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Sleeping with technology: cognitive, affective, and technology usage predictors of sleep problems among college students

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ABSTRACT

Objectives: Sleep problems related to technology affect college students through several potential mechanisms including displacement of sleep due to technology use, executive functioning abilities, and the impact of emotional states related to stress and anxiety about technology availability.
Design: In the present study, cognitive and affective factors that influence technology usage were examined for their impact upon sleep problems.
Participants and measurements: More than 700 US college students completed an online questionnaire addressing technology usage, anxiety/dependence, executive functioning, nighttime phone usage, bedtime phone location, and sleep problems.
Results: A path model controlling for background variables was tested using the data. The results showed that executive dysfunction directly predicted sleep problems as well as affected sleep problems through nighttime awakenings. In addition, anxiety/dependence increased daily smartphone usage and also increased nighttime awakenings, which, in turn, affected sleep problems.
Conclusions: Thus, both the affective and cognitive factors that influence technology usage affected sleep problems.

The National Sleep Foundation recommends that young adults of college age get between 7 and 9 hours of sleep per night with a caveat that 6 hours may be appropriate.[1] Studies have shown that college students are falling short of this recommendation.[2–4] A longitudinal study tracking Canadian university students from 2005 to 2009 found that the mean sleep hours ranged from 6.72 to 6.93 hours per night with a strong link between later bedtime and lower grade point averages.[5] According to this study, "A 14-min average delay in bedtime translated into a one letter-grade drop" (p. 20). The current study examines an explanatory model for sleep problems that includes affective and cognitive components as well as daily and nighttime technology use.

Technology use and sleep displacement

Numerous studies have proposed that technology use, particularly before bedtime, serves to displace sleep. Gradisar et al[6] reported that 9 in 10 Americans used a technological device during the last hour before bedtime with two-thirds of young adults using cell phones during that time and that more interactive devices used during the hour before bedtime predicted increased sleep problems. Gradisar et al pointed specifically at the cell phone showing data that of those who reported using their cell phones during the last hour before bed, more than half (57%) left their ringer on, which was, in turn, associated with difficulty returning to sleep after awakening; 20% of young adults reported being awakened at least a few nights a week, most often by an alert or notification from a cell phone. A 2013 study of college students[7] found that 47% reported nighttime awakenings to answer text messages and 40% awoke to answer phone calls, which, in turn, predicted poorer sleep quality.

Other recent studies have also validated and extended these findings among college-aged young adults. Specifically tracking college students, researchers have found that those students who used their mobile phones and texted more on a typical day showed more sleep problems.[8,9] In addition, Long Xu, Zhu, Sharma, and Zhao[10] found that those Chinese college students who used more social media evidenced more sleep problems. Similarly, Fossum, Nordnes, Storemark, Bjorvatn, and Pallesen[11] found that Norwegian college students who used more nighttime media in bed—particularly the computer and mobile phone for playing, surfing, and reading—showed more insomnia.

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These results have been validated with adolescents and young adults across a variety of countries and settings.[8,12–17]

Impact of anxiety on sleep

Several studies have investigated the impact of emotional states on sleep including the effects of stress and anxiety on sleep. For example, Doane and Thurston[18] found that high daily stress among adolescents was associated with reduced sleep duration. Using similar samples, Short, Gradisar, Lack, Wright, and Dohnt[19] discovered that anxious adolescents evidenced a longer time to fall asleep than nonanxious teens. Honing in on a possible reason for the impact of anxiety, Moore, Slane, Mindell, Burt, and Klump[20] found that the strongest predictor of sleep problems was sociability due to increased time that adolescents spent communicating with peers during the evening. Finally, Bartel, Gradisar, and Williamson[21] performed a meta-analysis of 41 studies including more than 85,000 adolescents and found that presleep worry was related to delayed bedtimes and sleep problems.

Several studies of university students and young adults have found similar impacts of stress and anxiety on sleep. In a longitudinal study of Swedish college students, Thomée et al[22] discovered that those who perceived mobile phone use as stressful showed the greatest risk of sleep problems. Similar impacts of anxiety on sleep problems were found in college students in the United States,[4] Canada,[5] and Hungary.[23] Similar to the impact of sociability on adolescent sleep, Galambos et al[5] found that whereas stress was predictive of all sleep indicators across a 4-year study, social support was a positive predictor of sleep quantity.

Cognitive and physiological correlates of sleep

As suggested by Gradisar et al,[6] the source of sleep difficulties may be due to cognitive or physiological arousal. Ferraro, Holfeld, Frankl, Frye, and Halvorson[24] compared good and poor sleepers and found that, compared with good sleepers, poor sleepers showed more state and trait anxiety as well as poorer executive functioning. Cheever, Rosen, Carrier, and Chavez[25] removed cell phones from 163 college students who were then not allowed to do anything for more than an hour and measured their anxiety 3 times, 20 minutes apart, starting 10 minutes after the students sat down in the classroom. Heavy smartphone users showed increased anxiety within 10 minutes that continued to rise for the remainder of the hour. Moderate users showed only an increase in anxiety halfway through the study, which then stayed constant, whereas light users showed no increase in anxiety. Because heavy smartphone users get anxious when they are not allowed to access their phone, this may suggest that physiological arousal (anxiety) leads them to overuse technology before and during bedtime hours.

As corroboration of the impact of arousal on not being able to access one's smartphone, Clayton, Leshner, and Almond[26] implemented a laboratory study where they did not allow iPhone users to answer their ringing phone and observed concomitant increases in blood pressure, heart rate, and self-reported anxiety as well as a decline in cognitive performance. Przybylski, Murayama, DeHaan, and Gladwell[27] suggested that this anxiety might stem from fear of missing out—FOMO—based on a desire to stay continually connected through email, messaging, and social media.

Using a sample of 17- to - 19-year-old Egyptian students, Morsy and Shalaby[16] found that those who evidenced the lowest attention scores were those who had the least sleep. Two additional studies examined the impact of sleep deprivation on cognitive arousal, with 1 study demonstrating that after total sleep deprivation adults showed changes in the way that prefrontal cortex areas, including working memory, communicated with each other.[28] A second study specifically showed that poor sleep led to decrements in processing in the dorsolateral prefrontal cortex and reduced the linkage between the ventral striatum and the insula during reward processing.[29]

Multitasking and sleep

Research has shown that college students multitask much of the time and with the most tasks.[30,31] Multitasking has been shown, in everyday college life, to add stress and to result in later nights using multiple forms of technology.[32–35] Recent studies have corroborated these multitasking effects with adolescents who are soon to become college students,[14] whereas others have found that adolescents who multitask more consume more caffeinated drinks, which, in turn, promote sleep disturbances.[36]

A model of sleep problems

Several research teams have attempted to model the impact of a variety of variables on sleep problems among adults, college students, and adolescents. Simor et al[23] found that adult sleep problems were a partial mediator between chronotype (when one prefers to sleep) and negative emotionality. Looking at the issue of sleep from a different perspective, Adams and Kisler[7] found that nearly half of their sample of college students evidenced nighttime awakenings to answer texts and phone calls. Their model found that more nighttime awakenings predicted lower sleep quality, which, in turn, mediated the prediction of increased depression and anxiety.

In a study examining life satisfaction among college students, Li, Lepp, and Barkley[37] validated a proposed model with total daily cell phone use predicting nighttime cell phone use and use during classroom lecture and study time, which both, along with locus of control, predicted sleep quality. Similarly, using sleep quality and computer use to predict psychological and somatic symptoms, a cross-cultural study in Finland, Denmark, and France[38] found that sleep duration was a partial mediator between computer use and symptomology. Arora et al[39] found that, for UK adolescents, sleep duration was a mediator between technology use and body mass index. Finally, Chen et al[40] found that a combination of factors including bedtime anxiety, body weight, bedtime excitement, and depression predicted sleep duration.

Based on the available research and previously tested models with adolescents, college students, and adults, the path model depicted in Figure 1 is proposed to account for sleep problems in college students. The model proposes that sleep problems arise through a possible series of paths that emanate from both cognitive (executive functioning) and affective (anxiety about missing out on technology use) factors, each of which may impact technology usage including amount of daily smartphone usage, multitasking, nighttime phone placement, and nighttime awakenings to check the phone.

Method

Participants

A sample of undergraduate university students at an urban Southern California state university completed an online, anonymous questionnaire as part of an extra credit assignment in 2 large, upper-division general education courses. The survey was hosted on SurveyMonkey.com, and participants accessed the survey at a location of their choice. The data set was collected in 2 waves in September 2014 and in February 2015 to obtain a sample size sufficient for performing a path analysis with multiple paths and variables.

Of the 873 students who participated, 734 completed the survey. Overall, the sample included 310 (42%) men and 424 (58%) women with a mean age of 25.87 (SD = 6.61; median [M] = 24), and the ethnic/cultural composition of the sample was 53% Hispanic (n = 390),