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Digital media use in the 2 h before bedtime is associated with sleep variables in university students



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ABSTRACT

Digital media use is widespread in University students, and use of digital media near bedtime has a broadly negative effect on sleep outcomes. Adequate and good quality sleep is important for physical and mental health, but few studies have rigorously measured both sleep and digital media use. In this study, we investigated whether self-reported sleep patterns were associated with digital media use in a first-year University student ($N = 254$, 48% male) population. Students tracked their sleep through daily online diaries and provided digital media use data in 15-min blocks for 2 h prior to bedtime on nine occasions. A longer duration of digital media use was associated with reduced total sleep time and later bedtime, while greater diversity of digital media use was associated with increased total sleep time and earlier bedtime. Analysis of activities in the last hour before bedtime indicated that activity type plays a role in digital media's effect on sleep, with computer work, surfing the Internet, and listening to music showing the strongest relationship to multiple sleep variables. These findings have implications for physical and mental health of University students and can inform design of devices to minimize negative effects of digital media on sleep.

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1. Introduction

Young adults rely heavily on digital media devices to complete many daily tasks, and this use is likely to interact with their daily activities, including sleep. Sleep is important for health, academic outcomes, and daily functioning in University students. Researchers in the fields of sleep research and human computer interaction (HCI) have documented interactions between sleep or daily rhythms¹ and digital media in University students. Sleep researchers have used experimental and self-report studies to test relationships in University students between particular digital media types and sleep. HCI researchers have used mixed methods,

combining varying combinations of computer and phone logging, biosensors, experience sampling, and surveys to investigate stress and multitasking related to daily rhythms in this population, and also to perform empirical studies of prototype phone applications (apps) for tracking sleep. Although the literature from these two fields indicates a negative relationship between digital media use and sleep/daily rhythms, what is missing is time and activity-specific analysis of digital media use in relation to rigorously collected information about sleep timing and quality. This paper adds to the literature by reporting on a study of digital media use near bedtime that was part of a larger study of sleep and depression vulnerability among normal University students.

Our focus on University students in this paper is important because increasing age and independence from parental restrictions may result in fewer restrictions on digital media. University students also tend to report poor sleep (e.g., Lund, Reider, Whiting, & Prichard, 2010). Given that digital media use plays a central role in the lives of University students, and many students report poor sleep both in terms of quantity (hours slept) and quality

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¹ Although these terms are not synonymous, they are put together here because sleep scientists typically report sleep outcomes while human–computer interaction (HCI) researchers tend to focus more on rhythms of rest and activity. Both sleep and daily rhythms interact with digital media use.

(interruptions to sleep), this paper will address the intersection of these factors and discuss implications for the wellbeing of University students and the improved design of digital media devices and systems.

1.1. Digital media use in university students

Polls of young adults in the U.S. (ages 18–29) show that 93% own cell phones and go online (Lenhart, Purcell, Smith, & Zickuhr, 2010) while 89% use social networking sites (Pew Research Internet Project, 2014). By 2013, 79% of U.S. 18–24-year-olds owned a smartphone (Smith, 2013). U.S. university students report spending an average of 12 h daily engaged with some type of media, including 9.5 h with computers, mobile devices, MP3 players and gaming devices (Alloy Media and Marketing, 2009). Another U.S. university student study found that smartphone owners used their phone “Often or Sometimes” to perform tasks other than voice calls during idle time at work or school (93%), while commuting (92%), while waiting in line (85%), when first waking in the morning (77%), and in bed before sleep at night (72%; Dean, 2010). In the hour before trying to sleep, technology use is high with reports that 67% of polled Americans use cell phones, 60% use computers or laptops, 43% use digital music devices, and 18% use video game consoles (National Sleep Foundation, 2011). Studies from other countries indicate that U.S. students’ digital media use is similar to other countries. For example, among U.K. young adults, 98% use the Internet, and 90% own a smartphone. More than 70% send emails and use instant messaging and 87% visit social networking sites on their smartphones (Ofcom, 2014).

1.2. Value of sleep for university students

Galambos and colleagues showed that less sleep among first year students predicted greater negative mood while better quality sleep increased positive mood and decreased stress (2009). Poor sleep and daytime sleepiness can also negatively affect academic performance (Gomes, Tavares, & de Azevedo, 2011; Orzech, Salafsky, & Hamilton, 2011) and driving skill (Hershner & Chervin, 2014) and shorter sleep has been associated with increased incidence of common illness in adolescents (Orzech, Acebo, Seifer, Barker, & Carskadon, 2013) and adults (Cohen, Doyle, Alper, Janicki-Deverts, & Turner, 2009). Restricted sleep is associated with cardiovascular, inflammatory and metabolic consequences (Knutson & Van Cauter, 2008; Mullington, Haack, Toth, Serrador, & Meier-Ewert, 2009).

1.3. Previous work on sleep and digital media use

Experimental studies have explored the effects of music (Harmat, Takács, & Bódizs, 2008; Iwaki, Tanaka, & Hori, 2003; Lazic & Ogilvie, 2007), television (Asaoka, Fukuda, Tsutsui, & Yamazaki, 2007) and video games (Higuchi, Motohashi, Liu, Ahara, & Kaneko, 2003; Higuchi, Motohashi, Liu, & Maeda, 2005; King et al., 2013; Smyth, 2007) on sleep. Music had an equivocal or slightly positive effect on self-reported and objective measures of sleep. Reducing television viewing increased self-reported sleep time, and video game effects were mixed. Self-report sleep studies found that both computer and mobile phone use contributed to sleep disturbance (broadly defined; Thomée, Dellve, Harenstam, & Hagberg, 2010). Similar conclusions were reached by a variety of quantitative studies that assessed media use and sleep variables over short (<30 days) (Asaoka et al., 2010; Kim et al., 2010; Mesquita & Reimão, 2010) and longer durations (up to 1 year follow-up; Thomée, Eklof, Gustafsson, Nilsson, & Hagberg, 2007; Thomée, Harenstam, & Hagberg, 2011).

Two recent review papers in human–computer interaction (HCI) point to the importance of understanding digital media use related to sleep, especially in an environment of ubiquitous computing (Aliakseyeu, Du, Zwartkruis-Pelgrim, & Subramanian, 2011; Choe, Consolvo, Watson, & Kientz, 2011). HCI empirical studies do not capture sleep as a named variable, but are moving toward the intersection of digital media and sleep. For example, Golder and colleagues have examined temporal rhythms of Facebook messaging (Golder, Wilkinson, & Huberman, 2007), and Mark and colleagues have addressed stress, multitasking, and rhythms of attentional states as they relate to online activity among University students (Mark, Wang, & Niiya, 2014). A few papers in HCI/interaction design have addressed the idea of networked alarm clocks, which used conditions such as ‘wake me if persons A & B are already out of bed’ (Schmidt, 2006) and another that tested sharing of sleep status among previously-existing social groups (S. Kim, Kientz, Patel, & Abowd, 2008). Recently, researchers in HCI have begun to test if it is possible to track sleep and sleep-related variables using Smartphone apps (Abdullah, Matthews, Murnane, Gay, & Choudhury, 2014; Min et al., 2014), and have found that it is possible, although estimates of sleep parameters may lack precision.

When experimental studies are performed in a laboratory, researchers have more control over media exposure and often the capacity to measure sleep more precisely, but the amount of media they can test is limited, and likely does not reflect real-world University student media use. Self-report and app-based studies may collect more real-world data, but may lose precision in the measurement of both sleep and media use. One solution to this paradox is better measurement of sleep and media use in a real-world setting, which is an aim of the study reported here.

2. Theory

2.1. Effects of digital media use on sleep

Several routes may link digital media to sleep. Cain and Gradisar (2010), discussing younger adolescents, suggest three likely routes. These include 1) direct displacement of sleep by media use, for example getting involved in a computer activity and staying up late to complete it (Li et al., 2007; Oka, Suzuki, & Inoue, 2008; Zimmerman, 2008); 2) heightened physiological arousal associated with the use of digital media close to bedtime, for example playing an exciting video game, (Higuchi et al., 2005; Wuyts et al., 2012; Zimmerman, 2008); and 3) bright screens affecting physiological markers that are linked to sleep, such as melatonin (Cajochen et al., 2011; Figueiro, Wood, Plitnick, & Rea, 2011; Heath et al., 2014). It is beyond the scope of this paper to discuss these pathways in detail, but it is important to understand that there is no agreement among researchers about which pathway might represent the dominant effect of digital media on sleep.

2.2. Issues of causality

Tavernier and Willoughby (2014) address the issue of causality through their report on a 3-year longitudinal study on the relations between sleep and digital media use. They conclude that media use does not seem to cause sleep problems, but rather that students with sleep problems spend more time using digital media. They point out, however, that their study is unique and call for more research on University-aged young adults, as opposed to younger adolescents and children (Chahal, Fung, Kuhle, & Veugelers, 2013; Punamäki, Wallenius, Nygård, Saarni, & Rimpelä, 2007; Wang, Luo, Luo, Gao, & Kong, 2012).

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