use, after lights-out use, and awareness), sleep (concerning self-reported quality, self-reported duration, wellness, fatigue, daydreams, and naps), attention, learning, and memory. These questions that are added to the previous two surveys will allow for a more in depth look at how mobile phone usage and sleep as the researcher does not believe that the existing surveys do not account for the relationship between the two variables.

Methods

Participants will be given a link to an online survey. There, they will be asked multiple questions based on self report. The entirety of the survey takes no more than 10 minutes. This is also a very harmless way of gathering information. Due to the restrictions placed on Texas from the COVID-19 disease, this was assumed to be the easiest and least invasive process for gathering data. There is minimal risk involved in this study and no benefits or incentives given to the individual after completion. There is also no deception involved in the study. Each question is geared to answer exactly what it is asking for.

Participation in the study is voluntary. Individuals do not have to answer any question they do not want to answer. If at any time and for any reason, the individual would prefer not to participate in this study, they can opt out. If at any time the individual would like to stop participating, inform the researcher and that data will be withdrawn from the collection. The individual can take a break, stop and continue at a later date, or stop altogether. Individuals may withdraw from this study at any time, and will not be penalized in any way for deciding to terminate participation. Debriefing the individual after the study is not necessary, however a kind “thank you for participation” may be said by the researcher.

Analysis

The main analysis of the data would be done on the relationship between mobile phone usage and sleep in general. Interesting breakdowns of the pre-existing scales could be done to see the amount of time on the phone as it may relate to addictions. Those behaviors might seep into the sleep index causing a significant finding. This is, however, mere speculation. The data with the questions from the researcher could allow for a deeper insight into the relationship. What research has found so far is that addictive use and behavior with smartphones is detrimental to attention and does affect sleep. The effect on sleep results in lower learning and memory skills as well as more risk seeking behavior. Since the scales and questions have been used in past research, it can be assumed that similar data would be found. Possible examination of the results from previous scales and how they relate to each other, as well as the results of this own study, could be used in further research. A way to do this would be to use T-tests on both of the scales mentioned to find the possible statistical significance between the two variables. Analyzing the additive questions might be a bit harder than with the two premade scales since they would not be necessarily valid or reliable questions. However, the analysis can still be done on these

questions as well as relating them to the two scales. In doing this, there may be a way to find further statistical evidence or even an unknown effect they could have on each other.

CHAPTER IV

Conclusion

Summary

The whole of this literature review was in part to gather a large portion of data surrounding these two nebulous variables. A significant amount of data relating to sleep found an extraordinary amount on what its benefits are. Attention, learning, and memory aids are to name a few (Chee, 2008; Krause, 2017). Contrasting the benefits of sleep is the introduction of the smartphone into the lives of individuals. Almost everyone has a smartphone in this current age and research has yet to clearly define all that it can do. Studies have shown deficits in anxiety control (Talbot, 2012), attention (Exelmens, 2016), and behaviors (Salehan, 2013; Henry, 2012). Phones must be considered for mitigation as many in the population seem to be overusing them to the point of sleep loss.

Application

The entire purpose of this literature review and proposed research was to examine the findings presented by previous studies and attempt to show them in a light that is applicable to the world. Some of the main points concluded were that sleep is truly meaningful for the body to be at its fullest capabilities. Lacking sleep in terms of quality or duration can immediately have an effect on an individual's daily life. Sleep has a say in learning and memory, attention, stress, and behavior. All of these concepts are unique and incredible facets of human ability that should not be hindered. Mobile phones have the possibility to do such great things; however, when used in the wrong way, these devices can, and more than likely will, disrupt basic functions of the population. Not only can they seize control of someone through addiction, mobile phones have the innate ability to distract one from sleep. This distraction is the main theme of the study—to

see if the mobile phone actively impairs the individual's sleeping ability. Almost all teens, young adults, and now parents, have some sort of mobile device. Knowing the haphazards of what phones can do to one's own sleep behaviors and schedules is extraordinarily important in a society where one can get lost doing something so seemingly harmless. The impact of simply knowing about better sleep may cause a rise in sleep awareness and sleep health. The demands of daily work life, familial life, and social life are high enough when the concern sleep is low. Shackling individuals down to even 80% of their capability is so detrimental.

Limitations

This literature review was written in just a few short months. If there had been more time to search for data and compile all things together, this would be a more comprehensive and exhaustive pool of information. Though this review went over some of the basic qualities of the functions of sleep and how mobile phones affect humans, going more into depth about conditions caused by these stated factors. To name a few, addictions and sleep related disorders could have had a bigger spotlight. Due to the broad nature of this review, the conditions did not get much thought. There were some studies that tried to be as exhaustive as possible, but with the ever-changing scope of the potential of the mobile phone it would be difficult to hone in on every aspect. Most of the studies gathered self-reported data which in and of itself can be wrong. Correctly examining individuals in a more behavioristic light would allow for more empirically based data, although this would be considerably more invasive into the private sectors of an individual's life. Consequently, this idea would more than likely not be solved by the researcher without a team of behaviorists to examine a multitude of individuals. However, with these limitations, the researcher would be able to open up the conversation about the dysfunctional use of smartphones and sleeping patterns.

Future Study

The implication that sleep and mobile phone usage are connected is a profound topic. Some studies have tried to be as inclusive as they can, but with the near limitless possibilities of phones, research might need to be a bit more thorough. As most of the studies have said, more research needs to be done to figure out the true nature of what sleep is. Sleep has become this enigmatic process that everyone needs and cannot live without. Similarly, mobile phones have become an object that humans cannot live without. Discovering further connections between these two could help to optimize development in adolescence, young adults, and the elderly. As stated in the previous two sections, an emphasis on behavioristic principles in studies may be the only route to go for more in depth data on the relationship between these two variables. It would be suggestable to look at all the facets of observation. Case studies, multiple types of surveys, and surveys completed by researchers are a few examples of what could be done differently.

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