



Broadband internet, digital temptations, and sleep[☆]

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ABSTRACT

There is a growing concern that the widespread use of computers, mobile phones and other digital devices before bedtime disrupts our sleep with detrimental effects on our health and cognitive performance. High-speed Internet promotes the use of electronic devices, video games and Internet addiction (e.g., online games and cyberloafing). Exposure to artificial light from tablets and PCs can alterate individuals' sleep patterns. However, there is little empirical evidence on the causal relationship between technology use near bedtime and sleep. This paper studies the causal effects of access to high-speed Internet on sleep. We first show that playing video games, using PC or smartphones, watching TV or movies are correlated with shorter sleep duration. Second, we exploit historical differences in pre-existing telephone infrastructure that affected the deployment of high-speed Internet across Germany (see Falck et al., 2014) to identify a source of plausibly exogenous variation in access to Broadband. Using this instrumental variable strategy, we find that access to high-speed Internet (DSL) access reduces sleep duration and sleep satisfaction. Results are driven by individuals who face work or family time constraints.

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1. Introduction

Insufficient sleep is recognized as a major public health challenge and is considered by some scholars as the most prevalent risky behavior in our society. Sleep deprivation is associated with detrimental effects on health and cognitive performance (Cappuccio et al., 2010). Statistics are alarming. In many advanced countries, the share of individuals sleeping less than the recommended 7–9 h of sleep is increasing (Hafner et al., 2016). The costs of sleep deprivation in terms of increased health care costs and decreased productivity are large (Gibson and Shrader, 2018; Giuntella et al., 2017; Giuntella and Mazzonna, 2017; Hafner et al., 2016; Heissel and Norris, 2017; Jin and Ziebarth, 2018).

Among the factors often blamed as a major cause of the sleep deprivation epidemic are Internet addiction and technology use near bedtime (Gradisar et al., 2013; Turel et al., 2016). The constant stimulation provided by electronic media devices, such as smartphones, tablets and computers disturbs our sleep process (Cain and Gradisar, 2010; Lemola et al., 2015). The ubiquity of the media devices and the “digitalization of the bedroom” before sleep can interfere with human circadian

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rhythms, the physiological processes that respond to the dark-light daily cycle. In particular, evening exposure to artificial light from computer or mobile screens suppresses the production of melatonin, the “sleep” hormone which regulates our sleep cycle (Cain and Gradisar, 2010; Turel et al., 2016). Furthermore, according to a recent poll on sleep behavior in the US, 20% of respondents aged 19 to 29 reported to be awakened at least a few times a week in the middle of the night by phone calls, texts, or emails (Source: Sleep Foundation).

Economists have long been interested in understanding time use allocation (Aguiar et al., 2017; Aguiar and Hurst, 2007; Aguiar et al., 2013; Becker, 1965; Gronau, 1977). However, although sleep is the most common use of time, economic research on the allocation of time to sleep has been sparse. While the first to introduce a discussion on the economics of sleeping were Bergstrom (1976); El Hodiri (1973), and Biddle and Hamermesh (1990); Hoffman (1977) were the first to formally model the sleeping decision. Motivated by the emergence of sleep deprivation as a public health epidemic, there has been a renewed interest in studying economic causes and consequences of insufficient sleep. A handful of recent studies exploit quasi-experiments and instrumental variable strategies to examine the effects of the lack of sleep on health (Giuntella and Mazzonna, 2017; Jin and Ziebarth, 2018), academic achievement (Hafner et al., 2017; Heissel and Norris, 2017), cognitive performance (Giuntella et al., 2017), fatal crashes (Smith, 2016), and economic productivity (Gibson and Shrader, 2018).

There is a growing number of studies analyzing the effects of broadband access on electoral outcomes (Falck et al., 2014; Nardotto et al., 2015), social capital (Bauernschuster et al., 2014), fertility (Billari et al., 2017; Guldi and Herbst, 2017), and sex crimes (Bhuller et al., 2013). However, despite the growing attention of doctors and medias on the potential negative effects of Internet and digital devices on sleep, to the best of our knowledge, there are no studies that examine the causal effect of the access to high-speed Internet on sleeping behavior. The goal of this paper is to fill this gap in the literature by exploiting a plausible source of exogenous variation in access to high-speed Internet.

We focus on Germany for three main reasons. First, Germany provides an interesting case study, as a recent report by Hafner et al. (2016) documents that about 200,000 working days are lost due to insufficient sleep in Germany, corresponding to an economic loss of approximately \$60 billion a year, or about 1.6% of its GDP. Second, this allows us to use the German Socioeconomic Panel (SOEP), one of the few panel surveys containing a rich set of information both on sleep and access to high-speed Internet. Third, it allows us to adopt an instrumental variable (IV) approach which relies on the historical peculiarities of the pre-existing telephone infrastructure across Germany (Bauernschuster et al., 2014; Falck et al., 2014).

We first document the relationship between digital temptations and sleep using data drawn from the German Time Use Survey (German TUS) on sleep duration, time spent playing video games, using computer and smartphones, and watching television and videos/DVDs. Among teenagers (aged 13–19) and young adults (aged up to 30), there is a significant association between the likelihood of reporting insufficient sleep and time spent on computer games or watching TV and videos/DVDs in the evening. Among adults of older ages (aged 31–59), we also find evidence of a significant correlation between shorter sleep duration and the use of computers and smartphones. Interestingly, these associations survive to the inclusion of individual fixed-effects. This descriptive evidence motivates us to further investigate the causal nexus between digital temptations and sleep outcomes. Therefore, we examine the effects of access to high-speed Internet (DSL) technology on sleep duration and sleep satisfaction using data drawn from the SOEP. Since Internet access increases the marginal utility of PC and tablets use, we hypothesize that it may lead to more technology use near bedtime, which in turn may affect sleep duration and sleep quality (Demirci et al., 2015; Lemola et al., 2015; Young, 1998). The main empirical challenge is that DSL access may be correlated with unobservable socio-demographic characteristics that simultaneously influence access to high-speed Internet and sleep duration. To tackle this potential endogeneity bias, we follow the IV approach proposed by Falck et al. (2014), who study the effects of Broadband on voting behavior. Their identification relies on the fact that the location of the main distribution frames (MDFs) across Germany was determined by historical circumstances unlikely to be correlated with the demand for high-speed Internet access. The idea underlying this strategy is that while the distance of a household from the MDF is a crucial cost factor for the adoption of DSL connection, the historical distribution of MDFs across Germany can be considered exogenous to current preferences for Internet access. Using confidential information on the residential geo-coordinates of the SOEP households, we calculate the distance of each household from the MDF. Furthermore, we also exploit the fact that several regions in East Germany adopted the optical access line (OPAL) technology in the early 1990s. While this telephone infrastructure was considered a state-of-the art technology at the time, it turned out to be incompatible with DSL technology. Thus, areas that adopted the OPAL technology in the 1990s faced higher barriers to broadband Internet deployment. In this paper, we rely on the variation in Broadband access induced by these historical peculiarities of the German communication network to identify the causal impacts of high-speed Internet on sleep duration and sleep satisfaction.

Our findings reveal a large, negative impact of high-speed Internet on sleep duration. Individuals with DSL access tend to sleep 25 min less than their counterparts without DSL Internet. They are significantly less likely to sleep between 7 and 9 h, the interval typically recommended by the scientific community (Hirshkowitz et al., 2015). Furthermore, they are less likely to be satisfied with their sleep. These effects are mostly concentrated among younger adults. Consistent with what found by Giuntella et al. (2017) and Giuntella and Mazzonna (2017), the effects are larger among individuals facing time constraints in the morning due to work schedules or family duties.

The remainder of this paper is organized as follows. Section 2 provides a description of the data. In Section 3, we describe our empirical specification and identification strategy. The main results of the paper are reported in Section 4, which also includes a set of robustness checks. Section 5 concludes.

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