The Association Between Social Media Experiences And Sleep Quality In Young Adults

Harshi Shetty

School of Psychology, Massey University- Albany

175.896 Thesis 120 Credits Part 2.

Supervisors: Dr. Aaron Drummond & Dr. Karyn O'Keeffe

February 1st, 2022

Contents

Abstract

With the advent of portable screen-based devices and an advancement in the functionality of social media, individuals are spending an increasing amount of time on social media over time. Alongside this increase in social media usage over time, daily sleep duration may be on a declining trend (Chou et al., 2009; Matricciani et al., 2017). A growing body of research now exists examining the relationship between sleep duration, quality, and social media use. Portable devices with screens that emit blue light could be one of the reasons contributing to this decline (Gringras et al., 2015; Mireku et al., 2019), and emerging research suggests that experiences on social media may also be affecting people's sleep (Rzewnicki et al., 2020; Tandon et al., 2020; Woods & Scott, 2016). While a growing body of research examines the use of social media and the subsequent associations with sleep, to date, only a small amount of this research specifically looks at the relationship between negative social media experiences and sleep quality. Here, a cross-sectional sample (*n* = 181) recruited via Prolific was asked to fill out a questionnaire about their social media use and sleep quality. A small positive correlation between negative experiences on social media (as measured by the modified PANAS-NA) and sleep quality (as measured by the sleep quality subscale of the GSDS) was found, suggesting that individuals who experience greater negative experiences on social media may also experience slightly poorer sleep quality compared to those who experience fewer negative social media experiences. The implications for social media use, measurement of negative social media experiences, and further research are discussed. Further research utilizing longitudinal and experimental methods to determine the mechanisms of this relationship is necessary.

Acknowledgements

I would like to thank my family for supporting my ambitions and making this study a possibility. I would also like to extend a big thanks to both my supervisors Dr. Aaron Drummond and Dr. Karyn O'Keeffe for always giving me heaps of corrections. A final thanks to my partner Kurt for helping me hit the gas pedal, and my cats, Newcat and Misty for the cuddles.

Introduction

Since the early 2000s, there has been a rapid growth of Social Networking Site (SNS) usage in individuals across all age groups, but perhaps the biggest demographic is that of young adults, aged 18 to 25 (McGorry & McGorry, 2017; Singh et al., 2019; Villanti et al., 2017). Facebook has had 1.28 billion active users since 2014, and it is only one of many available social networking websites in the 21st century. The use of social media now plays a large role in many individuals' self-expression as well as identity development, as more and more social interactions are shifted to the online realm (Berryman et al., 2018; Subrahmanyam & Smahel, 2010).

Individuals are highly motivated to post and remain active users of these websites (Brandtzæg & Heim, 2008; Karahanna et al., 2015) even though there are reported cases of excessive engagement with social media, negative experiences in the form of cyber-bullying or content which reportedly causes negative affect and an overall decline in wellbeing among some SNS users (Bellet et al., 2018; Boobalakrishnan, 2021; Bourke, 2013; DeJong, 2014; Patchin & Hinduja, 2010; Truell et al., 2019). Some researchers suggest that there may be a relationship between sleep and social media, and current research suggests that social media use may be linked to disturbance in sleep onset time, sleep duration and sleep quality among all age groups (Garett et al., 2018; Levenson et al., 2016; Scott & Woods, 2019).

Even though some users have negative experiences on social media, there is evidence that SNS use may be contributing to the displacement of some user's regular bedtimes (BBC News, 2021; Sampasa-Kanyinga et al., 2018; Troxel et al., 2015). Moreover, research has shown

that there may be a worldwide trend of decline in total sleep duration and sleep quality, evident within all age groups (Andrade et al., 1993; Hoyos et al., 2015; Sampasa-Kanyinga et al., 2018). One possible explanation for this decline may be attributed to the popularization and increased usage of portable devices with electronic screens that use light-emitting diode technology) and their use during the evening and nighttime (Fossum et al., 2014; Lemola et al., 2015; Mireku et al., 2019). Light exposure is one of the strongest signals for an individual's circadian system, and the circadian system has a role in regulating the timing of the sleep/wake cycle (Dumont & Beaulieu, 2007; R. M. Lunn et al., 2017; Smolensky et al., 2015). The human circadian timekeeping system relies on light and other environmental cues to remain in synchronization with the solar day/night cycle (Kaladchibachi et al., 2018; Schibler & Sassone-Corsi, 2002). (The cycle length (period) of circadian rhythms tends to be longer than the solar day/night cycle in most people.) Exposure to light in the evening or at the beginning of the biological night can cause a shift in the timing of the circadian system relative to the day-night cycle, which has a subsequent effect on the timing of the sleep/wake cycle (Rahman et al., 2021; Rahman et al., 2017). The human eye perceives light over a broad spectrum of wavelengths. Visible lights of short wavelengths (415-455nm) are observed as blue light (Lin, 2002). This wavelength of light is one of the most dominant wavelengths emitted by the majority of electronic screen-based devices, including cell phones, laptops, and televisions, as well as many other artificial light sources that use light-emitting diode (LED) technology (Behar-Cohen et al., 2011; Okuno et al., 2002). The circadian system is sensitive to this blue light (Tosini et al., 2016), and exposure to blue light a few hours before, or at bedtime, can have a negative effect on sleep due to cognitive stimulation as well as the phase delaying effects of the blue

light on the circadian system (Clayton et al., 2015; Grønli et al., 2016; Heo et al., 2017; Touitou et al., 2016).

Some research suggests that social media may be intentionally designed to be engaging to keep users online for as long as possible (Montag et al., 2019; Neyman, 2017), however whether this design is intentional is highly debated (Turel & Ferguson, 2020; Zhao & Zhou, 2021). Additionally, as social media has become a significant way of staying connected, some users appear to be falling prey to the fear of missing out. These users are choosing to stay active on social media for longer periods including later in the evening, which can result in a later sleep onset time (Beyens et al., 2016; Przybylski et al., 2013; Scott, 2019; Scott & Woods, 2018; Tandon et al., 2020). Furthermore, the negative experiences that some users face on social media (e.g., cyberbullying, cybervictimization, trolling, fake news, etc.) can have a range of effects on the individuals who experience them (Buckels et al., 2014; Jose & Vierling, 2018; Nyilasy, 2019; O'Keeffe et al., 2011). Peer-victimization is linked to increased distress. For instance, research indicates that exposure to cyber-aggression predicts increased rumination (Jose & Vierling, 2018; Tu et al., 2015). Exposure to these experiences on social media can be stressful and create a negative experience for some users, and a growing pool of research has linked greater exposure to negative social media experiences such as cyber-bullying to higher rates of depressive symptoms, higher levels of depression and anxiety, and overall negative mental wellbeing (see Charoenwanit, 2019; O'Reilly et al., 2018; Tennant et al., 2015; Xantus et al., 2015).

These negative experiences may have a negative effect on an individual's sleep duration and quality through a variety of proposed mechanisms (Horváth et al., 2016; Jose & Vierling, 2018). Reduced sleep duration has been correlated to negative health outcomes and poor day-to day functioning in individuals (American Medical Association, 2010; Gruber et al., 2014; Kaufmann et al., 2016; Owens & Group, 2014). Insufficient sleep duration and/or quality is associated with a plethora of psychological and physical disturbances, such as poorer cognitive and executive functions on both lower and higher-order cognitive tasks (Beebe, 2011; Rogers et al., 2003; Wilckens et al., 2014), an increased risk of various psychological disorders such as depression and anxiety, and an increased risk of relapse of those disorders. (Brooks et al., 2021; Chen et al., 2012; Sullivan & Ordiah, 2018). Poorer sleep is also associated with mood disturbances and confusion (Ahmad et al., 2020; Paunio et al., 2015), and an increased risk of obesity, type 2 diabetes, cardiovascular disease such as myocardial infarctions, and various other physical health issues (Atkinson & Davenne, 2007; da Estrela et al., 2021; Gohil & Hannon, 2018; Gottlieb et al., 2006; Ogilvie & Patel, 2017).

While a large amount of research focuses upon the effect of mental health problems on sleep duration and quality, there is an increasing body of research suggesting that this is a bi-directional relationship (Bixler et al., 2005). João et al. (2018) found that in a non-clinical population, sleep quality measured by the Pittsburgh Sleep Quality Index was correlated with mental health problems as measured by the Depression, Anxiety and Stress scale-21, suggesting that the two were correlated. Additionally, Anderson & Bradley (2013) conducted research with adolescents that showed that poorer sleepers were more likely to have higher scores on the Mental Health and Problem-behavior questionnaire, and that mental health problems can

contribute to poorer sleep, further adding support to the existence of a bi-directional relationship as well as suggesting a positive relationship.

The study presented in this thesis aimed to understand the effects of experiences on social media on subjective sleep quality. The study also aimed to explore the subjective experiences of users that consume social media content and partake in interactions online. Furthermore, the present study also aimed to expand upon existing research in the field (Rzewnicki et al., 2020; Tandon et al., 2020; Woods & Scott, 2016) by employing a novel way of measuring social media experiences

What is Sleep?

Most humans spend about one-third of their life sleeping (Aminoff et al., 2011). A simple definition of sleep provided by Carskadon & Dement (1989) describes it as "a reversible behavioural state of perceptual disengagement from and unresponsiveness to the environment", however it is in reality a much more complex combination of physiological and behavioural activity. The National Institute of Mental Health (2012, pg.3) defines sleep in tandem with wakefulness as "endogenous, recurring, behavioral states that reflect coordinated change in dynamic functional organization of the brain and that optimize physiology, behavior and health." Sleep is not merely an absence of wakefulness but is its own distinct state with varying physiological changes. While sleeping, individuals may have changes in all the main organ systems of the body, such as the cardiovascular system, autonomic nerve activity, respiratory system, cerebral blood flow and the endocrine system (Altevogt & Colten, 2006).

Understanding sleep is important because it plays a regulatory role in many essential life processes. A healthy amount of good quality sleep at the right time of the day is critical for maintaining mental health, physical health, and overall quality of life (Irish et al., 2015; Irwin, 2015). A minimum of 7 hours of sleep per night on a regular basis is necessary to support optimal health (Chaput et al., 2017; Hirshkowitz et al., 2015; Watson et al., 2015). In addition, healthy sleep should also occur at an appropriate time, be subjectively satisfactory and provide a sustained level of alertness during waking hours (Buysse, 2014).

Sleep has a major effect on almost all life processes, through its impact on an individual's physical and psychological wellbeing, as well as alertness and attention processes. Sleep is an important factor in stress regulation (Âkerstedt, 2006; Benham, 2010), mood regulation (Palagini et al., 2019; Zaki et al., 2018) and self-esteem (Lemola et al., 2013). Insufficient sleep is associated with increased risk of type 2 diabetes, cardiovascular disorders and stroke, obesity, and various other negative health outcomes (Cabeza de Baca et al., 2019; Ferre et al., 2013; Knutson et al., 2006; Patel, 2009). Although sleep plays a major role in the regulation of important life functions, in the past it has primarily been studied through the lens of abnormal sleep, such as sleep disorders and sleep deficiencies (Ohayon et al., 2017). While this serves the purpose of diagnosing and treating sleep-related disorders, it doesn't necessarily help in understanding what comprises good sleep health. Buysse (2014, pg. 12) defines the concept of sleep health as "a multidimensional pattern of sleep-wake-fulness, adapted to individual, social and environmental demands, that promote physical and mental wellbeing". It is important to understand and assess a person's optimal sleep timing, duration, and quality to improve their overall quality of life (Buysse, 2014; Hall, 2010; Luyster et al., 2012). Sleep quality

is often a measure of several factors of sleep, including the general architecture of sleep as well as an individual's subjective rating of their sleep (Fabbri et al., 2021; Krystal & Edinger, 2008; Landry et al., 2015).

Sleep Mechanisms

Human sleep is primarily regulated by two processes: sleep homeostasis and the circadian timekeeping system. Sleep homeostasis is a process that is characterized by the rise of sleep pressure during waking hours and its dissipation during sleep (Borbely & Achermann, 1999), and ensures a person meets their daily sleep needs. The process of sleep homeostasis is known colloquially as *sleep drive*. The circadian timekeeping system refers to the internal biological mechanisms that are responsible for daily cycles of activity in various physiological and psychological processes, such as maintenance of core body temperature and blood pressure, synthesis and secretion of various hormones, and overall task performance (Hastings et al., 2007).

The circadian system is largely regulated by the suprachiasmatic nuclei (SCN), a group of neurons within the anterior hypothalamus. The SCN is often called the "master circadian clock" as it coordinates the entirety of the circadian system to function in alignment with the natural day/night cycle. To do this, the SCN uses external cues, called zeitgebers ("time-givers" in German) for entrainment, which include environmental cues such as light exposure (Dimitriu & Barkoukis, 2007; Duffy & Wright Jr, 2005; Lewy et al., 2009). Other zeitgebers include mealtimes and calories in food eaten (Stephan, 1997, 2002), physical activity (Edwards et al., 2009; Nuñez et al., 2017), and social interaction (Grandin et al., 2006; Sharma &

Chandrashekaran, 2005; Wiss & Tordjman, 2016). Without environmental stimuli to synchronize the circadian system to the day/night cycle, an individual's circadian rhythms tend to be either slightly longer or shorter than 24 hours (Zhang et al., 2010).

The strongest zeitgeber for the circadian system is light in the external environment. Light exposure is detected by special photoreceptors in the retina (intrinsic photosensitive retinal ganglion cells). Light information is then transmitted to the SCN via the retinohypothalamic tract where it influences the firing rate of SCN neurons. Light exposure synchronizes circadian rhythms (which in most humans are slightly longer than 24 hours) to that of the solar light/dark cycle. In general, when an individual is exposed to light in the morning (after the nadir of the core body temperature rhythm), a phase advance occurs, causing physiological changes that promote alertness (Lack & Wright, 2007; Ruth M Lunn et al., 2017). Conversely, when an individual is exposed to light in the evening or night (prior to the nadir of the core body temperature rhythm), a phase delay occurs… (Lack & Wright, 1993). The magnitude and direction of phase shifts are highly dependent on the wavelength of the light, thphae intensity and duration of exposure, and the time of the exposure (Duffy & Wright Jr, 2005). Advances in industry and technology have now made it possible to have artificial light on demand at any time of the day, which has unintended consequences on the circadian system, such as delayed bedtime and circadian disruption (e.g., social jetlag), leading to daytime sleepiness, poorer sleep quality, fatigue, tiredness, etc. (Hunter & Figueiro, 2017; Lunn et al., 2017; Ohayon & Milesi, 2016; Smolensky et al., 2015).

Sleep Physiology and Architecture

The physiological changes related to sleep are well studied. Sleep in humans consists of two different types, rapid eye movement (REM) sleep and non-rapid eye movement (NREM) sleep. With the help of modern sleep-recording technology, such as polysomnography, the physiological changes associated with sleep have been studied in detail. Sensory responses such as the visual, somatosensory, auditory, and nociceptive sensory responses are diminished at varying stages as a person transition into sleep and display different characteristics during the two different types of sleep (Carley & Farabi, 2016; Fontanini & Katz, 2008).

NREM sleep has three distinct stages that are associated with progressively deeper sleep. These stages are called N1, N2, and N3 sleep, respectively (Iber et al., 2007). N1 sleep is the lightest sleep stage, characterized by reduced muscle tone and replacement of alpha waves with low-amplitude mixed frequency EEG activity. N2 sleep is light sleep and is characterized by the slowing down of heart rate and breathing, an absence of eye movements and a drop in body temperature. N3 is the deepest stage of sleep and is characterized by delta waves (high amplitude, slower frequency EEG activity), during which the “repairing and regrowth” of the body primarily occurs (Carskadon & Dement, 2005; Patel et al., 2021). REM sleep is commonly associated with dreaming and is characterized by the near-complete atonia of the large skeletal muscles (Carley & Farabi, 2016; Fontanini & Katz, 2008). While REM sleep is not divided into stages, two distinctions exist - tonic REM, in which alertness and environmental processing are partially maintained, and phasic REM, wherein cortical activity is detached from the

surrounding environment, and there is an attenuation of external information processing (Carskadon & Dement, 2005; Simor et al., 2020).

Normal Sleep Architecture

Individuals generally cycle through these sleep stages throughout the sleep period, going through the NREM sleep stages and REM sleep several times a night (Carskadon & Dement, 2005). Adult humans tend to enter sleep via NREM sleep, usually transitioning from N1 to N2 to N3 sleep. Sleep cycles usually alternate between NREM and REM sleep, with N3 sleep dominating the first third of the sleep period and REM sleep dominating the later stages of sleep (Chokroverty, 2017; Deatherage et al., 2009). The length of each sleep cycle ranges between 70 to 120 minutes, and is on average 90 minutes, with the second and later cycles getting progressively longer (Gath & Bar-On, 1983)

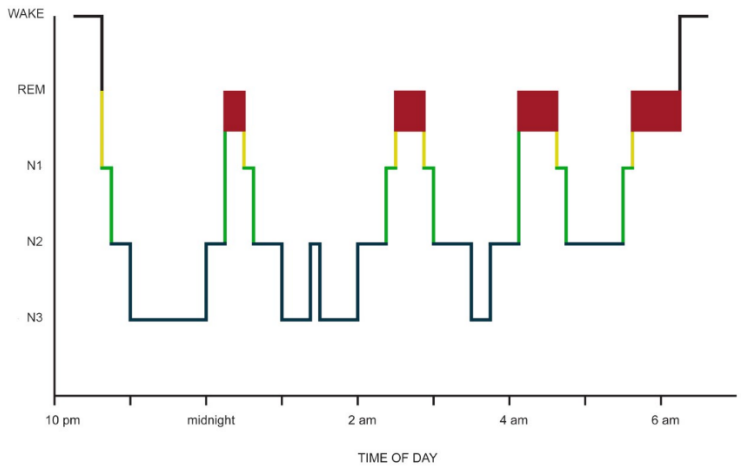

Fig 1. Schematic hypnogram representing adult human sleep (personal communication, O'Keeffe, 2021)

Usually, NREM sleep makes up 75 to 80% of the total sleep time (N3 sleep predominantly makes up about 20%-30% of the total sleep duration in most young adults), while the remaining 20 to 25% is spent in REM sleep (Altevogt & Colten, 2006; Iber, 2007). N1 sleep typically makes up around 5% of an entire night's sleep, while N2 sleep makes up around 50% (Carskadon & Dement, 2005; Patel et al., 2021). Individuals spend most of their sleep period in N3 sleep for the first half of the night, however the length of time continuously spent in N3 sleep gets shorter through the night as more time gets spent in REM sleep (Březinová, 1974).

What Constitutes "Good" sleep?

Many sleep studies are often carried out by the means of polysomnography. A Polysomnography is an effective tool that provides, at a minimum, quantitative data related to sleep architecture. The data captured include electroencephalography (to measure brain activity), electro-oculography (to measure eye movement) and electromyography (to measure muscle activity). Additional information that may be captured includes electrocardiography (to measure the electrical activity of the heart), pulse oximetry (to measure the oxygen saturation in the blood) and other physical markers of sleep.

Certain characteristics measured by the polysomnography can be used to quantitatively measure good sleep. The definitions of sleep quality measured include the following dimensions (Ohayon et al., 2017; Shrivastava et al., 2014):

1. Sleep Latency: refers to the duration of time between when attempts to fall asleep are made, and when the individual finally falls asleep. Normal sleep onset latency is generally around 10 to 20 minutes (Jung et al., 2013).

2. Total Sleep Time: The total time of sleep recorded a sleep period. This includes the time from sleep onset to sleep offset. Normal total sleep time is in the range of 7-9 hours (Hirshkowitz et al., 2015).

3. Sleep efficiency: refers to the ratio of total sleep time to the time spent in bed. Normal sleep efficiency is around 85% (Ohayon et al., 2004).

4. Wake After Sleep Onset: Represents the total amount of time spent awake after sleep onset and before the final awakening. Wake after sleep onset increases with age, with around 15 minutes at age 20, increasing approximately 10 minutes per ten-year increase in age from 30 to 60 years, after which it remains mostly unchanged (Li et al., 2018; Ohayon et al., 2004). A higher wake after sleep onset leads to a lower sleep efficiency.

In addition to physiological, objective markers of sleep, there has been intensive study on the subjective markers of the quality of sleep. One of the questionnaires used most widely for determining subjective sleep quality is the Pittsburgh Sleep Quality Index, which assesses seven components of sleep in an individual - subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction over the last month (Buysse et al., 1989). Another questionnaire with increasing use in sleep research is the Patient-Reported Outcomes Measurement Information System

Sleep Disturbance Short Form, which attempts to measure an individual's perception of sleep quality, sleep depth, and restoration associated with sleep (Buysse et al., 2010). Other questionnaires and rating scales, such as the Sleep Quality Scale and General Sleep Disturbance Scale (GSDS) also aim to measure the same concepts (Shahid et al., 2011; Yi et al., 2006). These subjective experiences of sleep are also often compared with the objective assessments from polysomnography to obtain a holistic idea of overall sleep characteristics in an individual.

Factors affecting sleep quality

Multiple factors affect the duration, timing, and quality of sleep. The identification of these factors has led to the development of sleep hygiene guidelines, to provide advice to the general public about factors that promote healthy sleep. Sleep hygiene is defined as a set of recommendations for behavioural and environmental practices, intended to encourage healthy sleep (Hauri, 1991). Common sleep hygiene recommendations focus on factors that affect sleep, such as the duration and timing of light exposure, inclusion and optimum timing of physical activity, timing of meals, reduction or avoidance of recreational drugs (e.g., caffeine, nicotine, alcohol), as well as optimal timing and duration of sleep and daytime napping (Hirshkowitz et al., 2015; Irish et al., 2015; Ohayon et al., 2017). However, other factors such as stress, social interactions and life events are also well-known determinants of sleep quality (Breslau et al., 1996; Irish et al., 2015; Oswald, 1962; St-Onge et al., 2016). The present section focuses on exposure to blue light, social interactions, stress, and particular life events which commonly co-occur with the use of social media, and that may also affect sleep quality.

Under normal usage (i.e., without any filters), artificial light emitted from electronic devices (e.g., televisions, cell phone screens, etc.) tends to display a strong concentration and large amount of blue-green wavelength light (450nm – 570nm; Lee et al., 2019; Warman et al., 2003). Recent literature has found that the blue light wavelengths emitted from screens on closely-held electronic devices can have unintended consequences on the circadian system (Caddas, 2021; Nash et al., 2019). Additionally, exposure to blue light may lead to an increased activation of the locus coeruleus, which is responsible for the secretion of norepinephrine, which in-turn is responsible for increased alertness and a lower desire to sleep (Alkozei, 2020; Vandewalle et al., 2009; Woudenberg et al., 2015). An increasing body of literature now exists suggesting a relationship between night-time screen use (on smartphones, televisions, etc.) and sleep. For example, Chang et al. (2015) found that the use of portable light-emitting devices before bedtime resulted in certain biological effects that may contribute to a reduction in sleep duration and disruption of circadian rhythms (i.e., increased sleep onset latency, suppression of the evening rise in melatonin, and a phase delay in the circadian timing system), which negatively alertness on waking the following morning. In addition, Cajochen et al. (2011) found that the light emitted by computer screens had a spectral profile that was associated with suppression of the evening rise in melatonin and evening sleepiness levels, and an increase in cognitive performance related to attention and working memory. Finally, Parent et al. (2016) found that higher levels of youth screen time were associated with more sleep disturbances.

While blue light exposure has been identified as a contributor to sleep disturbance in those who use electronic devices in the 1-2 hours before bed, research also suggests that other factors associated with social media use may be associated with sleep disturbances. For

example, Mesquita and Reimão (2010) found that internet use between 9 pm and 12 am increased the risk of poor sleep (measured by the Pittsburgh Sleep Quality Index) among young adults, in comparison with a sample of young adults who were engaging in television watching during the same time period. Social media use, especially before bedtime, is quite prevalent and individuals are often unaware of, or disregard, the effects it can have on their physical or psychological health (Harbard et al., 2016; Owens & Group, 2014; Xanidis & Brignell, 2016). Woods and Scott (2016) found that individuals who were more emotionally connected to social media websites were more likely to have poor sleep quality. Tandon et al., (2020) found that the fear of missing out on social media was a predictor for problematic sleep patterns (such as sleep onset delay and a lower quality of sleep) and reduced sleep quality in young adults. Recent research suggests that social media's effect on emotions and affect could be one of the factors that indirectly affects' an individual's sleep (Aldhawyan et al., 2020; Alonzo et al., 2021; Woods & Scott, 2016).

A well-known bi-directional effect on sleep is that of stress. Various studies have linked a reduction in sleep quality (whether it be physiological changes such as higher sleep latency, lower sleep efficiency, or poorer subjective ratings of sleep quality) to various stressors in life. Sleep deprivation and disturbances are linked to chronic stress (Armon et al., 2008; Lund et al., 2010). For example, Kim & Dimsdale (2007) found that individuals with post traumatic stress disorder tended to have a higher number of awakenings and lower sleep efficiency. They also found that stress induced via experimental manipulation in a laboratory setting resulted in decreased slow wave sleep, deceased sleep efficiency, and increased awakenings. Similarly, Âkerstedt (2006) found that an expectation of high workloads was associated with shorter and

more disturbed sleep. In a longitudinal study, van der Schuur et al. (2019) found that stress experienced on social media was associated with higher sleep latency as well as greater daytime sleepiness, suggesting that how users perceive and cope with their social media experiences is important, in addition to the amount of time that is spent on social networking websites and applications.

Anger may also have a negative effect on sleep quality. Kamphuis et al. (2012) suggested a bi-directional interaction between sleep and anger, similar to the interactions of other affective states with sleep. This effect of anger on sleep seems to have various mechanisms. Individuals who experience a bout of anger are more likely to perceive and reflect on that aggravation, which may increase cognitive arousal as well as physical arousal, such as increased blood pressure, before bedtime and during sleep (Deffenbacher et al., 1996; Gerin et al., 2006; Harvey, 2000; Thomsen et al., 2003; Wilkowski & Robinson, 2010). There is also some evidence that individuals who suppress their angry feelings tend to have worse sleep quality, comprising a greater number of awakenings and more difficulty falling asleep (Ottoni et al., 2011; Shin et al., 2005). Erreygers et al. (2019) found that for adolescents, cyberbullying or online aggression on social media affects an individual's sleep due to the heightened feelings of anger produced over time. Hisler and Krizan (2017) found that trait anger was associated with poorer sleep quality, not only in self-report sleep diaries, but also on an actigraphy assessment measuring sleep duration, sleep latency, sleep fragmentation, and wake after sleep onset. Finally, disturbed sleep may be followed with an increase in anger (Hisler and Kirzan, 2017).

Overall, the research suggests that social media's effect on sleep may be due to more than just the blue light exposure associated with viewing social media on an electronic screen. Social media has the potential to cause a range of emotional responses, including negative-valence responses such as stress and anger, that affect sleep duration and quality. The present thesis focuses upon the negative emotional responses associated with social media use and their associations with sleep quality. It is therefore important to consider what "social media" constitutes and what plausible theoretical pathways might cause the use of social media websites and apps to influence a person's sleep quality.

What is Social Media?

Socialization has been a cornerstone in human survival and evolution by being a vital and novel ability to collaborate, share, co-create and live co-dependently (Havighurst, 1973). An individual's social connections in the workplace, education institutions, society, ethnic and cultural communities are related to a variety of positive psychological outcomes, such as lower anxiety and higher self-esteem (Cockshaw & Shochet, 2010; Cohen, 2004; Lee & Robbins, 1995; Yoon & Lee, 2010) as well as positive physical health outcomes (Cohen, 2004). Tajfel et al. (1979) popularized the idea of an individual's identity as a part of a social community, i.e., the "in-group", and this idea has been supported by a sizeable body of literature (Crocetti et al., 2018; Dovidio et al., 2008; Gaertner et al., 1993; Scheepers & Ellemers, 2019). In the present day, technology is an integral means to connect and socialize with people around the globe (Humphreys, 2005).

The first web-based means of connecting to people launched in the early 1990s. One of the most popular websites from the early days of "social networking" was launched in 1997 and called SixDegrees, which had features that are still in use on websites popular today (Ngak, 2011). Social media websites are defined as mobile and web-based interactive platforms through which individuals and communities create, alter, share, and discuss content, much of which is user generated (Kietzmann et al., 2011). Social networking sites (SNS) are a part of social media which offer users three main features (boyd & Ellison, 2007); an ability to:

1. Construct a public or private "profile" of themselves within a system
2. Find and add other users with whom they would like to connect and socialize
3. View and navigate content posted by users they choose to connect with and others within the system.

One of the differences between social media in the early 1990s and today's platforms is their pervasiveness. It is estimated that over 3.6 billion users of social media existed worldwide in 2020, and this number is only expected to further increase in the coming years (Statista, 2021). A contributor to this prevalence is the availability of SNS on mobile smartphones, that make them increasingly easy to access wherever a user has these devices with them (Kaplan & Haenlein, 2012). A longitudinal study by Pew Research Center (2021) found that social media use in Americans rose from 5% of American adults in 2005 to 72% in 2021. While the young adult age group (18 to 29) was an early adopter of social media in its initial days, recently adults aged 30 to 49 also have similar usage statistics, which could represent the early adopters who have now aged (Pew Research Center, 2021).

In the present day, social media is not limited only to peer connections. The most recent definition of social media by Bayer et al. (2020, p. 472) conceptualizes it as communication channels, specifically device-mediated, that allow users to partake in social interaction with audiences, in real time or asynchronously. It is indeed true that social media has made great strides, from being a place to connect with peers and post one's own content, to being a place where texts and photos can be stored and shared, information can be imparted, music can be listened to, video games can be played, and self-advertisement can be undertaken in the hopes of monetary gains (Bertaglia et al., 2021; Khlaif & Salha, 2021; Kietzmann et al., 2011; O'Keeffe et al., 2011). There is a rise in individuals using social media as a form of livelihood, from being video content creators for websites such as YouTube, or "streamers" (e.g., someone who broadcasts live video of them undertaking activities like playing video games) of content, to being "influencers" or "social media managers" for various brands. As such, a social presence is often an important and integral part of SNS users' lives (Bertaglia et al., 2021; Hudders et al., 2021; Panay, 2011; Postigo, 2016; Wollan et al., 2011). Social networking sites provide individuals with a platform to create and control their personas and self-presentations (Carbonell & Panova, 2017; Oberst et al., 2016). These sites allow for socialization, especially when in-person interactions may not be possible, such as during the COVID-19 pandemic and the government-mandated lockdowns that were in place in many locations around the globe (Goel & Gupta, 2020; Shapiro & Margolin, 2014). Finally, social media offers a novel method of forming and maintaining new and existing relationships (Akram & Kumar, 2017; Lenhart et al., 2015).

These positive aspects, however, may be accompanied by a variety of potential negative effects on individuals. Some emerging research suggests that an overuse of social media is linked to lower self-esteem, higher depressive symptoms, reduced academic ability, and a reduction in interpersonal skills and experiences (Barker, 2009; Dumas et al., 2020; Kalpidou et al., 2011; Kirschner & Karpinski, 2010; Lei et al., 2020). This contrasts with other research that indicates a weak or no relationship between social media use and factors related to wellbeing (Heffer et al., 2019; Orben & Przybylski, 2019a, 2019b). A possible reason for the divergent findings in the literature attempting to understand the relationship between social media use and wellbeing is that engagement on social media can contain a variety of positive and negative experiences. Perhaps, only certain kinds of social media experiences are associated with a reduction in wellbeing. Some users are exposed to negative experiences (such as cyberbullying, online arguments, exposure to false news, etc.) which can affect their overall social media experience (Bebić & Volarević, 2018; Buckels et al., 2014; O'Keeffe et al., 2011; Pabian et al., 2018). In addition, some social media users are increasingly reporting experiencing a fear of missing out and a pressure to be online to keep up to date with their surroundings (Moore & Craciun, 2021; Roberts & David, 2020; Wang et al., 2011).

Social media and Wellbeing

Social media use is often accompanied by social comparison (Lee, 2014; Vogel et al., 2014). Social comparison serves a variety of functions for humans, such as fulfilling the needs of affiliation, making decisions, regulating emotions, and evaluating the self (Camerer & Lovallo, 1999; Festinger, 1954; Schachter, 1959; Taylor & Brown, 1988). Vogel et al. (2014) suggests that

a majority of social comparisons on social networking websites may be upwards social comparisons (comparing oneself to a perceived superior other with ostensibly positive characteristics). In addition, Steers et al. (2014) found that an increase in social media comparisons (higher or lower social comparisons), were linked to higher instances of social media use, as well as depressive symptoms regardless of genders, when compared with individuals that had a lower tendency to indulge in social comparisons online. Finally, Gomez et al. (2021) found that users of social media that displayed a higher number of depressive symptoms, also displayed behaviors of excessive social media use and were more likely to have a more negative self-perception, when compared to users that had a lower or did not have depressive symptoms. These users also display a higher likelihood of making upward self-comparisons. The authors argue that there may be a positive feedback loop at play, wherein with an increase in social media use, there is an increase in individuals making upward social comparisons, which could lead to an increase in depressive symptoms. In turn, this could precipitate an increase in social media use, feeding back into the beginning of the cycle.

There also exists a pressure on social media users to consistently make the best impression possible. Since social media platforms provide users with the ability to control their self-presentations, users are more likely to selectively post content that boosts their ideal self, rather than their actual self (Marom, 2017; Rosenberg & Egbert, 2011; Rui & Stefanone, 2013). This pressure to present the self in a positive light is also related to varying levels of mood disturbances and anxiety (Fox & Vendemia, 2016; Mills et al., 2018; Tiggemann et al., 2020). Boursier et al. (2020) found that self-expectancies about one's social appearance predict

problematic social media use for boys, and overall, the perception of a teens' own bodily appearance are a predictor in problematic/excessive social media use for both boys and girls.

Recent literature has pointed to "a need to belong" as a predictor for social media use (Dailey et al., 2020; Pelling & White, 2009). The need to belong in humans is an evolutionary trait, and the desire for social attachments is a fundamental human motivation (Baumeister & Leary, 1995; Caporael, 2001). Ostracism, or being ignored or excluded, is one of the threats to this intrinsic human drive (Williams, 2007). Ostracism seems to elicit a threat to the four fundamental needs of individuals, i.e., the need to belong, the need for control, the need for meaningful existence and the need for self-esteem (Williams, 2009). Individuals are highly sensitive to detecting ostracism, even if there are only short periods of being excluded (Williams & Zadro, 2005).

Research suggests that the power of feeling ostracized is not limited to face-to-face social interactions (Covert & Stefanone, 2020; Hayes et al., 2018; Reich et al., 2018; Williams & Jarvis, 2006). Wolf et al. (2015) found that social media ostracism (manipulated through receiving "likes" on a researcher created social media website) negatively influenced the participants' need-threat and mood. Similarly, Covert and Stefanone (2020) studied fictitious scenarios on Facebook and found that participants that were excluded experienced a negative emotional response. Finally, Büttner & Rudert (2021) suggest that not being "tagged" on social media posts is a form of ostracism on social media platforms and has a strong aversive effect for individuals with a higher need to belong, suggesting that passive use of social media (consuming content posted by others), can also cause feelings of ostracism. These studies

suggest that experiences of digital ostracism may impact an individuals' affect. Moreover, Greitemeyer et al. (2014) suggests that interpersonal neglect on social media websites (such as having unresponsive friends) seems to threaten the fundamental human need to belong, and in addition, Bevan et al. (2012)'s research found that being "un-friended" on social media can illicit negative emotions such as frustration, anger, and depression, as well as increased rumination in individuals, suggesting that digital ostracism has a negative effect on a person's affect, similar to the way in which real-world ostracism affects a person. Finally, Kramer et al., (2014) found that emotional states on social media (namely, Facebook), could be transferred from one individual to the other, via emotional contagion, without their awareness. This study, though highly controversial due to the absence of any informed consent (Verma I.M., 2014), supports the idea that social media use and exposure to emotion-laden content, generated by other users, could influence a viewer's own emotions as well.

Many of these social media websites and applications have a wide range of features that are free to use. It is a long-held marketing maxim that "If you are not paying for the product, then you are the product" (Serra et al. 1980), a quote still widely employed to explain how multi-billion dollars are made in profit from social media sites (Goodson, 2021; Papadopoulos et al., 2017). One of the main ways that many social media sites remain free to use for individuals is by collecting user's personal data, which may then be either used to display targeted advertisements, sold to other entities, or both (Isaak & Hanna, 2018; Knoll, 2016). With these vested interests in data mining, experts postulate that many social media sites may be designed with the intention of promoting user engagement, using calming color schemes and personalized newsfeeds and suggestions (Alutaybi et al., 2019; Montag et al., 2019; Nguyen,

2020). As an extension of these engaging designs, social media usage also has a "rewarding nature", which may be a factor in excessive use for some individuals (Oberst et al., 2016). Sherman et al., (2018) examined neural responses to receiving and providing "positive feedback" (i.e., likes) on Instagram. The research concluded that the experience of positive feedback mechanisms when using social media activated the neural circuitry involved in rewards, salience processing, and executive functioning. Thus, social media use stimulates neural networks associated with enjoyment, and may partially explain why overuse of social media occurs for some individuals. In addition, other research has also found that intensive activity online contributes to problematic excessive engagement, which some researchers argue may be similar to other behavioral addictions (Andreassen et al., 2017; Atroszko et al., 2018; Punyanunt-Carter et al., 2017), although further research is needed (Zendle & Bowden-Jones, 2019). Furthermore, an expectation of rewards and an implicit association of social media use with a positive experience is also found to be linked to excessive use (Brailovskaia & Teichert, 2020; Turel & Serenko, 2020).

Sleep quality and social media

Much of the research that investigates the relationship between sleep and electronic device use focuses on two key mechanisms that may be influencing the relationship. Firstly, as noted earlier, an increasing body of research has investigated the use of electronic devices at nighttime, including blue light exposure, and the subsequent effects on an individual's sleep duration and quality (Cabré-Riera et al., 2019; Jniene et al., 2019; Mireku et al., 2019). The second mechanism that could explain the relationship between sleep and electronic device use

attempts to understand how the use of electronic devices may be displacing normal bedtimes, leading to later sleep onset (Bartel & Gradisar, 2017; Cain & Gradisar, 2010; Exelmans & Van den Bulck, 2017).

Recently, studies have begun examining the association between experiences on social media, and the sleep quality and duration for users (Berryman et al., 2018; Levenson et al., 2016, 2017; Scott & Woods, 2019; Tettegah, 2016). For example, Woods and Scott (2016) conducted research with 467 Scottish adolescents, examining the emotional investment reported in social media use. They found that in individuals who were more emotionally invested in social media, the use of social media was associated with poorer sleep quality, anxiety, and depression. While this study was one of the pioneers in examining night-time specific social media use and emotional investment, it did not take control variables such as age and gender into consideration. More recently, Garett et al. (2018) attempted to determine the relationship between social media use and sleep quality among 197 freshmen undergraduate students. Their results suggested that there was a link between sleep quality and not only the frequency of social media use, but also the content of the social media posts. In contrast, the research also found positive associations between sleep quality and general wellbeing, suggesting a bi-directional relationship. However, one of the main limitations of the study is that it only focused on one social media website (namely, Twitter). Secondly, this study also had a disproportionately high number of health science students, as well as an overrepresentation of minority racial and ethnic groups. The latter is both a strength and weakness of the study, because it means that the study is conducted with participant groups often overlooked in psychological research (Ceci et al., 2010), however the overrepresentation may imply that the

results require replication in representative samples to determine to what degree the results are cross-culturally generalizable.

More recently, Rzewnicki et al. (2020) investigated the effects of positive and negative social media experiences on sleep disturbances in a population of U.S. young adults. Social media experiences were measured using a single item scale "About what percentage of your time using social media involves some kind of negative social experience that you are personally involved in?", while sleep disturbances were measured using the Patient Reported Outcomes Measurement Information System which perceived sleep quality, sleep depth and sleep restoration. The results showed an association between high levels of negative social media experience and high levels of sleep disturbance. While the study had a large sample size (n=2,354), it only included U.S. nationals, leaving it unclear whether the results generalise to other countries and cultures. This study also did not include an in-depth means of measuring negative experiences, and instead only used a single item questionnaire which was not validated. Finally, the study only asked about negative experiences that participants were involved in, instead of also measuring experiences that they could have observed.

The present study

This study aims to replicate and extend the current literature by examining the effect of social media experiences on self-reported sleep quality of young adults. The pre-registration of the study (attached in Appendix 2) ensured a transparent analysis process with clear analytic decisions ahead of data collection to minimize unidentified researcher degrees of freedom (Simons et al., 2014). As the study made use of participants from around the world, the sample

is a broad sample of English-speaking young adults. The study employs age, gender, hours on social media, use of blue light filtering apps, and general wellbeing as statistical control variables to better understand the correlations between positive and negative social media experiences and the quality of sleep. This study also attempts to further extrapolate upon the recent findings of Rzewnicki et al. (2020), by comparing associations between sleep quality and the single item measure of negative social media experiences employed in previous research, to the associations between sleep quality and a more comprehensive emotional experiences scale - the Positive and Negative Affect Scale (Watson et al., 1988).

Based upon past research, this research predicted that individuals who report a greater amount of negative social media experiences will have poorer self-reported sleep quality, after controlling for age, gender, hours on social media, use of blue light filtering apps and general wellbeing. This association was predicted to occur for both the single item scale and for the multi-item PANAS scale we employed.

Methods

The present project was evaluated by peer review and judged to be low risk as it involved only adults, no deception, no sensitive topics, and allowed for full informed consent for participation. Consequently, it has not been reviewed by one of Massey University's Human Ethics Committees. A low risk notification was submitted to the Massey University Human Ethics Committee, notification number 4000024372.

Participants

One hundred and ninety-nine responses were collected from participants recruited and compensated via Prolific. The use of Prolific allowed for recruitment across a broad range of demographics. Participants recruited were required to be older than 18 and younger than 35 to limit the effect of any age-related sleep disturbances (Moraes et al., 2014; Wolfson, 2010). Participants were also excluded if they had any diagnosed sleep disorders. Participants were also required to speak English fluently to participate, as the questionnaires used in the study were mainly constructed and validated in English.

Pre-registration

The hypothesis, exclusion, and inclusion criteria, stopping rules, tools used, and analyses carried out were pre-registered on Open Science Framework, and can be found here: https://osf.io/qs278/?view_only=b447f9a84328417c81df078e6ca66eb9

The pre-registered number of participants was 199, as calculated by a G-Power analysis. While responses were collected from 200 individuals through Prolific, after applying the

exclusion criteria, only 181 participants were deemed fit for the research and included in the final analyses.

The preregistration included three exclusion criteria. Firstly, participants over the age of 35 were excluded. Secondly, participants with a diagnosed sleep disorder were excluded. Both these exclusions prevented extraneous variables that could affect the sleep quality in participants not directly related to social media use. Lastly, participants that failed the attention check were excluded.

After pre-registration, a minor deviation from the pre-registered study was made. Contrary to the pre-registration, the use of devices at night-time was not used as a control variable in the multiple regression analyses. This was replaced with a binary control variable that captured device users without blue light filters during nighttime for two main reasons. First, the vast majority of the participants (n = 181) reported using devices at nighttime, and as such the number of non-users would have rendered the results of the analyses underpowered and invalid. Secondly, the current research literature suggests that blue light filtering apps and screen filters may be helpful in blocking the blue wavelength of light (Ayaki et al., 2017; Bossi & Hopker, 2017; Höhn, 2020), suggesting that inclusion of participants who used devices at night with such filters activated would allow us to make valid inferences about the effect of social media while controlling for blue light exposure. This means that the blue light filter applied to the present data was an alternative which captured the intent of, if not the precise specified phrasing, of the pre-registration document. As noted above, restricting the sample to those

participants who reported not using night-time device use rendered the sample too small for valid analysis. This analysis was therefore not performed, and as such is not reported herein.

Design

The study made use of a cross-sectional sample collected through Prolific. Prolific is an online crowdsourcing platform that connects researchers with participants, which is likely to provide a wider pool of participants, help protect their privacy, and help to avoid any researcher bias in the sample (Hirth et al., 2017; Peer et al., 2017).The information given to participants before beginning the survey is attached in Appendix A.

Materials and measures

Demographic details (age and gender) were collected from the participants. The study made use of three self-report scales to measure general wellbeing, social media experiences and general sleep disturbance scale. Age and gender were asked through the means of single item questions. The participants were also asked about their use of social media during an average week (measured in hours), device use in the two hours before bed (and if yes, whether they used blue light filters on their devices in the two hours before bed). Participants were also asked about the presence of any sleep disorders through individual single item questions (see below).

The general wellbeing of participants was measured by the Scale of General Wellbeing (SGWB; Longo et al., 2017). The SGWB is a 65 item Likert-type questionnaire which attempts to capture a comprehensive general wellbeing score. The SGWB has omega hierarchical coefficient

ratings from 0.81 to 0.92 in U.S Adult samples. Re-test correlation values for the general factor was a highly stable value of 0.88. Content validity determined by subject matter experts produced an AVE of 0.50, supporting internal convergent validity (Longo et al., 2017, 2018; Longo et al., 2016).

Participant's experiences on social media were measured with a modified version of the Positive and Negative Affect Schedule-Short Form (PANAS-SF; Watson et al., 1988). The modification consisted of a change in the instructions for the PANAS "For the following questions, please indicate the extent to which you have felt this way due to a social media post over the past week". This modification was made so the PANAS scale could be used to measure participant's experiences on social media. When compared with a measure of subjective wellbeing, the PANAS Positive Affect (PA) correlated positively ($r=0.33$; $p< 0.01$) and the PANAS Negative Affect (NA) correlated negatively ($r=-0.33$; $p< 0.01$) (Thompson, 2007). An acceptable alpha of 0.74 for the NA and an alpha of 0.80 for the PA confirms internal consistency reliability (Karim et al., 2011). Finally, there was a medium-run temporal stability of 0.84 for both the PA and the NA as test-retest reliability (Meimann, 2016). Participants were also asked to rate the percentage of negative or positive social media experiences during the past week, as single item questions, to validate the modified PANAS-SF

Finally, subjective sleep quality was measured using the Sleep Quality subscale of the General Sleep Disturbance Scale (Lee, 1992). The GSDS measured sleep quality over the same time period as the other scales (one week) and is also termed to be a valid and reliable scale. The Sleep Quality subscale of the GSDS was rated to be an internally consistent subscale with a

Cronbach's alpha=0.79 (Lee, 1992). Validity has been measured for sleep quality through the use of sleep diaries, r=0.41. For sleep efficiency, validity has been measured against wrist actigraphy results (r= 0.42), suggesting that the scale successfully captures some aspect of sleep quality. The Sleep quality subscale of the GSDS was used as it was deemed valid, reliable, and concise, and has the same timeframe as the PANAS (i.e., both ask about the previous week), making it the ideal choice over the other available scales.

Procedures

Responses were collected using the Prolific survey platform and participants were reimbursed for survey completion. There were no restrictions of location for participants however they did have to be older than 18 and younger than 35. Participants were screened for any pre-existing sleep disorders during the survey by the means of the question: "Do you currently have a diagnosed sleep disorder, such as obstructive sleep apnoea, insomnia, restless legs syndrome, narcolepsy or night terrors? (Note. Your sleep disorder must have been diagnosed by a General Physician or health professional.)". The survey was opened for collection of responses on 23rd of September 2021 and was closed after 199 responses were received, corresponding with the pre-registration criteria.

Results

Exclusions

A total of 3 exclusions were pre-registered. Participants under the age of 18 and over the age of 35 were screened out in the information sheet as well as by the means of a single item question. Participants who had a currently diagnosed sleep disorder were also screened out and excluded from the study. Finally, an attention check was also included to make sure the participants were paying attention and responding seriously to the questions: “I once owned a three-headed dog”. No other exclusions were pre-registered or applied.

Descriptive Statistics

One hundred and ninety-nine responses were collected for the purposes of this study. Participants were recruited by the means of Prolific. Seven participants were excluded from the analyses as they indicated that they were under the age of 18 and as such, could not provide informed consent for the study. Nine participants were excluded as they reported currently having a diagnosed sleeping disorder. Finally, 2 participants were excluded for failing the attention check. The total number of participants after the exclusions was 181.

Average age of the participants was 24.1 years old. 42.5% of the sample identified as males, and 56.9% identified as females, with 0.6% of the sample identifying as non-binary. Out of the 181 responses, 4 reported to be in remission from a sleeping disorder. A majority (99.4%) of the population reported being a user of social media. The average time spent on social media

in a week was 54.9 hours. All users reported using screen-based devices at nighttime, with 22.1% using a blue light filter while 77.9% used social media without a filter.

The mean SGWB sample was 227 (SD=41.7; Range=115-308). The mean scores on the GSDS were 3.83 (SD=1.74; Range= 0-7). Participants' mean score on the modified PANAS-PA was 28.8 (SD=7.99; Range=10-46), while the mean score on the modified PANAS-NA was 20.8 (SD=7.90; Range= 9-46). The mean score on the positive social media experience (PSME) single item question was 66.1 (SD=17.4; Range=15-95) while the mean scores on the negative social media experience (NSME) single item question was 34.6 (SD=19.1; Range=0-85). The modified PANAS-PA scores and the single item PSME scale had a small to moderate positive correlation ($r=0.362$; $p<0.001$) and similarly, the correlation for the modified PANAS-NA scores and the single item NSME question had a small positive correlation ($r=0.215$, $p<0.004$) suggesting that the modified PANAS scale was measuring social media experiences, although the scales were not closely related. This suggests that the scales were successfully measuring distinct aspects of social media experiences.

Confirmatory Analyses

A linear regression between negative social media experience and the GSDS scores was carried out. The results show no relationship between negative social media experience and the GSDS scores, $\beta=0.09$ [-0.04, 0.24], $p = .187$. A linear regression between the PANAS-NA and the GSDS scores was also carried out, showing a weak positive statistically significant correlation between PANAS-NA and the GSDS scores, $\beta = 0.20$ [0.05, 0.34], $p = .006$. This showed that

higher negative emotions from social media experiences were associated with poorer sleep quality.

Moderation Analyses

A multiple regression between the negative social media experience and GSDS was also carried out, with age, gender, hours on social media, night-time screen filter usage and general wellbeing as the controlled variables. Concordant with the results when no statistical controls were employed, the results showed no significant association between negative social media experience and GSDS with statistical controls, $\beta = 0.0671$ [-0.0727, 0.2069], $p = 0.345$,

Another multiple regression analysis was carried out to understand the association between the modified PANAS-NA and the GSDS scores, when controlled for age, gender, hours on social media, use of blue light filters, and general wellbeing. Concordant with the results when no statistical controls were employed, the results showed that after statistical controls were employed a significant small positive relationship between negative emotions from social media experience remained (see Table 1). The results suggest that when controlled for extraneous variables, higher amounts of negative experience on social media remained associated with a poorer sleep quality.

Table 1: Multiple regression between modified PANAS-NA scores and GSDS scores, controlled for age, gender, hours on social media, use of blue light filters and general wellbeing.

Model Coefficients – Negative PANAS and GSDS					
				95% Confidence Interval	

Predictor	Stand. Estimate	Lower	Upper	p
Intercept				< .001
Neg_PANAS	0.1792	0.0391	0.3193	0.012
Age	-0.0716	-0.2133	0.0701	0.32
Gender	0.0671	-0.0724	0.2065	0.344
Hours on Social Media	-0.0551	-0.1958	0.0856	0.441
Use of Bluelight Filter	-0.0538	-0.1943	0.0867	0.451
General Wellbeing	-0.3436	-0.4838	-0.2034	< .001

Discussion

As social media use becomes increasingly prevalent, there is also an increase in the reported negative consequences of using social media. One possible aspect of this is the potential for reduced sleep quality. While a majority of the current research focuses on blue light emission and its effects on an individual's sleep, another prominent feature of social media is its ability to impact various parts of an individual's life, such as their wellbeing, emotions, and sleep (Levenson et al., 2016; O'Reilly et al., 2018; Wongkoblap et al., 2017; Woods & Scott, 2016). The present study aimed to investigate the relationship between negative experiences on social media and sleep quality in young adults.

The results showed a small positive relationship between sleep quality (measured by the GSDS sub-scale) and negative social media experiences (measured by a modified PANAS) when controlled for extraneous factors such as age, gender, hours on social media, use of blue light filtering applications, and general wellbeing. The results also showed no relationship between self-reported negative social media experiences and sleep quality, suggesting that the modified PANAS was measuring negative social media experience in perhaps more details and with finer grain size than the single item questions about the overall valence of social media experiences.

These results suggest that there is an association between an individual's negative experiences on social media and their sleep quality, however, the association is quite subtle. There may be a debate whether the results of the present study are clinically significant, specifically due to the small effect size (Cohen, 2013; Ferguson, 2016). One possible explanation for the small effect sizes could be the timeframe of the study, which only looked at the past

week. While the results of this study are in line with Rzewnicki et al. (2020)'s study which investigated a similar relationship over the time of a week, as well as Woods and Scott's (2016) study that investigated the relationship between sleep and social media use over the duration of a month, there is a distinct gap in the literature in terms of assessing this relationship over a longer period of time. Perhaps the effects are consistently small and may be further mitigated over time, resulting in the observed effect being clinically unimportant. Equally, it is possible that the effects could accumulate in magnitude over time and produce a larger effect over longer timeframes (see Funder & Ozer, 2018 and Sauer & Drummond, 2019 for discussions of the potential accumulation of small magnitude effects). Ultimately, further research is required to understand the magnitude and accumulation of any effect.

The direction of the relationship is also presently unclear. Research suggests that sleep quality has an effect on an individual's response to stress, life satisfaction and overall wellbeing (Bassett et al., 2015; Lane et al., 2014; Rönnlund et al., 2021), suggesting that a reduction in sleep quality may be responsible for the perceived negativity of social media experiences. While the present study provides support to previous findings on the relationship between sleep duration and quality and negative social media valences (Primack et al., 2019; Levenson et al., 2016; Tandon et al., 2020; Woods & Scott, 2016), it is important to note that the association may be a result of an extraneous variable not measured herein. There are multiple studies suggesting an association between social media use and real-world personality changes, lower general wellbeing and increased symptoms of depression and anxiety (Anderson & Jiang, 2018; Lin et al., 2016; McLeod et al., 2014), all of which could affect sleep quality over time (Stephan et al., 2018; Wakefield et al., 2020). Hence, it is important for any future studies to consider not

only the multiple variables that arise by social media use, but also consider the prolonged use of social media and its effects on an individual's characteristics to gain a deeper understanding on the causality and temporality of the proposed associations between social media use and sleep.

An important aspect of the present study is its particular focus upon the large user base of social media platforms, many of whom are adolescents and young adults (Bányai et al., 2017; Pacheco & Melhuish, 2018). Research shows that the frontal lobe development continues into young adulthood; in order to maintain the healthy development, it is crucial that individuals get good quality sleep with adequate timing and duration (Sowell et al., 1999). Sleep duration and quality are both important contributors to the physical and psychological growth in adolescents (Dahl, 1999; Fuligni & Hardway, 2006; Owens & Weiss, 2017), and the displacement of bedtimes as well as the reduction in quality of sleep due to social media use may be a cause of concern for younger generations. These unintended consequences on an individual's health outcomes are not limited only to adolescents. There is an increase in adverse health outcomes, specifically mood disturbances, diabetes, coronary heart disease and mental disorders (Daly et al., 2021; Egede, 2004; Lao et al., 2018; Scott et al., 2021; Twenge et al., 2018), all of which may be correlated with a decrease in sleep quality and/or duration. Thus, it becomes increasingly important to understand the relationship between social media use and its effects on sleep characteristics.

Many applications exist to help users limit their time on social media. Most phones now have a "digital wellbeing" application that allows for monitoring of the time spent on apps and allows individuals to set times for phone usage (Almourad et al., 2021; Parry et al., 2020).

Additionally, blue light filtering applications, such as Twilight, apply a red filter to reduce the amount of blue light an individual is exposed to (Bossi & Hopker, 2017; Šmotek et al., 2020). While these filters work towards reducing the exposure to blue light, specifically in the evenings and before bedtime, the effectiveness of these filters is highly debated (Bigalke et al., 2021; Shechter et al., 2020). While these efforts help reduce the total amount of time spent on social media and reduce the amount of artificial blue light exposure, it is also important to note that as the world becomes increasingly digital, it may become increasingly difficult for individuals to limit their nighttime interactions with social media.

Strengths, Limitations & Suggestions for future research.

The present study has a number of strengths compared to previous research. Perhaps one of the greatest strengths of this study is the use of the modified PANAS scale to measure negative-valence social media experiences. Where previous research (e.g., Rzewnicki et al., 2020) has employed single item scales to assess positive and negative experiences on social media, here a greater number of potential negative emotions which could be caused by social media experiences were asked. While some research suggests that, for some constructs and under some conditions, single item scales are equally valid and reliable as multiple item scales (de Boer et al., 2004; Wanous & Hudy, 2001; Wanous et al., 1997), studies suggest that under most conditions, multiple item measures tend to outperform single item measures (Diamantopoulos et al., 2011). Moreover, Loo (2002) suggested that single-item scales did not capture broader, more heterogenous, specific facets of constructs. Use of multiple-item scales is supported by a variety of researchers, mainly as they capture a broader view of constructs

(Oshagbemi, 1999; Warren & Landis, 2007). Concordantly, here we found that the predicted associations between negative experiences and sleep quality were only observed when we employed the multi-item scale. This suggests that the use of the modified PANAS served to capture a wider range of negative social media related experiences.

The pre-registration of this study was also a strength of the present study. There is a growing understanding that unidentified researcher degrees of freedom and other researcher biases can influence the results of a study (Simmons et al., 2011). The pre-registration of this study provided an ethical method of conducting research as well as making sure that researcher bias was reduced. Pre-registration also allows for the study to be replicated, and the analyses duplicated, which provide further transparency for the results.

Nonetheless, several limitations of the study do exist. One limitation of the present study is that the study measured sleep quality using only the General Sleep Disturbance Scale. The GSDS was chosen because of its conciseness, as well as the timeframe over which it assesses sleep quality (one week), however it is important to note that it only captures three factors - overall subjective sleep quality, feeling refreshed upon waking and subjective satisfaction with sleep. On the other hand, a scale such as the Pittsburgh Sleep Quality Index captures more sleep characteristics, including the latency, duration, efficiency, and disruption as well as the ones measured by the GSDS. Inclusion of a comprehensive scale could possibly provide a more nuanced understanding of the association between negative social media experiences and sleep, due to the greater number of factors measured. Moreover, although sleep-quality is an often-overlooked dimension of sleep, it is only one aspect of what constituents “good sleep”. The present study did not make use of physiological markers of

sleep, which would provide further understanding of the effects on sleep duration and architecture. Additionally, a longitudinal research study could obtain results that help in understanding the effects of negative social media use on individuals over a longer period of time.

Further research would be required to determine if a causal relationship exists between sleep and social media use, the direction and nature of the relationship and the size of the effect. Longitudinal studies would be particularly effective at understanding these causal pathways, as well as highlighting how changes in participants' social media use over time influenced their sleep quality. Future research could also consider adopting a mixed-method approach to obtain a greater understanding of how negative social media experiences affect the lived experiences of individuals. Additionally, as previously noted, laboratory testing as well as polysomnography measurements could provide a deeper understanding of the effects of social media on sleep physiology.

Conclusion

In conclusion, the study of social media experiences and how they affect an individual's sleep characteristics is an important yet overlooked facet of public health. As more people adopt social media and spend a longer amount of time on the sites, it becomes increasingly important to understand how experiences on social media affect an individual's affect. More importantly, since a large user-base of social media are adolescents and young adults that need healthy sleep characteristics for normal brain development, it is important to understand mechanisms and effects that social media use may have on sleep. The present study aimed to examine the relationship between negative social media experiences and sleep quality in young

adults. We found that there was a small positive relationship between negative social media experiences as measured by a modified PANAS-SF, and reduced sleep quality as measured by the sleep quality subscale of the GSDS. The results suggest that negative social media experiences may have a small, yet potentially important, association with lower sleep quality for users.

References

Ahmad, M., Md Din, N. S. B., Tharumalay, R. D., Che Din, N., Ibrahim, N., Amit, N., Farah, N. M., Osman, R. A., Abdul Hamid, M. F., Ibrahim, I. A., Jamsari, E. A., Palil, M. R., & Ahmad, S. (2020). The Effects of Circadian Rhythm Disruption on Mental Health and Physiological Responses among Shift Workers and General Population. Int J Environ Res Public Health, 17(19). https://doi.org/10.3390/ijerph17197156

Åkerstedt, T. (2006). Psychosocial stress and impaired sleep. Scandinavian journal of work, environment & health, 493-501.

Akram, W., & Kumar, R. (2017). A study on positive and negative effects of social media on society. International Journal of Computer Sciences and Engineering, 5(10), 351-354.

Aldhawyan, A. F., Alfaraj, A. A., Elyahia, S. A., Alshehri, S. Z., & Alghamdi, A. A. (2020). Determinants of subjective poor sleep quality in social media users among Freshman college students. Nature and science of sleep, 12, 279.

Alkozei, A. (2020). Understanding the Mechanisms of Blue Light Exposure on Cognitive Performance.

Almourad, M. B., Alrobai, A., Skinner, T., Hussain, M., & Ali, R. (2021). Digital wellbeing tools through users lens. Technology in Society, 67, 101778.

Alonzo, R., Hussain, J., Stranges, S., & Anderson, K. K. (2021). Interplay between social media use, sleep quality, and mental health in youth: A systematic review. Sleep medicine reviews, 56, 101414.

Altevogt, B. M., & Colten, H. R. (2006). Sleep disorders and sleep deprivation: an unmet public health problem.

Alutaybi, A., Arden-Close, E., McAlaney, J., Stefanidis, A., Phalp, K., & Ali, R. (2019). How can social networks design trigger fear of missing out? 2019 IEEE International Conference on Systems, Man and Cybernetics (SMC),

American Medical Association. (2010). Resolution 503: Insufficient sleep-in adolescents. Chicago, IL: American Medical Association, American Academy of Sleep Medicine.

Aminoff, M. J., Boller, F., & Swaab, D. F. (2011). We spend about one-third of our life either sleeping or attempting to do so. Handb Clin Neurol, 98, vii. https://doi.org/10.1016/b978-0-444-52006-7.00047-2

Anderson, K. N., & Bradley, A. J. (2013). Sleep disturbance in mental health problems and neurodegenerative disease. Nature and science of sleep, 5, 61.

Anderson, M., & Jiang, J. (2018). Teens, social media & technology 2018. Pew Research Center, 31(2018), 1673-1689.

Andrade, M. M., Benedito-Silva, A. A., Domenice, S., Arnhold, I. J., & Menna-Barreto, L. (1993). Sleep characteristics of adolescents: a longitudinal study. Journal of Adolescent Health, 14(5), 401-406.

Andreassen, C. S., Pallesen, S., & Griffiths, M. D. (2017). The relationship between addictive use of social media, narcissism, and self-esteem: Findings from a large national survey. Addictive Behaviors, 64, 287-293. https://doi.org/https://doi.org/10.1016/j.addbeh.2016.03.006

Armon, G., Shirom, A., Shapira, I., & Melamed, S. (2008). On the nature of burnout–insomnia relationships: A prospective study of employed adults. Journal of psychosomatic research, 65(1), 5-12.

Atkinson, G., & Davenne, D. (2007). Relationships between sleep, physical activity and human health. Physiology & behavior, 90(2-3), 229-235.

Atroszko, P. A., Balcerowska, J. M., Bereznowski, P., Biernatowska, A., Pallesen, S., & Andreassen, C. S. (2018). Facebook addiction among Polish undergraduate students: Validity of measurement and relationship with personality and well-being. Computers in human behavior, 85, 329-338.

Ayaki, M., Hattori, A., Maruyama, Y., Tsubota, K., & Negishi, K. (2017). Large-scale integration in tablet screens for blue-light reduction with optimized color: The effects on sleep, sleepiness, and ocular parameters. Cogent Biology, 3(1), 1294550.

Bányai, F., Zsila, Á., Király, O., Maraz, A., Elekes, Z., Griffiths, M. D., Andreassen, C. S., & Demetrovics, Z. (2017). Problematic social media use: Results from a large-scale nationally representative adolescent sample. PloS one, 12(1), e0169839.

Barker, V. (2009). Older adolescents' motivations for social network site use: The influence of gender, group identity, and collective self-esteem. Cyberpsychology & behavior, 12(2), 209-213.

Bartel, K., & Gradisar, M. (2017). New directions in the link between technology use and sleep in young people. In Sleep disorders in children (pp. 69-80). Springer.

Bassett, S. M., Lupis, S. B., Gianferante, D., Rohleder, N., & Wolf, J. M. (2015). Sleep quality but not sleep quantity effects on cortisol responses to acute psychosocial stress. Stress, 18(6), 638-644.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. Psychological bulletin, 117(3), 497.

Bayer, J. B., Triệu, P., & Ellison, N. B. (2020). Social media elements, ecologies, and effects. Annual review of psychology, 71, 471-497.

BBC News. 2021. Heavy social media use linked to poor sleep. [online] Available at: <https://www.bbc.com/news/health-50140111> [Accessed 12 October 2021].

Bebić, D., & Volarević, M. (2018). New Problems, Old Solutions? A Critical Look on the Report of the High Level Expert Group on Fake News and On-Line Disinformation. Medijske studije, 9(17), 106-117.

Beebe, D. W. (2011). Cognitive, behavioral, and functional consequences of inadequate sleep in children and adolescents. Pediatr Clin North Am, 58(3), 649-665. https://doi.org/10.1016/j.pcl.2011.03.002

Behar-Cohen, F., Martinsons, C., Viénot, F., Zissis, G., Barlier-Salsi, A., Cesarini, J. P., Enouf, O., Garcia, M., Picaud, S., & Attia, D. (2011). Light-emitting diodes (LED) for domestic lighting: Any risks for the eye? Progress in Retinal and Eye Research, 30(4), 239-257. https://doi.org/https://doi.org/10.1016/j.preteyeres.2011.04.002

Bellet, B. W., Jones, P. J., & McNally, R. J. (2018). Trigger warning: Empirical evidence ahead. Journal of Behavior Therapy and Experimental Psychiatry, 61, 134-141.

Benham, G. (2010). Sleep: an important factor in stress-health models. Stress and Health, 26(3), 204-214. https://doi.org/10.1002/smi.1304

Berryman, C., Ferguson, C. J., & Negy, C. (2018). Social media use and mental health among young adults. Psychiatric quarterly, 89(2), 307-314.

Bertaglia, T., Dubois, A., & Goanta, C. (2021). Clout Chasing for the Sake of Content Monetization: Gaming Algorithmic Architectures with Self-moderation Strategies. Forthcoming in Morals and Machines, 1.

Bevan, J. L., Pfyl, J., & Barclay, B. (2012). Negative emotional and cognitive responses to being unfriended on Facebook: An exploratory study. Computers in human behavior, 28(4), 1458-1464.

Beyens, I., Frison, E., & Eggermont, S. (2016). "I don't want to miss a thing": Adolescents' fear of missing out and its relationship to adolescents' social needs, Facebook use, and Facebook related stress. Computers in human behavior, 64, 1-8.

Bigalke, J. A., Greenlund, I. M., Nicevski, J. R., & Carter, J. R. (2021, 2021/08/01/). Effect of evening blue light blocking glasses on subjective and objective sleep in healthy adults: A randomized control trial. Sleep Health, 7(4), 485-490. https://doi.org/https://doi.org/10.1016/j.sleh.2021.02.004

Bixler, E. O., Vgontzas, A. N., Lin, H.-M., Calhoun, S. L., Vela-Bueno, A., & Kales, A. (2005). Excessive daytime sleepiness in a general population sample: the role of sleep apnea, age, obesity, diabetes, and depression. The Journal of Clinical Endocrinology & Metabolism, 90(8), 4510-4515.

Boobalakrishnan, N. (2021). Social Media and Polity: Network, Exposure, Preferences and Triggers Department of Media and Communication, School of Communication, Central …].

Borbely, A. A., & Achermann, P. (1999). Sleep homeostasis and models of sleep regulation. Journal of biological rhythms, 14(6), 559-570.

Bossi, A. H., & Hopker, J. (2017). Twilight: filter the blue light of your device and sleep better. British Journal of Sports Medicine, 51(14), 1103-1104.

Bourke, N. (2013). Online social networking & wellbeing in adolescents.

Boursier, V., Gioia, F., & Griffiths, M. D. (2020). Do selfie-expectancies and social appearance anxiety predict adolescents' problematic social media use? Computers in human behavior, 110, 106395. https://doi.org/https://doi.org/10.1016/j.chb.2020.106395

boyd, d. m., & Ellison, N. B. (2007). Social Network Sites: Definition, History, and Scholarship. Journal of Computer-Mediated Communication, 13(1), 210-230. https://doi.org/10.1111/j.1083-6101.2007.00393.x

Brailovskaia, J., & Teichert, T. (2020). "I like it" and "I need it": Relationship between implicit associations, flow, and addictive social media use. Computers in human behavior, 113, 106509. https://doi.org/https://doi.org/10.1016/j.chb.2020.106509

Brandtzæg, P. B., & Heim, J. (2008). User loyalty and online communities: why members of online communities are not faithful. Proceedings of the 2nd international conference on INtelligent TEchnologies for interactive enterTAINment,

Breslau, N., Roth, T., Rosenthal, L., & Andreski, P. (1996). Sleep disturbance and psychiatric disorders: a longitudinal epidemiological study of young adults. Biological psychiatry, 39(6), 411-418.

Březinová, V. (1974). Sleep cycle content and sleep cycle duration. Electroencephalography and clinical neurophysiology, 36, 275-282.

Brooks, A. T., Kazmi, N., Yang, L., Tuason, R. T., Krumlauf, M. C., & Wallen, G. R. (2021). Sleep-related cognitive/behavioral predictors of sleep quality and relapse in individuals with alcohol use disorder. International journal of behavioral medicine, 28, 73-82.

Buckels, E. E., Trapnell, P. D., & Paulhus, D. L. (2014). Trolls just want to have fun. Personality and Individual Differences, 67, 97-102.

Büttner, C. M., & Rudert, S. C. (2021). Why didn't you tag me?!: Social exclusion from Instagram posts hurts, especially those with a high need to belong. Computers in human behavior, 127, 107062. https://doi.org/https://doi.org/10.1016/j.chb.2021.107062

Buysse, D. J. (2014). Sleep health: can we define it? Does it matter? Sleep, 37(1), 9-17.

Buysse, D. J., Reynolds, C. F., 3rd, Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res, 28(2), 193-213. https://doi.org/10.1016/0165-1781(89)90047-4

Buysse, D. J., Yu, L., Moul, D. E., Germain, A., Stover, A., Dodds, N. E., Johnston, K. L., Shablesky-Cade, M. A., & Pilkonis, P. A. (2010). Development and validation of patient-reported outcome measures for sleep disturbance and sleep-related impairments. Sleep, 33(6), 781-792. https://doi.org/10.1093/sleep/33.6.781

Cabeza de Baca, T., Chayama, K. L., Redline, S., Slopen, N., Matsushita, F., Prather, A. A., Williams, D. R., Buring, J. E., Zaslavsky, A. M., & Albert, M. A. (2019). Sleep debt: the impact of weekday sleep deprivation on cardiovascular health in older women. Sleep, 42(10), zsz149.

Cabré-Riera, A., Torrent, M., Donaire-Gonzalez, D., Vrijheid, M., Cardis, E., & Guxens, M. (2019). Telecommunication devices use, screen time and sleep in adolescents. Environmental research, 171, 341-347.

Caddas, A. (2021). Blue Light and Adult Sleep Outcomes Otterbein University].

Cain, N., & Gradisar, M. (2010). Electronic media use and sleep in school-aged children and adolescents: A review. Sleep medicine, 11(8), 735-742.

Cajochen, C., Frey, S., Anders, D., Späti, J., Bues, M., Pross, A., Mager, R., Wirz-Justice, A., & Stefani, O. (2011). Evening exposure to a light-emitting diodes (LED)-backlit computer screen affects circadian physiology and cognitive performance. Journal of applied physiology, 110(5), 1432-1438.

Camerer, C., & Lovallo, D. (1999). Overconfidence and excess entry: An experimental approach. American economic review, 89(1), 306-318.

Caporael, L. R. (2001). Parts and wholes: The evolutionary importance of groups. Individual self, relational self, collective self, 241-258.

Carbonell, X., & Panova, T. (2017). A critical consideration of social networking sites' addiction potential. Addiction Research & Theory, 25(1), 48-57.

Carley, D. W., & Farabi, S. S. (2016). Physiology of Sleep. Diabetes Spectrum, 29(1), 5-9. https://doi.org/10.2337/diaspect.29.1.5

Carskadon, M. A., & Dement, W. C. (2005). Normal human sleep: an overview. Principles and practice of sleep medicine, 4, 13-23.

Carskadon, M. A., & Dement, W. C. (2017). Chapter 2 - Normal Human Sleep: An Overview. In M. Kryger, T. Roth, & W. C. Dement (Eds.), Principles and Practice of Sleep Medicine (Sixth Edition) (pp. 15-24.e13). Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-323-24288-2.00002-7

Carskadon, M., & Dement, W. (1989). Normal Human Sleep: An Overview. Principles and Practice of Sleep Medicine. M.H. Kryger (Ed.). W.B. Saunders, Philadelphia, 3-13.

Ceci, S. J., Kahan, D. M., & Braman, D. (2010). The WEIRD are even weirder than you think: Diversifying contexts is as important as diversifying samples. *Behavioral and Brain Sciences*, *33*(2-3), 87.

Chang, A.-M., Aeschbach, D., Duffy, J. F., & Czeisler, C. A. (2015). Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. Proceedings of the National Academy of Sciences, 112(4), 1232-1237.

Chaput, J.-P., Wong, S. L., & Michaud, I. (2017). Duration and quality of sleep among Canadians aged 18 to 79. Health reports, 28(9), 28.

Charoenwanit, S. (2019). The relationship of cyber-bullying and academic achievement, general health, and depression in adolescents in Thailand. Walailak Journal of Science and Technology (WJST), 16(4), 231-241.

Chen, M. C., Burley, H. W., & Gotlib, I. H. (2012). Reduced sleep quality in healthy girls at risk for depression. J Sleep Res, 21(1), 68-72. https://doi.org/10.1111/j.1365-2869.2011.00934.x

Chokroverty, S. (2017). Overview of normal sleep. In Sleep disorders medicine (pp. 5-27). Springer.

Chou, W.-Y. S., Hunt, Y. M., Beckjord, E. B., Moser, R. P., & Hesse, B. W. (2009). Social media use in the United States: implications for health communication. Journal of medical Internet research, 11(4), e48.

Clayton, R. B., Leshner, G., & Almond, A. (2015). The extended iSelf: The impact of iPhone separation on cognition, emotion, and physiology. Journal of Computer-Mediated Communication, 20(2), 119-135.

Cockshaw, W. D., & Shochet, I. (2010). The link between belongingness and depressive symptoms: An exploration in the workplace interpersonal context. Australian Psychologist, 45(4), 283-289.

Cohen, J. (2013). Statistical power analysis for the behavioral sciences. Routledge.

Cohen, S. (2004). Social relationships and health. American psychologist, 59(8), 676.

Covert, J. M., & Stefanone, M. A. (2020). Does rejection still hurt? Examining the effects of network attention and exposure to online social exclusion. Social Science Computer Review, 38(2), 170-186.

Crocetti, E., Prati, F., & Rubini, M. (2018). The interplay of personal and social identity. European Psychologist.

da Estrela, C., McGrath, J., Booij, L., & Gouin, J.-P. (2021). Heart rate variability, sleep quality, and depression in the context of chronic stress. Annals of Behavioral Medicine, 55(2), 155-164.

Dacey, D. M., Liao, H. W., Peterson, B. B., Robinson, F. R., Smith, V. C., Pokorny, J., Yau, K. W., & Gamlin, P. D. (2005). Melanopsin-expressing ganglion cells in primate retina signal colour and irradiance and project to the LGN. Nature, 433(7027), 749-754. https://doi.org/10.1038/nature03387

Dahl, R. E. (1999). The consequences of insufficient sleep for adolescents. Phi Delta Kappan, 80(5), 354-359.

Dailey, S. L., Howard, K., Roming, S. M. P., Ceballos, N., & Grimes, T. (2020). A biopsychosocial approach to understanding social media addiction. Human Behavior and Emerging Technologies, 2(2), 158-167. https://doi.org/https://doi.org/10.1002/hbe2.182

Daly, M., Sutin, A. R., & Robinson, E. (2021). Depression reported by US adults in 2017–2018 and March and April 2020. Journal of affective disorders, 278, 131-135.

Das-Friebel, A., Lenneis, A., Realo, A., Sanborn, A., Tang, N. K., Wolke, D., von Mühlenen, A., & Lemola, S. (2020). Bedtime social media use, sleep, and affective wellbeing in young adults: an experience sampling study. Journal of Child Psychology and Psychiatry, 61(10), 1138-1149.

de Boer, A. G., van Lanschot, J. J., Stalmeier, P. F., van Sandick, J. W., Hulscher, J. B., de Haes, J. C., & Sprangers, M. A. (2004). Is a single-item visual analogue scale as valid, reliable and responsive as multi-item scales in measuring quality of life? Quality of Life Research, 13(2), 311-320.

Deatherage, J. R., Roden, R. D., & Zouhary, K. (2009). Normal Sleep Architecture. Seminars in Orthodontics, 15(2), 86-87. https://doi.org/https://doi.org/10.1053/j.sodo.2009.01.002

Deffenbacher, J. L., Oetting, E. R., Thwaites, G. A., Lynch, R. S., Baker, D. A., Stark, R. S., Thacker, S., & Eiswerth-Cox, L. (1996). State–trait anger theory and the utility of the trait anger scale. Journal of counseling psychology, 43(2), 131.

DeJong, S. M. (2014). Problematic internet use: a case of social media addiction. Adolescent Psychiatry, 4(2), 112-115.

Demographics of Social Media Users and Adoption in the United States. Pew Research Center: Internet, Science & Tech. (2021). Retrieved 20 October 2021, from https://www.pewresearch.org/internet/fact-sheet/social-media/.

Diamantopoulos, A., Sarstedt, M., Fuchs, C., Wilczynski, P., & Kaiser, S. (2012). Guidelines for choosing between multi-item and single-item scales for construct measurement: a predictive validity perspective. *Journal of the Academy of Marketing Science*, *40*(3), 434-449.

Dimitriu, V., & Barkoukis, T. J. (2007). CHAPTER 12 - Normal Sleep Patterns. In T. J. Barkoukis & A. Y. Avidan (Eds.), Review of Sleep Medicine (Second Edition) (pp. 211-236). Butterworth-Heinemann. https://doi.org/https://doi.org/10.1016/B978-075067563-5.10012-4

Dovidio, J. F., Gaertner, S. L., & Saguy, T. (2008). Another view of "we": Majority and minority group perspectives on a common ingroup identity. European review of social psychology, 18(1), 296-330.

Duffy, J. F., & Wright Jr, K. P. (2005). Entrainment of the human circadian system by light. Journal of biological rhythms, 20(4), 326-338.

Dumas, T. M., Maxwell-Smith, M. A., Tremblay, P. F., Litt, D. M., & Ellis, W. (2020). Gaining likes, but at what cost? Longitudinal relations between young adults' deceptive like-seeking on instagram, peer belonging and self-esteem. Computers in human behavior, 112, 106467.

Dumont, M., & Beaulieu, C. (2007). Light exposure in the natural environment: relevance to mood and sleep disorders. Sleep medicine, 8(6), 557-565.

Edwards, B. J., Reilly, T., & Waterhouse, J. (2009). Zeitgeber-effects of exercise on human circadian rhythms: what are alternative approaches to investigating the existence of a phase-response curve to exercise? Biological Rhythm Research, 40(1), 53-69.

Egede, L. E. (2004). Diabetes, major depression, and functional disability among US adults. Diabetes care, 27(2), 421-428.

Erreygers, S., Vandebosch, H., Vranjes, I., Baillien, E., & De Witte, H. (2019). The longitudinal association between poor sleep quality and cyberbullying, mediated by anger. Health communication, 34(5), 560-566.

Exelmans, L., & Van den Bulck, J. (2017). Bedtime, shuteye time and electronic media: Sleep displacement is a two-step process. Journal of sleep research, 26(3), 364-370.

Fabbri, M., Beracci, A., Martoni, M., Meneo, D., Tonetti, L., & Natale, V. (2021). Measuring subjective sleep quality: a review. International journal of environmental research and public health, 18(3), 1082.

Facebook (2014). Company info: Facebook newsroom.news-room.fb.com. Retrieved May 20, 2014, from http://newsroom.fb.com/company-info/

Ferguson, C. J. (2016). An effect size primer: a guide for clinicians and researchers.

Ferre, A., Ribó, M., Rodriguez-Luna, D., Romero, O., Sampol, G., Molina, C., & Álvarez-Sabin, J. (2013). Strokes and their relationship with sleep and sleep disorders. Neurologia (English Edition), 28(2), 103-118.

Festinger, L. (1954). A theory of social comparison processes. Human relations, 7(2), 117-140.

Fontanini, A., & Katz, D. B. (2008). Behavioral states, network states, and sensory response variability. J Neurophysiol, 100(3), 1160-1168. https://doi.org/10.1152/jn.90592.2008

Fossum, I. N., Nordnes, L. T., Storemark, S. S., Bjorvatn, B., & Pallesen, S. (2014). The association between use of electronic media in bed before going to sleep and insomnia symptoms, daytime sleepiness, morningness, and chronotype. Behavioral Sleep Medicine, 12(5), 343-357.

Fox, J., & Vendemia, M. A. (2016). Selective self-presentation and social comparison through photographs on social networking sites. Cyberpsychology, behavior, and social networking, 19(10), 593-600.

Fuligni, A. J., & Hardway, C. (2006). Daily variation in adolescents' sleep, activities, and psychological well-being. Journal of Research on Adolescence, 16(3), 353-378.

Gaertner, S. L., Dovidio, J. F., Anastasio, P. A., Bachman, B. A., & Rust, M. C. (1993). The common ingroup identity model: Recategorization and the reduction of intergroup bias. European review of social psychology, 4(1), 1-26.

Galeoto, G., Scialpi, A., Grassi, M. L., Berardi, A., Valente, D., Tofani, M., & Paoloni, M. (2021). General Sleep Disturbance Scale: Translation, cultural adaptation, and psychometric properties of the Italian version. CRANIO®, 39(4), 326-334. https://doi.org/10.1080/08869634.2019.1627067

Gardner, D. G., Cummings, L. L., Dunham, R. B., & Pierce, J. L. (1998). Single-item versus multiple-item measurement scales: An empirical comparison. Educational and psychological measurement, 58(6), 898-915.

Garett, R., Liu, S., & Young, S. D. (2018). The relationship between social media use and sleep quality among undergraduate students. Information, Communication & Society, 21(2), 163-173.

Gath, I., & Bar-On, E. (1983). Classical sleep stages and the spectral content of the EEG signal. International journal of neuroscience, 22(1-2), 147-155.

Gerin, W., Davidson, K. W., Christenfeld, N. J., Goyal, T., & Schwartz, J. E. (2006). The role of angry rumination and distraction in blood pressure recovery from emotional arousal. Psychosomatic medicine, 68(1), 64-72.

Gillman, A. G., Kosobud, A. E. K., & Timberlake, W. (2008). Pre- and post-nicotine circadian activity rhythms can be differentiated by a paired environmental cue. Physiology & behavior, 93(1-2), 337-350. https://doi.org/10.1016/j.physbeh.2007.09.013

Goel, A., & Gupta, L. (2020). Social media in the times of COVID-19. Journal of Clinical Rheumatology.

Gohil, A., & Hannon, T. S. (2018). Poor sleep and obesity: concurrent epidemics in adolescent youth. Frontiers in endocrinology, 9, 364.

Gomez, M., Klare, D., Ceballos, N., Dailey, S., Kaiser, S., & Howard, K. (2021). Do You Dare to Compare?: The Key Characteristics of Social Media Users Who Frequently Make Online Upward Social Comparisons. International Journal of Human–Computer Interaction, 1-11.

Goodson, S. (2021). If You're Not Paying For It, You Become The Product. Forbes. Retrieved 22 October 2021, from https://www.forbes.com/sites/marketshare/2012/03/05/if-youre-not-paying-for-it-you-become-the-product/.

Gottlieb, D. J., Redline, S., Nieto, F. J., Baldwin, C. M., Newman, A. B., Resnick, H. E., & Punjabi, N. M. (2006). Association of usual sleep duration with hypertension: the Sleep Heart Health Study. Sleep, 29(8), 1009-1014.

Grandin, L. D., Alloy, L. B., & Abramson, L. Y. (2006). The social zeitgeber theory, circadian rhythms, and mood disorders: review and evaluation. Clinical psychology review, 26(6), 679-694.

Greitemeyer, T., Mügge, D. O., & Bollermann, I. (2014). Having responsive Facebook friends affects the satisfaction of psychological needs more than having many Facebook friends. Basic and Applied Social Psychology, 36(3), 252-258.

Gringras, P., Middleton, B., Skene, D. J., & Revell, V. L. (2015). Bigger, brighter, bluer-better? Current light-emitting devices–Adverse sleep properties and preventative strategies. Frontiers in public health, 3, 233.

Grønli, J., Byrkjedal, I. K., Bjorvatn, B., Nødtvedt, Ø., Hamre, B., & Pallesen, S. (2016). Reading from an iPad or from a book in bed: the impact on human sleep. A randomized controlled crossover trial. Sleep medicine, 21, 86-92.

Gruber, R., Carrey, N., Weiss, S. K., Frappier, J. Y., Rourke, L., Brouillette, R. T., & Wise, M. S. (2014). Position statement on pediatric sleep for psychiatrists. Journal of the Canadian academy of child and adolescent psychiatry, 23(3), 174.

Hall, M. H. (2010). Behavioral medicine and sleep: Concepts, measures, and methods. In Handbook of behavioral medicine (pp. 749-765). Springer.

Harbard, E., Allen, N. B., Trinder, J., & Bei, B. (2016). What's keeping teenagers up? Prebedtime behaviors and actigraphy-assessed sleep over school and vacation. Journal of Adolescent Health, 58(4), 426-432.

Harvey, A. G. (2000). Pre-sleep cognitive activity: a comparison of sleep-onset insomniacs and good sleepers. British Journal of Clinical Psychology, 39(3), 275-286.

Hastings, M., O'Neill, J. S., & Maywood, E. S. (2007). Circadian clocks: regulators of endocrine and metabolic rhythms. Journal of Endocrinology, 195(2), 187-198.

Hauri, P. J. (1991). Sleep hygiene, relaxation therapy, and cognitive interventions. In Case studies in insomnia (pp. 65-84). Springer.

Havighurst, R. J. (1973). History of developmental psychology: Socialization and personality development through the life span. In Life-span developmental psychology (pp. 3-24). Elsevier.

Hayes, R. A., Wesselmann, E. D., & Carr, C. T. (2018). When nobody "likes" you: Perceived ostracism through paralinguistic digital affordances within social media. Social media+ society, 4(3), 2056305118800309.

Heffer, T., Good, M., Daly, O., MacDonell, E., & Willoughby, T. (2019). The Longitudinal Association Between Social-Media Use and Depressive Symptoms Among Adolescents and Young Adults: An Empirical Reply to Twenge et al. (2018). Clinical Psychological Science, 7(3), 462-470. https://doi.org/10.1177/2167702618812727

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. Journal of the academy of marketing science, 43(1), 115-135.

Heo, J.-Y., Kim, K., Fava, M., Mischoulon, D., Papakostas, G. I., Kim, M.-J., Kim, D. J., Chang, K.-A. J., Oh, Y., & Yu, B.-H. (2017). Effects of smartphone use with and without blue light at night in healthy adults: A randomized, double-blind, cross-over, placebo-controlled comparison. Journal of psychiatric research, 87, 61-70.

Higuchi, S., Motohashi, Y., Liu, Y., & Maeda, A. (2005). Effects of playing a computer game using a bright display on presleep physiological variables, sleep latency, slow wave sleep and REM sleep. Journal of sleep research, 14(3), 267-273.

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Hazen, N., Herman, J., Katz, E. S., & Kheirandish-Gozal, L. (2015). National Sleep Foundation's sleep time duration recommendations: methodology and results summary. Sleep Health, 1(1), 40-43.

Hirth, M., Jacques, J., Rodgers, P., Scekic, O., & Wybrow, M. (2017). Crowdsourcing technology to support academic research. In Evaluation in the Crowd. Crowdsourcing and Human-Centered Experiments (pp. 70-95). Springer.

Hisler, G., & Krizan, Z. (2017). Anger tendencies and sleep: Poor anger control is associated with objectively measured sleep disruption. Journal of Research in Personality, 71, 17-26.

Höhn, C. (2020). The impact of smartphone night-shift modes on alertness, sleep and memory consolidation.

Horváth, A., Montana, X., Lanquart, J.-P., Hubain, P., Szűcs, A., Linkowski, P., & Loas, G. (2016). Effects of state and trait anxiety on sleep structure: A polysomnographic study in 1083 subjects. Psychiatry research, 244, 279-283.

Hoyos, C., Glozier, N., & Marshall, N. S. (2015). Recent Evidence on Worldwide Trends on Sleep Duration. Current Sleep Medicine Reports, 1(4), 195-204. https://doi.org/10.1007/s40675-015-0024-x

Hudders, L., De Jans, S., & De Veirman, M. (2021). The commercialization of social media stars: a literature review and conceptual framework on the strategic use of social media influencers. International Journal of Advertising, 40(3), 327-375.

Humphreys, L. (2005). Cellphones in public: social interactions in a wireless era. New media & society, 7(6), 810-833.

Hunter, C. M., & Figueiro, M. G. (2017). Measuring Light at Night and Melatonin Levels in Shift Workers: A Review of the Literature. Biol Res Nurs, 19(4), 365-374. https://doi.org/10.1177/1099800417714069

Iber, C. (2007). The AASM manual for the scoring of sleep and associated events: Rules. Terminology and Technical Specification.

Iber, C., Ancoli-Israel, S., Chesson, A., & Quan, S. (2007). Westchester, Ill: American Academy of Sleep Medicine; 2007. The AASM Manual for the Scoring of Sleep and Associated Events: Rules. Terminology and Technical Specifications.

Irish, L. A., Kline, C. E., Gunn, H. E., Buysse, D. J., & Hall, M. H. (2015). The role of sleep hygiene in promoting public health: A review of empirical evidence. Sleep medicine reviews, 22, 23-36.

Irwin, M. R. (2015). Why sleep is important for health: a psychoneuroimmunology perspective. Annual review of psychology, 66, 143-172.

Isaak, J., & Hanna, M. J. (2018). User data privacy: Facebook, Cambridge Analytica, and privacy protection. Computer, 51(8), 56-59.

Jniene, A., Errguig, L., El Hangouche, A. J., Rkain, H., Aboudrar, S., El Ftouh, M., & Dakka, T. (2019). Perception of sleep disturbances due to bedtime use of blue light-emitting devices and its impact on habits and sleep quality among young medical students. BioMed research international, 2019.

João, K. A. D. R., Jesus, S. N. d., Carmo, C., & Pinto, P. (2018). The impact of sleep quality on the mental health of a non-clinical population. Sleep medicine, 46, 69-73. https://doi.org/https://doi.org/10.1016/j.sleep.2018.02.010

Jose, P. E., & Vierling, A. (2018). Cybervictimisation of adolescents predicts higher rumination, which in turn, predicts worse sleep over time. Journal of adolescence, 68, 127-135. https://doi.org/https://doi.org/10.1016/j.adolescence.2018.07.011

Jung, D. W., Hwang, S. H., Chung, G. S., Lee, Y. J., Jeong, D. U., & Park, K. S. (2013). Estimation of sleep onset latency based on the blood pressure regulatory reflex mechanism. IEEE J Biomed Health Inform, 17(3), 534-544. https://doi.org/10.1109/jbhi.2013.2257816

Kaladchibachi, S., Negelspach, D. C., & Fernandez, F. (2018). Circadian phase-shifting by light: Beyond photons. Neurobiology of Sleep and Circadian Rhythms, 5, 8-14. https://doi.org/https://doi.org/10.1016/j.nbscr.2018.03.003

Kalpidou, M., Costin, D., & Morris, J. (2011). The relationship between Facebook and the well-being of undergraduate college students. Cyberpsychology, behavior, and social networking, 14(4), 183-189.

Kamphuis, J., Meerlo, P., Koolhaas, J. M., & Lancel, M. (2012). Poor sleep as a potential causal factor in aggression and violence. Sleep medicine, 13(4), 327-334.

Kaplan, A., & Haenlein, M. (2012). If you love something, let it go mobile: Mobile marketing and mobile social media 4x4. Business horizons, 55. https://doi.org/10.1016/j.bushor.2011.10.009

Karahanna, E., Xu, S. X., & Zhang, N. (2015). Psychological ownership motivation and use of social media. Journal of Marketing Theory and Practice, 23(2), 185-207.

Karim, J., Weisz, R., & Rehman, S. U. (2011). International positive and negative affect schedule short-form (I-PANAS-SF): Testing for factorial invariance across cultures. Procedia-Social and Behavioral Sciences, 15, 2016-2022.

Kaufmann, T., Elvsåshagen, T., Alnæs, D., Zak, N., Pedersen, P. Ø., Norbom, L. B., Quraishi, S. H., Tagliazucchi, E., Laufs, H., Bjørnerud, A., Malt, U. F., Andreassen, O. A., Roussos, E., Duff, E. P., Smith, S. M., Groote, I. R., & Westlye, L. T. (2016). The brain functional connectome is robustly altered by lack of sleep. NeuroImage, 127, 324-332. https://doi.org/https://doi.org/10.1016/j.neuroimage.2015.12.028

Khlaif, Z. N., & Salha, S. (2021). Using TikTok in Education: A Form of Micro-learning or Nano-learning? Interdisciplinary Journal of Virtual Learning in Medical Sciences, 12(3), 213-218.

Kietzmann, J. H., Hermkens, K., McCarthy, I. P., & Silvestre, B. S. (2011). Social media? Get serious! Understanding the functional building blocks of social media. Business horizons, 54(3), 241-251.

Kim, E.-J., & Dimsdale, J. E. (2007). The Effect of Psychosocial Stress on Sleep: A Review of Polysomnographic Evidence. Behavioral Sleep Medicine, 5(4), 256-278. https://doi.org/10.1080/15402000701557383

Kirschner, P. A., & Karpinski, A. C. (2010). Facebook® and academic performance. Computers in human behavior, 26(6), 1237-1245.

Knoll, J. (2016). Advertising in social media: a review of empirical evidence. International Journal of Advertising, 35(2), 266-300.

Knutson, K. L., Ryden, A. M., Mander, B. A., & Van Cauter, E. (2006). Role of sleep duration and quality in the risk and severity of type 2 diabetes mellitus. Archives of internal medicine, 166(16), 1768-1774.

Kosobud, A. E., Gillman, A. G., Leffel, J. K., Pecoraro, N. C., Rebec, G., & Timberlake, W. (2007). Drugs of abuse can entrain circadian rhythms. TheScientificWorldJournal, 7, 203-212.

Kramer, A. D. I., Guillory, J. E., & Hancock, J. T. (2014). Experimental evidence of massive-scale emotional contagion through social networks. Proceedings of the National Academy of Sciences, 111(24), 8788-8790. https://doi.org/10.1073/pnas.1320040111

Krystal, A. D., & Edinger, J. D. (2008). Measuring sleep quality. Sleep medicine, 9, S10-S17.

Lack, L., & Wright, H. (1993). The effect of evening bright light in delaying the circadian rhythms and lengthening the sleep of early morning awakening insomniacs. sleep, 16(5), 436-443.

Lack, L. C., & Wright, H. R. (2007). Chronobiology of sleep in humans. Cellular and molecular life sciences, 64(10), 1205-1215.

Landry, G. J., Best, J. R., & Liu-Ambrose, T. (2015). Measuring sleep quality in older adults: a comparison using subjective and objective methods. Frontiers in aging neuroscience, 7, 166.

Lane, N. D., Lin, M., Mohammod, M., Yang, X., Lu, H., Cardone, G., Ali, S., Doryab, A., Berke, E., & Campbell, A. T. (2014). Bewell: Sensing sleep, physical activities and social interactions to promote wellbeing. Mobile Networks and Applications, 19(3), 345-359.

Lao, X. Q., Liu, X., Deng, H.-B., Chan, T.-C., Ho, K. F., Wang, F., Vermeulen, R., Tam, T., Wong, M. C., & Tse, L. A. (2018). Sleep quality, sleep duration, and the risk of coronary heart disease: a prospective cohort study with 60,586 adults. Journal of Clinical Sleep Medicine, 14(1), 109-117.

Lee, J.-H., Chen, C.-H., Lee, P.-H., Lin, H.-Y., Leung, M.-k., Chiu, T.-L., & Lin, C.-F. (2019). Blue organic light-emitting diodes: current status, challenges, and future outlook. Journal of Materials Chemistry C, 7(20), 5874-5888.

Lee, K. A. (1992). Self-reported sleep disturbances in employed women. Sleep, 15(6), 493-498. https://doi.org/10.1093/sleep/15.6.493

Lee, R. M., & Robbins, S. B. (1995). Measuring belongingness: The social connectedness and the social assurance scales. Journal of counseling psychology, 42(2), 232.

Lee, S. Y. (2014). How do people compare themselves with others on social network sites?: The case of Facebook. Computers in human behavior, 32, 253-260.

Lei, H., Mao, W., Cheong, C. M., Wen, Y., Cui, Y., & Cai, Z. (2020). The relationship between self-esteem and cyberbullying: a meta-analysis of children and youth students. Current Psychology, 39(3), 830-842.

Lemola, S., Perkinson-Gloor, N., Brand, S., Dewald-Kaufmann, J. F., & Grob, A. (2015). Adolescents' electronic media use at night, sleep disturbance, and depressive symptoms in the smartphone age. Journal of youth and adolescence, 44(2), 405-418.

Lemola, S., Räikkönen, K., Gomez, V., & Allemand, M. (2013). Optimism and self-esteem are related to sleep. Results from a large community-based sample. International journal of behavioral medicine, 20(4), 567-571.

Lenhart, A., Smith, A., Anderson, M., Duggan, M., & Perrin, A. (2015). Teens, technology and friendships.

Levenson, J. C., Shensa, A., Sidani, J. E., Colditz, J. B., & Primack, B. A. (2016). The association between social media use and sleep disturbance among young adults. Preventive medicine, 85, 36-41.

Levenson, J. C., Shensa, A., Sidani, J. E., Colditz, J. B., & Primack, B. A. (2017). Social media use before bed and sleep disturbance among young adults in the United States: A nationally representative study. Sleep, 40(9).

Levenson, J. C., Shensa, A., Sidani, J. E., Colditz, J. B., & Primack, B. A. (2016). The association between social media use and sleep disturbance among young adults. Preventive medicine, 85, 36-41.

Lewy, A. J., Emens, J., Songer, J., & Rough, J. (2009). 80 - The Neurohormone Melatonin as a Marker, Medicament, and Mediator. In D. W. Pfaff, A. P. Arnold, A. M. Etgen, S. E. Fahrbach, & R. T. Rubin (Eds.), Hormones, Brain and Behavior (Second Edition) (pp. 2505-2528). Academic Press. https://doi.org/https://doi.org/10.1016/B978-008088783-8.00080-2

Li, J., Vitiello, M. V., & Gooneratne, N. S. (2018). Sleep in Normal Aging. Sleep medicine clinics, 13(1), 1-11. https://doi.org/10.1016/j.jsmc.2017.09.001

Lin, C. (2002). Blue light receptors and signal transduction. The Plant Cell, 14(suppl_1), S207-S225.

Lin, L. Y., Sidani, J. E., Shensa, A., Radovic, A., Miller, E., Colditz, J. B., Hoffman, B. L., Giles, L. M., & Primack, B. A. (2016). Association between social media use and depression among US young adults. Depression and anxiety, 33(4), 323-331.

Longo, Y., Coyne, I., & Joseph, S. (2017). The scales of general well-being (SGWB). Personality and Individual Differences, 109, 148-159.

Longo, Y., Coyne, I., & Joseph, S. (2018). Development of the short version of the scales of general well-being: The 14-item SGWB. Personality and Individual Differences, 124, 31-34.

Longo, Y., Coyne, I., Joseph, S., & Gustavsson, P. (2016). Support for a general factor of well-being. Personality and Individual Differences, 100, 68-72.

Loo, R. (2002). A caveat on using single-item versus multiple-item scales. Journal of managerial psychology.

Lund, H. G., Reider, B. D., Whiting, A. B., & Prichard, J. R. (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. Journal of adolescent health, 46(2), 124-132.

Lunn, R. M., Blask, D. E., Coogan, A. N., Figueiro, M. G., Gorman, M. R., Hall, J. E., Hansen, J., Nelson, R. J., Panda, S., Smolensky, M. H., Stevens, R. G., Turek, F. W., Vermeulen, R., Carreón, T., Caruso, C. C., Lawson, C. C., Thayer, K. A., Twery, M. J., Ewens, A. D., Garner, S. C., Schwingl, P. J., & Boyd, W. A. (2017). Health consequences of electric lighting practices in the

modern world: A report on the National Toxicology Program's workshop on shift work at night, artificial light at night, and circadian disruption. Sci Total Environ, 607-608, 1073-1084. https://doi.org/10.1016/j.scitotenv.2017.07.056

Lunn, R. M., Blask, D. E., Coogan, A. N., Figueiro, M. G., Gorman, M. R., Hall, J. E., Hansen, J., Nelson, R. J., Panda, S., Smolensky, M. H., Stevens, R. G., Turek, F. W., Vermeulen, R., Carreón, T., Caruso, C. C., Lawson, C. C., Thayer, K. A., Twery, M. J., Ewens, A. D., Garner, S. C., Schwingl, P. J., & Boyd, W. A. (2017). Health consequences of electric lighting practices in the modern world: A report on the National Toxicology Program's workshop on shift work at night, artificial light at night, and circadian disruption. Science of The Total Environment, 607-608, 1073-1084. https://doi.org/https://doi.org/10.1016/j.scitotenv.2017.07.056

Luyster, F. S., Strollo, P. J., Zee, P. C., & Walsh, J. K. (2012). Sleep: a health imperative. Sleep, 35(6), 727-734.

Marom, D. (2017). Curating the self on social media and perceptions of authenticity: an exploratory study

Matricciani, L., Bin, Y. S., Lallukka, T., Kronholm, E., Dumuid, D., Paquet, C., & Olds, T. (2017). Past, present, and future: trends in sleep duration and implications for public health. Sleep health, 3(5), 317-323.

McGorry, S. Y., & McGorry, M. R. (2017). Who are the Centennials: Marketing Implications of Social Media Use and Preferences.

McLeod, P. L., Liu, Y.-C., & Axline, J. E. (2014). When your Second Life comes knocking: Effects of personality on changes to real life from virtual world experiences. Computers in human behavior, 39, 59-70.

Meimann, A. (2016). Positive emotions in daily life, measured by means of an experience sampling application: assessing the validity of the I-PANAS-SF University of Twente].

Mesquita, G., & Reimão, R. (2010). Quality of sleep among university students: effects of nighttime computer and television use. Arquivos de neuro-psiquiatria, 68, 720-725.

Mills, J. S., Musto, S., Williams, L., & Tiggemann, M. (2018). “Selfie” harm: Effects on mood and body image in young women. Body image, 27, 86-92.

Mireku, M. O., Barker, M. M., Mutz, J., Dumontheil, I., Thomas, M. S., Röösli, M., Elliott, P., & Toledano, M. B. (2019). Night-time screen-based media device use and adolescents' sleep and health-related quality of life. Environment international, 124, 66-78.

Mireku, M. O., Barker, M. M., Mutz, J., Dumontheil, I., Thomas, M. S., Röösli, M., Elliott, P., & Toledano, M. B. (2019). Night-time screen-based media device use and adolescents' sleep and health-related quality of life. Environment international, 124, 66-78.

Montag, C., Lachmann, B., Herrlich, M., & Zweig, K. (2019). Addictive features of social media/messenger platforms and freemium games against the background of psychological and economic theories. International journal of environmental research and public health, 16(14), 2612.

Moore, K., & Craciun, G. (2021). Fear of missing out and personality as predictors of social networking sites usage: The Instagram case. Psychological reports, 124(4), 1761-1787.

Moraes, W., Piovezan, R., Poyares, D., Bittencourt, L. R., Santos-Silva, R., & Tufik, S. (2014). Effects of aging on sleep structure throughout adulthood: a population-based study. Sleep medicine, 15(4), 401-409.

Mortazavi, S., Parhoodeh, S., Hosseini, M., Arabi, H., Malakooti, H., Nematollahi, S., Mortazavi, G., Darvish, L., & Mortazavi, S. (2018). Blocking short-wavelength component of the visible light emitted by smartphones' screens improves human sleep quality. Journal of biomedical physics & engineering, 8(4), 375.

Narishige, S., Kuwahara, M., Shinozaki, A., Okada, S., Ikeda, Y., Kamagata, M., Tahara, Y., & Shibata, S. (2014). Effects of caffeine on circadian phase, amplitude and period evaluated in cells in vitro and peripheral organs in vivo in PER2::LUCIFERASE mice. British journal of pharmacology, 171(24), 5858-5869. https://doi.org/10.1111/bph.12890

Nash, T. R., Chow, E. S., Law, A. D., Fu, S. D., Fuszara, E., Bilska, A., Bebas, P., Kretzschmar, D., & Giebultowicz, J. M. (2019). Daily blue-light exposure shortens lifespan and causes brain neurodegeneration in Drosophila. npj Aging and Mechanisms of Disease, 5(1), 1-8.

National Institute of Mental Health, N. (2012). Arousal and Regulatory Systems: Workshop Proceedings. NIH. https://www.nimh.nih.gov/research/research-funded-by-nimh/rdoc/arousal-and-regulatory-systems-workshop-proceedings

Neyman, C. J. (2017). A survey of addictive software design.

Ngak, C. (2011). Then and now: a history of social networking sites. Cbsnews.com. Retrieved 20 October 2021, from https://www.cbsnews.com/pictures/then-and-now-a-history-of-social-networking-sites/.

Nguyen, N. (2020). Doomscrolling: Why We Just Can't Look Away. The Wall Street Journal.

Number of social media users 2025 | Statista. Statista. (2021). Retrieved 20 October 2021, from https://www.statista.com/statistics/278414/number-of-worldwide-social-network-

users/#:~:text=How%20many%20people%20use%20social,almost%204.41%20billion%20in%20
2025.

Nuñez, P., Diaz, I., Perillan, C., Arguelles, J., & Diaz, E. (2017). Circadian urinary citrate excretion in a rat model of exercise. Life Sci, 169, 65-68.
https://doi.org/10.1016/j.lfs.2016.11.019

Nyilasy, G. (2019). Fake news: When the dark side of persuasion takes over. International Journal of Advertising, 38(2), 336-342.

O'Reilly, M., Dogra, N., Whiteman, N., Hughes, J., Eruyar, S., & Reilly, P. (2018). Is social media bad for mental health and wellbeing? Exploring the perspectives of adolescents. Clinical child psychology and psychiatry, 23(4), 601-613.

O'Reilly, M., Dogra, N., Whiteman, N., Hughes, J., Eruyar, S., & Reilly, P. (2018). Is social media bad for mental health and wellbeing? Exploring the perspectives of adolescents. Clinical child psychology and psychiatry, 23(4), 601-613.

Oberst, U., Renau, V., Chamarro, A., & Carbonell, X. (2016). Gender stereotypes in Facebook profiles: Are women more female online? Computers in human behavior, 60, 559-564.

Ogilvie, R. P., & Patel, S. R. (2017). The epidemiology of sleep and obesity. Sleep Health, 3(5), 383-388.

Ohayon, M. M., & Milesi, C. (2016). Artificial outdoor nighttime lights associate with altered sleep behavior in the American general population. Sleep, 39(6), 1311-1320.

Ohayon, M. M., Carskadon, M. A., Guilleminault, C., & Vitiello, M. V. (2004). Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals:

developing normative sleep values across the human lifespan. Sleep, 27(7), 1255-1273. https://doi.org/10.1093/sleep/27.7.1255

Ohayon, M., Wickwire, E. M., Hirshkowitz, M., Albert, S. M., Avidan, A., Daly, F. J., Dauvilliers, Y., Ferri, R., Fung, C., Gozal, D., Hazen, N., Krystal, A., Lichstein, K., Mallampalli, M., Plazzi, G., Rawding, R., Scheer, F. A., Somers, V., & Vitiello, M. V. (2017). National Sleep Foundation's sleep quality recommendations: first report. Sleep Health, 3(1), 6-19. https://doi.org/10.1016/j.sleh.2016.11.006

O'Keeffe, G. S., Clarke-Pearson, K., Communications, C. o., & Media. (2011). The Impact of Social Media on Children, Adolescents, and Families. Pediatrics, 127(4), 800-804. https://doi.org/10.1542/peds.2011-0054

Okuno, T., Saito, H., & Ojima, J. (2002). Evaluation of blue-light hazards from various light sources. Developments in ophthalmology, 35, 104-112. https://doi.org/10.1159/000060814

Orben, A., & Przybylski, A. K. (2019a). The association between adolescent well-being and digital technology use. Nature Human Behaviour, 3(2), 173-182. https://doi.org/10.1038/s41562-018-0506-1

Orben, A., & Przybylski, A. K. (2019b). Screens, Teens, and Psychological Well-Being: Evidence From Three Time-Use-Diary Studies. Psychological Science, 30(5), 682-696. https://doi.org/10.1177/0956797619830329

Oshagbemi, T. (1999). Overall job satisfaction: how good are single versus multiple-item measures? Journal of managerial psychology.

Oswald, I. (1962). Sleeping and waking: Physiology and psychology [doi:10.1037/11541-000]. Elsevier. https://doi.org/10.1037/11541-000

Ottoni, G. L., Lorenzi, T. M., & Lara, D. R. (2011). Association of temperament with subjective sleep patterns. Journal of affective disorders, 128(1-2), 120-127.

Owens, J. A., & Weiss, M. R. (2017). Insufficient sleep in adolescents: causes and consequences. Minerva pediatrica, 69(4), 326-336.

Owens, J., & Group, A. S. W. (2014). Insufficient sleep in adolescents and young adults: an update on causes and consequences. Pediatrics, 134(3), e921-e932.

Pabian, S., Erreygers, S., Vandebosch, H., Van Royen, K., Dare, J., Costello, L., Green, L., Hawk, D., & Cross, D. (2018). “Arguments online, but in school we always act normal”: The embeddedness of early adolescent negative peer interactions within the whole of their offline and online peer interactions. Children and youth services review, 86, 1-13.

Pacheco, E., & Melhuish, N. (2018). New Zealand teens’ digital profile: A factsheet. New Zealand Teens’ Digital Profile: A Factsheet (2018).

Palagini, L., Bastien, C. H., Marazziti, D., Ellis, J. G., & Riemann, D. (2019). The key role of insomnia and sleep loss in the dysregulation of multiple systems involved in mood disorders: A proposed model. Journal of sleep research, 28(6), e12841.

Panay, P. (2011). Rethinking music: The future of making money as a performing musician. Rethinking Music, 57.

Papadopoulos, P., Kourtellis, N., Rodriguez, P. R., & Laoutaris, N. (2017). If you are not paying for it, you are the product: How much do advertisers pay to reach you? Proceedings of the 2017 Internet Measurement Conference,

Parent, J., Sanders, W., & Forehand, R. (2016). Youth screen time and behavioral health problems: The role of sleep duration and disturbances. Journal of developmental and behavioral pediatrics: JDBP, 37(4), 277.

Parry, D. A., le Roux, D. B., Morton, J., Pons, R., Pretorius, R., & Schoeman, A. (2020). Digital Wellbeing Applications: Adoption, Use and Perceived Effects.

Patchin, J. W., & Hinduja, S. (2010). Cyberbullying and self-esteem. Journal of school health, 80(12), 614-621.

Patel, A. K., Reddy, V., & Araujo, J. F. (2021). Physiology, sleep stages. StatPearls [Internet].

Patel, S. (2009). Reduced sleep as an obesity risk factor. Obesity Reviews, 10, 61-68.

Paunio, T., Tuisku, K., & Korhonen, T. (2015). Sleep, work and mental health. Psychiatr. Fennica, 46, 54-61.

Peer, E., Brandimarte, L., Samat, S., & Acquisti, A. (2017). Beyond the Turk: Alternative platforms for crowdsourcing behavioral research. Journal of Experimental Social Psychology, 70, 153-163.

Pelling, E. L., & White, K. M. (2009). The theory of planned behavior applied to young people's use of social networking web sites. Cyberpsychology & behavior, 12(6), 755-759.

Postigo, H. (2016). The socio-technical architecture of digital labor: Converting play into YouTube money. New media & society, 18(2), 332-349.

Primack, B. A., Karim, S. A., Shensa, A., Bowman, N., Knight, J., & Sidani, J. E. (2019). Positive and negative experiences on social media and perceived social isolation. American Journal of Health Promotion, 33(6), 859-868.

Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). Motivational, emotional, and behavioral correlates of fear of missing out. Computers in human behavior, 29(4), 1841-1848.

Punyanunt-Carter, N. M., De La Cruz, J., & Wrench, J. S. (2017). Investigating the relationships among college students' satisfaction, addiction, needs, communication apprehension, motives, and uses & gratifications with Snapchat. Computers in human behavior, 75, 870-875.

Rahman, S. A., Brainard, G. C., Czeisler, C. A., & Lockley, S. W. (2021). Spectral sensitivity of circadian phase resetting, melatonin suppression and acute alerting effects of intermittent light exposure. Biochemical Pharmacology, 114504.

Rahman, S. A., Hilaire, M. A. S., Chang, A.-M., Santhi, N., Duffy, J. F., Kronauer, R. E., Czeisler, C. A., Lockley, S. W., & Klerman, E. B. (2017). Circadian phase resetting by a single short-duration light exposure. JCI insight, 2(7).

Raikes, A. C., Dailey, N. S., Shane, B. R., Forbeck, B., Alkozei, A., & Killgore, W. D. (2020). Daily morning blue light therapy improves daytime sleepiness, sleep quality, and quality of life following a mild traumatic brain injury. The Journal of Head Trauma Rehabilitation, 35(5), E405-E421.

Reich, S., Schneider, F. M., & Heling, L. (2018). Zero Likes–Symbolic interactions and need satisfaction online. Computers in human behavior, 80, 97-102.

Roberts, J. A., & David, M. E. (2020). The Social media party: fear of missing out (FoMO), social media intensity, connection, and well-being. International Journal of Human–Computer Interaction, 36(4), 386-392.

Rogers, N. L., Dorrian, J., & Dinges, D. F. (2003). Sleep, waking and neurobehavioural performance. Front Biosci, 8(6), s1056-s1067.

Rönnlund, M., Åström, E., Westlin, W., Flodén, L., Unger, A., Papastamatelou, J., & Carelli, M. G. (2021). A time to sleep well and be contented: time perspective, sleep quality, and life satisfaction. Frontiers in Psychology, 12, 1225.

Rosenberg, J., & Egbert, N. (2011). Online impression management: Personality traits and concerns for secondary goals as predictors of self-presentation tactics on Facebook. Journal of Computer-Mediated Communication, 17(1), 1-18.

Rosenwasser, A. M. (2001). Alcohol, antidepressants, and circadian rhythms: human and animal models. Alcohol Research & Health, 25(2), 126.

Rui, J., & Stefanone, M. A. (2013). Strategic self-presentation online: A cross-cultural study. Computers in human behavior, 29(1), 110-118.

Rzewnicki, D. I., Shensa, A., Levenson, J. C., Primack, B. A., & Sidani, J. E. (2020). Associations between positive and negative social media experiences and sleep disturbance among young adults. Sleep health, 6(5), 671-675.

Rzewnicki, D. I., Shensa, A., Levenson, J. C., Primack, B. A., & Sidani, J. E. (2020). Associations between positive and negative social media experiences and sleep disturbance among young adults. Sleep health, 6(5), 671-675.

Rzewnicki, D. I., Shensa, A., Levenson, J. C., Primack, B. A., & Sidani, J. E. (2020). Associations between positive and negative social media experiences and sleep disturbance among young adults. Sleep health, 6(5), 671-675.

Sampasa-Kanyinga, H., Hamilton, H. A., & Chaput, J. P. (2018). Use of social media is associated with short sleep duration in a dose–response manner in students aged 11 to 20 years. Acta Paediatrica, 107(4), 694-700.

Sauer, J. D., & Drummond, A. (2020). Boundary conditions for the practical importance of small effects in long runs: A comment on funder and ozer (2019). *Advances in Methods and Practices in Psychological Science*, *3*(4), 502-504.

Schachter, S. (1959). The psychology of affiliation: Experimental studies of the sources of gregariousness.

Scheepers, D., & Ellemers, N. (2019). Social identity theory. In Social psychology in action (pp. 129-143). Springer.

Schibler, U., & Sassone-Corsi, P. (2002). A web of circadian pacemakers. Cell, 111(7), 919-922. https://doi.org/10.1016/s0092-8674(02)01225-4

Scott, H. (2019). Beyond “screentime”: reframing bedtime social media use as a social interaction with unique implications for adolescent sleep University of Glasgow].

Scott, H., & Woods, H. C. (2018). Fear of missing out and sleep: Cognitive behavioural factors in adolescents' nighttime social media use. Journal of adolescence, 68, 61-65.

Scott, H., & Woods, H. C. (2019). Understanding links between social media use, sleep and mental health: Recent progress and current challenges. Current Sleep Medicine Reports, 5(3), 141-149.

Scott, J., Kallestad, H., Vedaa, O., Sivertsen, B., & Etain, B. (2021). Sleep disturbances and first onset of major mental disorders in adolescence and early adulthood: a systematic review and meta-analysis. Sleep medicine reviews, 57, 101429.

Serra, R., Weyergraf, C., & Museum, H. R. (1980). Richard Serra: Interviews, Etc., 1970-1980. Hudson River Museum. https://books.google.co.nz/books?id=gI_jNL7PN2QC

Shahid, A., Wilkinson, K., Marcu, S., & Shapiro, C. M. (2011). General Sleep Disturbance Scale (GSDS). In STOP, THAT and One Hundred Other Sleep Scales (pp. 181-183). Springer.

Shapiro, L. A. S., & Margolin, G. (2014). Growing up wired: Social networking sites and adolescent psychosocial development. Clinical child and family psychology review, 17(1), 1-18.

Sharma, V. K., & Chandrashekaran, M. (2005). Zeitgebers (time cues) for biological clocks. Current Science, 1136-1146.

Shechter, A., Quispe, K. A., Mizhquiri Barbecho, J. S., Slater, C., & Falzon, L. (2020). Interventions to reduce short-wavelength ("blue") light exposure at night and their effects on sleep: A systematic review and meta-analysis. SLEEP Advances, 1(1). https://doi.org/10.1093/sleepadvances/zpaa002

Sherman, L. E., Hernandez, L. M., Greenfield, P. M., & Dapretto, M. (2018). What the brain 'Likes': neural correlates of providing feedback on social media. Social Cognitive and Affective Neuroscience, 13(7), 699-707. https://doi.org/10.1093/scan/nsy051

Shin, C., Kim, J., Yi, H., Lee, H., Lee, J., & Shin, K. (2005). Relationship between trait-anger and sleep disturbances in middle-aged men and women. Journal of psychosomatic research, 58(2), 183-189.

Shrivastava, D., Jung, S., Saadat, M., Sirohi, R., & Crewson, K. (2014). How to interpret the results of a sleep study. Journal of community hospital internal medicine perspectives, 4(5), 24983-24983. https://doi.org/10.3402/jchimp.v4.24983

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological science*, *22*(11), 1359-1366.

Simor, P., van der Wijk, G., Nobili, L., & Peigneux, P. (2020). The microstructure of REM sleep: Why phasic and tonic? Sleep medicine reviews, 52, 101305. https://doi.org/https://doi.org/10.1016/j.smrv.2020.101305

Singh, A., Halgamuge, M. N., & Moses, B. (2019). An analysis of demographic and behavior trends using social media: Facebook, Twitter, and Instagram. Social Network Analytics, 87.

Smolensky, M. H., Sackett-Lundeen, L. L., & Portaluppi, F. (2015). Nocturnal light pollution and underexposure to daytime sunlight: Complementary mechanisms of circadian disruption and related diseases. In: Taylor & Francis.

Šmotek, M., Fárková, E., Manková, D., & Kopřivová, J. (2020). Evening and night exposure to screens of media devices and its association with subjectively perceived sleep: should “light hygiene” be given more attention? Sleep health, 6(4), 498-505.

Steers, M.-L. N., Wickham, R. E., & Acitelli, L. K. (2014). Seeing everyone else's highlight reels: How Facebook usage is linked to depressive symptoms. Journal of Social and Clinical Psychology, 33(8), 701-731.

Stephan, F. K. (1997). Calories affect zeitgeber properties of the feeding entrained circadian oscillator. Physiology & behavior, 62(5), 995-1002.

Stephan, F. K. (2002). The “other” circadian system: food as a Zeitgeber. Journal of biological rhythms, 17(4), 284-292.

Stephan, Y., Sutin, A. R., Bayard, S., Križan, Z., & Terracciano, A. (2018). Personality and sleep quality: Evidence from four prospective studies. Health Psychology, 37(3), 271.

St-Onge, M.-P., Roberts, A., Shechter, A., & Choudhury, A. R. (2016). Fiber and Saturated Fat Are Associated with Sleep Arousals and Slow Wave Sleep. Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine, 12(1), 19-24. https://doi.org/10.5664/jcsm.5384

Subrahmanyam, K., & Smahel, D. (2010). Digital youth: The role of media in development. Springer Science & Business Media.

Sullivan, K., & Ordiah, C. (2018). Association of mildly insufficient sleep with symptoms of anxiety and depression. Neurology, Psychiatry and Brain Research, 30, 1-4.

Tajfel, H., Turner, J. C., Austin, W. G., & Worchel, S. (1979). An integrative theory of intergroup conflict. Organizational identity: A reader, 56(65), 9780203505984-9780203505916.

Tandon, A., Kaur, P., Dhir, A., & Mäntymäki, M. (2020). Sleepless due to social media? Investigating problematic sleep due to social media and social media sleep hygiene. Computers in human behavior, 113, 106487.

Tandon, A., Kaur, P., Dhir, A., & Mäntymäki, M. (2020). Sleepless due to social media? Investigating problematic sleep due to social media and social media sleep hygiene. Computers in human behavior, 113, 106487.

Tandon, A., Kaur, P., Dhir, A., & Mäntymäki, M. (2020). Sleepless due to social media? Investigating problematic sleep due to social media and social media sleep hygiene. Computers in human behavior, 113, 106487.

Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: a social psychological perspective on mental health. Psychological bulletin, 103(2), 193.

Tennant, J. E., Demaray, M. K., Coyle, S., & Malecki, C. K. (2015). The dangers of the web: Cybervictimization, depression, and social support in college students. Computers in human behavior, 50, 348-357. https://doi.org/https://doi.org/10.1016/j.chb.2015.04.014

Tettegah, S. (2016). Emotions, technology, and social media. Academic Press.

Thompson, E. R. (2007). Development and validation of an internationally reliable short-form of the positive and negative affect schedule (PANAS). Journal of cross-cultural psychology, 38(2), 227-242.

Thomsen, D. K., Mehlsen, M. Y., Christensen, S., & Zachariae, R. (2003). Rumination—relationship with negative mood and sleep quality. Personality and Individual Differences, 34(7), 1293-1301.

Tiggemann, M., Anderberg, I., & Brown, Z. (2020). Uploading your best self: Selfie editing and body dissatisfaction. Body image, 33, 175-182.

Tosini, G., Ferguson, I., & Tsubota, K. (2016). Effects of blue light on the circadian system and eye physiology. Molecular vision, 22, 61.

Touitou, Y., Touitou, D., & Reinberg, A. (2016). Disruption of adolescents' circadian clock: the vicious circle of media use, exposure to light at night, sleep loss and risk behaviors. Journal of Physiology-Paris, 110(4), 467-479.

Troxel, W. M., Hunter, G., & Scharf, D. (2015). Say "GDNT": frequency of adolescent texting at night. Sleep Health, 1(4), 300-303.

Truell, A. D., Zhao, J. J., Lazaros, E. J., Davison, C., & Nicley, D. L. (2019). CYBERBULLYING: IMPORTANT CONSIDERATIONS. Issues in Information Systems, 20(2).

Tu, K. M., Erath, S. A., & El-Sheikh, M. (2015). Peer victimization and adolescent adjustment: The moderating role of sleep. Journal of abnormal child psychology, 43(8), 1447-1457.

Turel, O., & Ferguson, C. (2020). Excessive use of technology: can tech providers be the culprits? Commun. ACM, 64(1), 42–44. https://doi.org/10.1145/3392664

Turel, O., & Serenko, A. (2020). Cognitive biases and excessive use of social media: The facebook implicit associations test (FIAT). Addictive Behaviors, 105, 106328.

Twenge, J. M., Joiner, T. E., Rogers, M. L., & Martin, G. N. (2018). Increases in depressive symptoms, suicide-related outcomes, and suicide rates among US adolescents after 2010 and links to increased new media screen time. Clinical Psychological Science, 6(1), 3-17.

Twenge, J. M., Krizan, Z., & Hisler, G. (2017). Decreases in self-reported sleep duration among US adolescents 2009–2015 and association with new media screen time. Sleep medicine, 39, 47-53.

van der Schuur, W. A., Baumgartner, S. E., & Sumter, S. R. (2019). Social media use, social media stress, and sleep: Examining cross-sectional and longitudinal relationships in adolescents. Health communication, 34(5), 552-559.

Vandewalle, G., Maquet, P., & Dijk, D. J. (2009). Light as a modulator of cognitive brain function. Trends Cogn Sci, 13(10), 429-438. https://doi.org/10.1016/j.tics.2009.07.004

Verma I. M. (2014). Editorial expression of concern: Experimental evidence of massive-scale emotional contagion through social networks. *Proceedings of the National Academy of*

Sciences of the United States of America, *111*(29), 10779. https://doi.org/10.1073/pnas.1412469111

Villanti, A. C., Johnson, A. L., Ilakkuvan, V., Jacobs, M. A., Graham, A. L., & Rath, J. M. (2017). Social media use and access to digital technology in US young adults in 2016. Journal of medical Internet research, 19(6), e7303.

Vogel, E. A., Rose, J. P., Roberts, L. R., & Eckles, K. (2014). Social comparison, social media, and self-esteem. Psychology of popular media culture, 3(4), 206.

Wakefield, J. R., Bowe, M., Kellezi, B., Butcher, A., & Groeger, J. A. (2020). Longitudinal associations between family identification, loneliness, depression, and sleep quality. British Journal of Health Psychology, 25(1), 1-16.

Wang, Q., Chen, W., & Liang, Y. (2011). The effects of social media on college students. MBA Student Scholarship, 5(13), 1548-1379.2010.

Wanous, J. P., & Hudy, M. J. (2001). Single-item reliability: A replication and extension. Organizational Research Methods, 4(4), 361-375.

Wanous, J. P., Reichers, A. E., & Hudy, M. J. (1997). Overall job satisfaction: how good are single-item measures? Journal of applied Psychology, 82(2), 247.

Warman, V. L., Dijk, D. J., Warman, G. R., Arendt, J., & Skene, D. J. (2003). Phase advancing human circadian rhythms with short wavelength light. Neurosci Lett, 342(1-2), 37-40. https://doi.org/10.1016/s0304-3940(03)00223-4

Warren, C. R., & Landis, R. S. (2007). One is the loneliest number: a meta-analytic investigation on single-item measure fidelity. Ergometrika, 4(1), 32-53.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. Journal of personality and social psychology, 54(6), 1063.

Watson, N. F., Consensus Conference Panel, Badr, M. S., Belenky, G., Bliwise, D. L., Buxton, O. M., Buysse, D., Dinges, D. F., Gangwisch, J., & Grandner, M. A. (2015). Recommended amount of sleep for a healthy adult: a joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society. Journal of Clinical Sleep Medicine, 11(6), 591-592.

Webb, W., & Agnew Jr, H. (1975). Sleep efficiency for sleep-wake cycles of varied length. Psychophysiology, 12(6), 637-641.

Wilckens, K. A., Woo, S. G., Kirk, A. R., Erickson, K. I., & Wheeler, M. E. (2014). Role of sleep continuity and total sleep time in executive function across the adult lifespan. Psychology and aging, 29(3), 658.

Wilkowski, B. M., & Robinson, M. D. (2010). The anatomy of anger: An integrative cognitive model of trait anger and reactive aggression. Journal of personality, 78(1), 9-38.

Williams, K. D. (2007). Ostracism. Annu. Rev. Psychol., 58, 425-452.

Williams, K. D. (2009). Ostracism: A temporal need-threat model. Advances in experimental social psychology, 41, 275-314.

Williams, K. D., & Jarvis, B. (2006). Cyberball: a program for use in research on interpersonal ostracism and acceptance. Behav Res Methods, 38(1), 174-180. https://doi.org/10.3758/bf03192765

Williams, K. D., & Zadro, L. (2005). Ostracism: The indiscriminate early detection system.

Wiss, M., & Tordjman, S. (2016). Creating a 'social zeitgeber' to synchronize family emotional rhythms: A new therapeutic approach in child and adolescent psychiatry. J Physiol Paris, 110(4 Pt B), 480-486. https://doi.org/10.1016/j.jphysparis.2017.07.001

Wolf, W., Levordashka, A., Ruff, J. R., Kraaijeveld, S., Lueckmann, J.-M., & Williams, K. D. (2015). Ostracism Online: A social media ostracism paradigm. Behavior Research Methods, 47(2), 361-373.

Wolfson, A. R. (2010). Adolescents and emerging adults' sleep patterns: New developments. Journal of adolescent health, 46(2), 97-99.

Wollan, R., Smith, N., & Zhou, C. (2011). The social media management handbook: Everything you need to know to get social media working in your business. John Wiley & Sons.

Wongkoblap, A., Vadillo, M. A., & Curcin, V. (2017). Researching mental health disorders in the era of social media: systematic review. Journal of medical Internet research, 19(6), e228.

Woods, H. C., & Scott, H. (2016). # Sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. Journal of adolescence, 51, 41-49.

Woods, H. C., & Scott, H. (2016). # Sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. Journal of adolescence, 51, 41-49.

Woods, H. C., & Scott, H. (2016). # Sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. Journal of adolescence, 51, 41-49.

Woudenberg, F., van den Berg, M., Erisman, J., van den Hazel, P., Lebret, E., Leemans, R., van der Sluijs, J., van Vliet, P., & Wardekker, J. (2015). Advisory letter Health risks associated with LEDs. In: Health Council of the Netherlands.

Xantus, A., Saltz, S., & Shaw, J. (2015). The relationship between social media bullying and the Adolescent's self report of emotional health: A study of urban youth on an acute inpatient psychiatric unit. J. Depress. Anxiety, 4, 2-7.

Yi, H., Shin, K., & Shin, C. (2006). Development of the sleep quality scale. J Sleep Res, 15(3), 309-316. https://doi.org/10.1111/j.1365-2869.2006.00544.x

Yoon, E., & Lee, R. M. (2010). Importance of social connectedness as a moderator in Korean immigrants' subjective well-being. Asian American Journal of Psychology, 1(2), 93.

Youngstedt, S. D., Goff, E. E., Reynolds, A. M., Kripke, D. F., Irwin, M. R., Bootzin, R. R., Khan, N., & Jean-Louis, G. (2016). Has adult sleep duration declined over the last 50+ years? Sleep medicine reviews, 28, 69-85. https://doi.org/10.1016/j.smrv.2015.08.004

Zaki, N. F., Spence, D. W., BaHammam, A. S., Pandi-Perumal, S. R., Cardinali, D. P., & Brown, G. M. (2018). Chronobiological theories of mood disorder. European archives of psychiatry and clinical neuroscience, 268(2), 107-118.

Zendle, D., & Bowden-Jones, H. (2019). Is excessive use of social media an addiction?. *BMJ (Clinical research ed.)*, *365*, l2171. https://doi.org/10.1136/bmj.l2171

Zhang, J., Bierman, A., Wen, J. T., Julius, A., & Figueiro, M. (2010). Circadian system modeling and phase control. 49th IEEE Conference on Decision and Control (CDC),

Zhao, N., & Zhou, G. (2021). COVID-19 stress and addictive social media use (SMU): Mediating role of active use and social media flow. Frontiers in Psychiatry, 12, 85.

Appendix A- Information to Participants

We invite you to participate in this anonymous online survey to learn more about how your experiences with social media affect your sleep quality.

What is the study about?

Very little is known about the effects that social media content has on a person's general wellbeing. This study attempts to understand the relationship between social media experiences and sleep quality, which is an integral component of general wellbeing.

Who will participate?

To participate, you need to meet the following criteria

- Be aged 18 to 35 years.
- Do not have any pre-existing diagnosed sleep disorders.

What will you need to do?

To participate in this study, you will need to complete an online survey that will take approximately 12 minutes. This survey will ask you questions related to your general wellbeing, your experiences on social media and the quality of your sleep. The responses to the survey are anonymous and the researchers will not be able to identify you from your responses.

What will happen to my data?

The data will be used by the research team to examine associations between sleep quality, wellbeing and social media use. A copy of the deidentified data will be archived in the OSF repository. A copy of the research findings will be available on OSF after completion of the research and publication.

What are my rights?

Participation is voluntary. The completion of the questionnaire implies consent. You have the right to decline to answer any particular question and you may exit the survey at any time. You may withdraw at any time without reason. You may refuse to answer any question without providing a reason. As the questionnaire is anonymous, once you have submitted the questionnaire, you will not be able to withdraw from the study.

If you wish to participate in this study and all of your questions have been answered, then please move to the next screen. If you do not wish to participate in this study, please return your submission on Prolific by selecting the "Stop without completing" button.

How can I contact the researchers?

If you have any questions with regards to the research, feel free to reach out to any of the researchers listed below:

Harshi Shetty

Student

Massey School of Psychology

Phone: +64 (21) 259 5504

Harshi.shetty.1@uni.massey.ac.nz

Dr. Aaron Drummond

Senior Lecturer

School of Psychology, College of Humanities and Social Sciences

Ph.: +64 (06) 9519238

Email: A.Drummond@massey.ac.nz

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Prof Craig Johnson, Director, Research Ethics, telephone 06 356 9099 x 85271, email humanethics@massey.ac.nz.

Appendix B: Pre-Registration

A. Hypotheses - Essential elements

Description of essential elements

Describe the (numbered) hypotheses in terms of directional relationships between your (manipulated or measured) variables.

i. There will be a significant negative association between participants levels of negative social media induced mood on the adapted Positive and Negative Affect Scale (PANAS) will be associated and subjective sleep quality, such that higher negative social media related moods will be associated with lower subjective sleep quality. ii. Higher proportions of negative social media experiences will be associated with lower subjective sleep quality.

For interaction effects, describe the expected shape of the interactions.

-

If you are manipulating a variable, make predictions for successful check variables or explain why no manipulation check is included.

-

Recommended elements

Recommended elements

A figure or table may be helpful to describe complex interactions; this facilitates correct specification of the ordering of all group means.

No files selected

For original research, add rationales or theoretical frameworks for why a certain hypothesis is tested.

No response

If multiple predictions can be made for the same IV-DV combination, describe what outcome would be predicted by which theory.

No response

B. Methods - Essential elements

Description of essential elements

Design

List, based on your hypotheses from section A: Independent variables with all their levels a. whether they are within- or between-participant b. the relationship between them (e.g., orthogonal, nested).

i. Social media related negative mood (Adapted PANAS); ii. Proportion of Social media experiences which are negative.

List dependent variables, or variables in a correlational design

i. Subjective sleep quality (based on the General Sleep Disturbance Scale or GSDS)

Third variables acting as covariates or moderators.

i. Age

ii. Time spent on social media

iii. General wellbeing

iv. Use of devices before bedtime.

Planned Sample

If applicable, describe pre-selection rules.

-

Indicate where, from whom and how the data will be collected.

The sample will consist of adults ranging from ages 18 to 35. This sample age was selected as the age group consists of the largest users of social media. Data will be collected from individuals through the means of social media recruitment, from countries including New Zealand, India, USA, etc. and by the use of Prolific Academic software.

Justify planned sample size

The sample size determined by a G-Power analysis is 199. Input parameters were as follows: Effect size f2: 0.04 α err prob: 0.05 Power (1-β err prob): 0.8 Number of tested predictors: 1 Total number of predictors: 5

If applicable, you can upload a file related to your power analysis here (e.g., a protocol of power analyses from G*Power, a script, a screenshot, etc.).

No files selected

Describe data collection termination rule.

Data will be collected early August 2021 and the data collection will stop when the sample size has been achieved or one month after the survey is opened, whichever is earlier.

Exclusion Criteria

Describe anticipated specific data exclusion criteria. For example: a) missing, erroneous, or overly consistent responses; b) failing check-tests or suspicion probes; c) demographic exclusions; d) data-based outlier criteria; e) method-based outlier criteria (e.g. too short or long response times).

i. Participants with any pre-existing sleep disorders will be excluded from the study.

ii. Participants that are under 18 years of age or over 35 years of age will be excluded from the study

iii. Participants failing the attention check will be excluded from the study.

Procedure

Describe all manipulations, measures, materials and procedures including the order of presentation and the method of randomization and blinding (e.g., single or double blind), as in a published Methods section.

i. The subjects will be recruited online through Prolific Academic as well as social media and will be invited to participate in the online survey. ii. Subjects will not be exposed to any material. They will be asked to read the information sheet and sign the consent form. They will then be asked to fill out the questionnaires to understand their emotions and experiences with social media and sleep quality.

Recommended elements

Recommended elements

Procedure

Set fail-safe levels of exclusion at which the whole study needs to be stopped, altered, and restarted. You may pre-determine what proportion of excluded participants will cause the study to be stopped and restarted.

No response

If applicable, you can upload any files related to your methods and procedure here (e.g., a paper describing a scale you are using, experimenter instructions, etc.)

No files selected

C. Analysis plan - Essential elements

Confirmatory Analyses

Describe the analyses that will test the first main prediction from the hypotheses section. Include:

the relevant variables and how they are calculated;

1. Social media related negative mood will be calculated through the means of the modified PANAS-SF. Higher scores indicate higher overall negative social media experience, while a low score will indicate a lower overall negative social media experience. This will be calculated as the total of the items Distressed, Upset, Guilty, Scared, Hostile, Irritable, Ashamed, Nervous, Jittery and Afraid on the question "Indicate the extent to which you have felt this way due to a social media post over the past week"

2. Proportion of negative social media experiences will be measured by the question: "Please indicate what percentage of your social media experiences have been negative" from 0-100%

3. Subjective sleep quality will be measured by the sleep quality subscale of the GSDS. An average score will be computed for each participant. A low score will indicate a poor subjective sleep quality, while a high score will indicate a high subjective sleep quality.

4. Control variable will be measured as follows:

a. Age will be asked by the means of a simple demographic detail question, “What is your age?”

b. Use of device before bedtime: A single item question asking participants if they use their electronic devices in the 2 hours before bedtime will be used (“Do you use any of your devices in the 2 hours before you go to bed?”). Participants will be asked whether they use any dark mode themes or blue-light filters on their devices before bedtime (“Do you use any dark modes or blue light filtering apps or settings on your devices when you use your device at night?”). Participants that use these filters will not be marked as using devices before bedtime.

c. The time spent on social media by a participant is asked by the means of a single item, “On average, how many hours of a week do you spend on social media?”.

d. General wellbeing will be measured by the SGWB composite score, where a high score would indicate a high general wellbeing, and a low score would indicate overall low general wellbeing.

the statistical technique;

1. Scores for the SGWB, Modified PANAS-SF, and the General Sleep Disturbance Scale will be computed using SPSS.

2. A linear regression analysis will be carried out between the social media related negative mood and subjective sleep quality scores in the participants. A separate linear regression will examine the relationship between proportion of negative social media experiences and subjective sleep quality scores.

3. A multiple linear regression will be carried out between the social media related negative mood and the subjective sleep quality scores, controlling for the general wellbeing, time on social media and use of devices before bedtime. A second multiple linear regression will assess the relationship between the proportion of negative social media experiences and subjective sleep quality when general wellbeing, time on social media and use of devices before bedtime are statistically controlled.

each variable’s role in the technique (e.g., IV, DV, moderator, mediator, covariate);

Independent Variable: Social media related negative mood

Dependent Variable: Subjective sleep quality

Control Variable: Age, use of device before bedtime, time spent on social media and general wellbeing

rationale for each covariate used, if any;

-

if using techniques other than null hypothesis testing (for example, Bayesian statistics), describe your criteria and inputs toward making an evidential conclusion, including prior values or distributions.

-

Recommended elements

Recommended Elements

Specify contingencies and assumptions, such as:

Method of correction for multiple tests.

The modified PANAS-SF will be validated against the single item question regarding the positive and negative social media experience.

The method of missing data handling (e.g., pairwise or listwise deletion, imputation, interpolation).

Participants that have not completed the questionnaire will be handled using SPSS's pairwise deletion.

Reliability criteria for item inclusion in scale.

No response

Anticipated data transformations.

No response

Assumptions of analyses, and plans for alternative/corrected analyses if each assumption is violated.

No response

Optionally, upload any files here that are related to your analyses (e.g., syntaxes, scripts, etc.).

No files selected

Final questions

Has data collection begun for this project?

No, data collection has not begun

If data collection has begun, have you looked at the data?

No

The (estimated) start and end dates for this project are

05/08/2021 - 05/09/2021

Any additional comments before I pre-register this project

No response

Contributors

Anonymous contributors

Description

Many recent studies have been carried out examining and illustrating the relationship between sleep characteristics (such as the duration, timing and quality of sleep) and use of electronic devices, especially the usage of social media on these devices. However, a large amount of these studies tend to focus two broad aspects- the time spent on the devices, and the impact of use close to bedtime. Only a handful of studies examine the relationship between sleep characteristics and the content on social media websites. With the sharp increase in social media usage, it is imperative to understand the effects that social media can have on a person's wellbeing and affect. The content on social media is generally directed to individual users through algorithms, and can be designed to elicit certain feelings (positive and negative). There are established relationships between negative affect and sleep outcomes, specifically that negative affect is often associated with shorter sleep and a poorer quality of sleep. This makes it important to study the impact of social media

on a person's affect. This study, therefore, aims to investigate the associations between a person's social media experiences and their sleep quality. Participants will be recruited through Prolific Academic and social media recruitment and asked to fill out a brief online survey about their quality of sleep and use of social media. The study controls for general wellbeing, use of devices before bed time, and age, which are the common confounding variables in sleep studies.

Registration type

Pre-Registration in Social Psychology (van 't Veer & Giner-Sorolla, 2016): Pre-Registration

Date registered

July 8, 2021

Date created

July 8, 2021

Associated project

osf.io/qs278

Category

Uncategorized

Subjects

Social and Behavioral Sciences

Medicine and Health Sciences

License

Appendix C: Modified PANAS scale

For the following questions, please indicate the extent to which you have felt this way due to a social media post over the past week.

Positive and Negative Affect Schedule (PANAS-SF)

		Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
PANAS 1	Interested	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 2	Distressed	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 3	Excited	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 4	Upset	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 5	Strong	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 6	Guilty	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 7	Scared	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 8	Hostile	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 9	Enthusiastic	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 10	Proud	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 11	Irritable	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 12	Alert	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 13	Ashamed	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 14	Inspired	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 15	Nervous	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 16	Determined	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 17	Attentive	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 18	Jittery	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 19	Active	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 20	Afraid	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5