



## Media multitasking and sleep problems: A longitudinal study among adolescents



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### ABSTRACT

The increase in media multitasking among adolescents has raised concerns regarding its possible negative impact on sleep. Although cross-sectional studies have found a relationship between media multitasking and sleep problems, knowledge about the causal direction is lacking. In a first step to understand causality, we examined the longitudinal relationship between media multitasking and sleep problems among 1443 adolescents (7th and 8th graders, 11–15 years, 51% boys), who completed a questionnaire three times at three-to-four month intervals. We employed random intercept cross-lagged panel models, which specifically examine cross-lagged correlations within (rather than between) individuals. The findings showed no cross-lagged correlations for the overall sample. However, the results indicated that, for 7th graders and girls, media multitasking was (marginally) related to more subsequent sleep problems. Our findings provide first evidence that media multitasking may affect the sleep of 7th graders and girls.

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### 1. Introduction

Adolescents are growing up in technologically immersive environments. Due to the ongoing development of mobile media devices, young people have access to media 24/7. Consequently, along with the increased amount of time that adolescents spend using media, *how* they use media has changed dramatically (Rideout, Foehr, & Roberts, 2010). More than ever before, young people use multiple media devices simultaneously or switch rapidly between media on a single device – a behavior that is referred to as media multitasking. Over the past twenty years, the proportion of media time that eleven-to eighteen-year-olds spend media multitasking has increased from 16% to 29% (Rideout et al., 2010). In the same period, concerns and research about the possible negative consequences of media multitasking on adolescents' development have rapidly accumulated (van der Schuur, Baumgartner, Sumter, & Valkenburg, 2015).

Adolescence is acknowledged as a unique phase of development

characterized by the continuing maturation of cognitive, emotional, and social domains of functioning (e.g., Burnett, Sebastian, Kadosh, & Blakemore, 2011). Growing evidence shows that sleep plays a crucial role in the healthy development of adolescents (Shochat, Cohen-Zion, & Tzischinsky, 2014). Sleep problems have been shown to interfere with adolescents' functioning, such as their psychosocial health and academic performance (e.g., Owens, 2014). Sleep problems are multifaceted and include various aspects of sleep-related disturbances, such as shortness of sleep, night awakenings, and difficulties falling asleep (Cain & Gradisar, 2010). These sleep problems typically manifest themselves in increased feelings of sleepiness during the day, which may hinder adolescents' everyday functioning in multiple ways (Cain & Gradisar, 2010; van Maanen et al., 2014). Although the importance of healthy sleep in adolescence is widely recognized, sleep problems are common in this phase of life (Gradisar, Gardner, & Dohnt, 2011), and have significantly increased in recent decades (e.g., Keyes, Maslowsky, Hamilton, & Schulenberg, 2015). Estimates of the prevalence of sleep problems among adolescents range from approximately 25%–40% (Kilincaslan, Yilmaz, Batmaz Oflaz, & Aydin, 2014; Ohayon, Roberts, Zully, Smirne, & Priest, 2000).

The simultaneous increase in media use and sleep problems among adolescents has captured the attention of researchers. A

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growing number of studies have found that the use of screen-based media (e.g., the time spent watching television or playing video-games) has a negative impact on adolescents' sleep (e.g., Cain & Gradisar, 2010). Recently, researchers have suggested that media multitasking may also contribute to the high rates of sleep problems among adolescents (Calamaro, Mason, & Ratcliffe, 2009). However, only three studies have examined the relationship between media multitasking and sleep problems. These studies showed that media multitasking was related to shortened sleep (Calamaro et al., 2009; Mark, Wang, Niiya, & Reich, 2016; Pea et al., 2012), more difficulties in falling asleep, and daytime sleepiness (Calamaro et al., 2009).

Although these three studies have provided preliminary evidence for the relationship between media multitasking and sleep problems, two main shortcomings in the current literature on media multitasking warrant our attention. First, due to the cross-sectional nature of the available studies, there is as yet no evidence of the causal direction of the relationship between media multitasking and sleep problems. Second, although contemporary media effects theories (e.g., Slater, 2015; Valkenburg & Peter, 2013) have repeatedly pointed at the importance of examining individual differences in the susceptibility to media effects, most previous media multitasking studies have failed to assess the moderating influence of even the standard demographic factors like age and sex. Therefore, the present study employed a three-wave panel design in a first attempt to understand the causal direction of the relationship between media multitasking and sleep problems, and to examine the moderating role of age and sex.

### 1.1. The causal direction of the relationship between media multitasking and sleep problems

Although researchers generally assume that media multitasking interferes with adolescents' healthy sleep, the relationship between media multitasking and sleep problems may be more complex than previously assumed. Most contemporary media effect theories posit that media effects are transactional (Bandura, 2001; Knobloch-Westerwick, 2014; Slater, 2015; Valkenburg, Peter, & Walther, 2016). These theories assume reciprocal causal relationships between media use and media outcomes, resulting in predictive paths both from media use to media outcomes and from these outcomes to media use (e.g., Bandura, 2001; Slater, 2015). Based on theories of transactional media effects, we anticipate that a reciprocal causal relationship also holds for the relationship between media multitasking and sleep problems. That is, media multitasking may positively predict sleep problems as most often assumed, while sleep problems may also positively predict media multitasking.

As studies have only examined the cross-sectional relationship between media multitasking and sleep problems (Calamaro et al., 2009; Mark et al., 2016; Pea et al., 2012), empirical evidence for a reciprocal relationship between media multitasking and sleep problems is lacking. However, several longitudinal studies on the relationship between *screen-based media use* and sleep problems have investigated reciprocal relationships, albeit with mixed results (e.g., Becker, Langberg, & Byars, 2015). Some studies found a reciprocal relationship between screen-based media use and sleep problems (Chen & Gau, 2016; Magee, Lee, & Vella, 2014), whereas other studies found that screen-based media use acted as either a predictor (e.g., Johnson, Cohen, Kasen, First, & Brook, 2004; van den Bulck, 2007) or a consequence of sleep problems (Tavernier & Willoughby, 2014). These mixed findings in the field of screen-based media use further emphasize the importance of examining the reciprocal causal direction of the relationship between media multitasking and sleep problems.

Existing studies mainly assume that media multitasking leads to sleep problems. This assumption is primarily based on the reasoning for the effect of screen-based media use on sleep problems (Calamaro et al., 2009; Pea et al., 2012). Three underlying mechanisms of the effect of screen-based media use on sleep problems have been proposed. First, screen-based media use may displace sleep (Cain & Gradisar, 2010). Second, exposure to bright screen light may lead to delayed sleep onset because of the suppressed secretion of melatonin, which is necessary to regulate the circadian timing system (e.g., Crowley, Cain, Burns, Acebo, & Carskadon, 2015). Third, screen-based media use may enhance physiological arousal (i.e., bodily sensations such as accelerated heart rate and breathing; Cain & Gradisar, 2010), which has been associated with sleep problems (Paavonen, Pennonen, Roine, Valkonen, & Lahikainen, 2006; van den Bulck, 2004).

These three explanations for the effects of screen-based media use on sleep problems may also explain the impact of media multitasking on sleep problems. Moreover, the effects of media multitasking on sleep problems may even be stronger than those of general time spent using screen-based media (Calamaro et al., 2009). Specifically, with respect to the displacement of sleep, media multitasking may result in more displacement than exposure to a single screen-based medium. To illustrate, when adolescents simultaneously engage in a video game and a social networking site on a laptop, it may take them longer to finish the video game or get to the next level - than when they would only focus on that video game. As for the exposure to bright screen lights, those adolescents who engage in media multitasking using multiple devices are exposed to more screen lights compared to their peers who use one screen at a time (Calamaro et al., 2009). Finally, because of the constant switching between media, media multitasking may constitute a more arousing activity than the use of a single medium. In fact, switching between media on a computer (e.g., e-mail and Facebook) has been shown to lead to temporarily increased physiological arousal (Yeykelis, Cummings, & Reeves, 2014).

Based on these explanations, we argue that media multitasking enhances sleep problems among adolescents. To better understand the causal relationship between media multitasking and sleep problems, we employ a three wave longitudinal design. We assume that adolescents who show increased levels of media multitasking will experience more sleep problems three-to-four months later, resulting in the following hypothesis:

**Hypothesis 1.** The frequency of media multitasking will be positively related to subsequent sleep problems among adolescents.

Although the main assumption is that media multitasking leads to sleep problems, there is also reason to hypothesize that sleep problems are related to an increase in subsequent media multitasking. Several studies have found support for the negative effect of sleep problems on adolescents' executive functions (e.g., Ferraro, Holfeld, Frankl, Frye, & Halvorson, 2015; Gruber, Cassoff, Frenette, Wiebe, & Carrier, 2012; Warren, Riggs, & Pentz, 2017; Xanidis & Brignell, 2016). Executive functions are cognitive processes that regulate an individual's attention and behavior, including impulsivity and inhibition (e.g., Miyake et al., 2000). For example, compared to children whose sleep was extended, children whose sleep was restricted engaged in more restless impulsive behaviors after five nights (Gruber et al., 2012). Similarly, a longitudinal study demonstrated that sleep problems were associated with more deficits in subsequent inhibitory control (e.g., doing things without thinking first) among adolescents (Warren et al., 2017).

These studies are particularly relevant as executive functions are known to be key predictors of media multitasking (e.g., Sanbonmatsu, Strayer, Medeiros-Ward, & Watson, 2013; Yang & Zhu, 2015; Zhang, 2015). For example, college students who

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