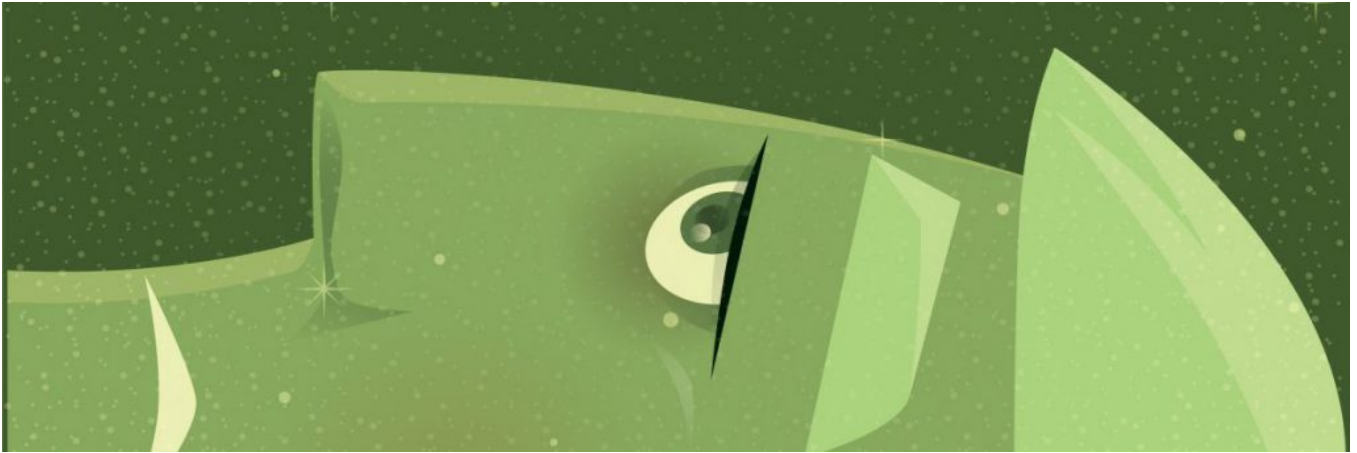


The Hidden Costs of Sleep Deficits

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Throughout modern history, the concept of a good night's sleep has often been painted as almost an indulgence. Virginia Woolf referred to it as “that deplorable curtailment of the joy of life.” Vladimir Nabokov called it “the most moronic fraternity in the world.” And more recently, internet pioneer Vint Cerf simply dismissed sleep as “a waste of time.”

These types of sentiments — along with burdensome work schedules and plenty of electronic distractions that make it tempting and easy to delay bedtime — are seeping into everyday life across the industrialized world. Recent reports indicate that nearly 30% of American adults report an average of 6 or fewer hours of sleep per night — at least an hour short of the amount recommended by the World Health Organization. School-age children ideally should have 10 hours of daily sleep, but heavy homework loads, crack-of-dawn school starts, and extracurricular activities are keeping them up far too late and forcing them out of bed way too early.

Science has produced a strong body of evidence showing how lack of sleep impairs not only a variety of bodily functions, but also cognitive processes such as memory and executive control.

“There does not seem to be one major organ within the body, or process within the brain, that isn't optimally enhanced by sleep (and detrimentally impaired when we don't get enough),” says Matthew P. Walker, a cognitive psychologist who heads the University of California, Berkeley's (UCB) Sleep and Neuroimaging Lab, in his book *Why we sleep: Unlocking the power of sleep and dreams*.

Psychology researchers are expanding the scope of sleep research to explore how ties between sleep and cognition affect central aspects of our societal fabric, including fairness, justice, relationships, and morality.

Why Sleep Isn't a Waste of Time

As early as infancy, sleep plays a central role in the development of higher-order cognition, including

executive functioning, working memory, and self-control.

As we grow, sleep continues to support mental functioning, including noncognitive abilities such as mastering emotional processing and control.

“Benevolently servicing our psychological health, sleep recalibrates our emotional brain circuits, allowing us to navigate next-day social and psychological challenges with cool-headed composure,” Walker writes in his book.

Indeed, research has supported the correlation between sleep and emotion regulation. A lab study led by APS Fellow Iris Mauss of UCB, for example, showed that participants with poor self-reported sleep quality exhibited lowered ability to cognitively reappraise negative thoughts — considered a key skill in emotional control.

When we don’t get sufficient sleep, it can seep into our social lives in a variety of ways, as APS Past Board Member Wendy Berry Mendes and her University of California, San Francisco (UCSF) colleagues Amie M. Gordon and Aric A. Prather point out in an article in the October 2017 issue of *Current Directions in Psychological Science*. In examining the literature on the relationship between sleep and a number of social processes, lead author Gordon and the other scientists note that poor sleepers have difficulty overriding initial impulses and employing effortful cognition, which can produce behavior that is driven by implicit biases. Additionally, sleep deficits may disrupt our ability to process subtle social cues, they note.

Indeed, Walker’s own research indicates that a person’s ability to accurately read others’ emotions, especially nuanced ones, is impeded by insufficient sleep. In a 2010 lab study, Walker assigned college-age participants to evaluate pictures of three different faces expressing varying degrees of sadness, happiness, and anger. Some of the students performed the task once under conditions of sleep deprivation and twice when rested after different durations of sleep. The others evaluated the pictures twice, with plenty of rest both times.

Results showed that participants were less able to recognize moderate expressions of anger and happiness after being deprived of sleep, although they were still able to recognize extreme manifestations of those emotions.

University of Arizona neuropsychologist William D.S. Killgore and his colleagues published results of a similar experiment using a larger set of emotional depictions, part of an examination of sleep deprivation’s effects on social, emotional, and moral judgment that began while Killgore worked as a research psychologist for the US Army. He notes that such results show how insufficient sleep can take a toll on critical social interactions.

“You may be responding inappropriately to somebody that you just don’t read correctly, especially those social emotions that make us human,” Killgore said. “Or you may not be as empathic. Your spouse or significant other may need something from you and you’re less able to read that. It’s possible that this could lead to problems in your relationships or problems at work. To me, that is one of the biggest problems — how this affects our relationships.”

Relationship Costs

It seems intuitive that sleep loss could lead to heightened conflict with family, friends, and colleagues: Low on sleep, short on temper.

A 2014 empirical report authored by UCSF's Gordon and APS Fellow Serena Chen (UCB) showed some correlations among sleep quality, emotions, and relationship conflict. In one lab study, the researchers asked 70 heterosexual couples to discuss a top source of conflict within their relationship and then offered the couples an opportunity to resolve that conflict while being videotaped. Prior to the conversation participants independently rated their previous night's sleep duration and quality along with their daytime dysfunction (i.e., current feelings of tiredness). They also completed questionnaires rating their levels of appreciation, caring, anger, resentment, and other emotions, and as well as how much they thought their partners had experienced those emotions. Three independent observers also watched the conflict conversations and coded each individual's affect.

In multilevel analyses of the measures, Gordon and Chen found that participants who reported poor sleep the previous night showed more negative and less positive affect during the conflict conversation, as did their partners. The independent coders corroborated those results. What's more, the people who slept poorly were less able to gauge their partners' feelings, and their partners showed a similar impediment in empathy. The data indicated that couples were best able to resolve the conflict during the experiment if both were well-rested. If one partner slept poorly, it hindered conflict resolution.

Economic Costs

The costs of sleep deprivation appear to be taking a heavy toll on economic vitality as well. A 2016 RAND Europe study concluded that the effects of sleep loss on workplace productivity and mortality risk is costing the combined economies of the leading industrialized nations — the United States, Japan, Germany, and the United Kingdom — \$660 billion a year.

In a 2015 article published in *Perspectives on Psychological Science*, Christopher Barnes (University of Washington) and Christopher Drake (Henry Ford Hospital, Sleep Disorders and Research Center) explain how these economic costs seem to arise from employee fatigue.

“Overall, sleep deprived employees will be more prone to mistakes, less aware that they are making mistakes, less creative, and more likely to be injured,” Barnes explains. “Other workplace effects include more cyberloafing, less work engagement, more unethical behavior, and jerkier bosses.”

Psychological scientists Michael S. Christian (University of North Carolina at Chapel Hill) and Aleksander P.J. Ellis (University of Arizona) conducted a study that demonstrated such effects. Testing the hypothesis that sleep-deprived workers would have more trouble resisting negative impulses than their well-rested peers, Christian and Ellis surveyed 171 nurses at the beginning and end of their shifts, asking them to rate their own levels of sleep deprivation, self-control, and hostility. At the end of their 12-hour shifts, they were asked about whether they had engaged in any deviant behavior, such as making hurtful comments or intentionally working slowly. The results showed that nurses who reported less than 6 hours of sleep the night before were significantly more likely to report committing deviant acts at work than those who were better rested.

In a follow-up study, 75 business students participated in a lab experiment that examined whether sleep deprivation would lead to increased rates of cheating and hostility. The students were divided into two groups: One stayed awake for a full 24 hours in the lab, while the other group was told to sleep normally — no fewer than 7 hours of sleep per night — for the two nights before the experiment.

The next day, both groups of students responded to a set of emails from prospective students who were interested in applying to their business school as part of a new electronic mentoring program. The researchers specifically told the participants that they would be representing the business school with their responses to the potential applicants.

The emails from potential students contained a number of grammatical and spelling mistakes, as well as negative comments about the business school.

Using a predetermined coding system, the researchers rated participants' responses to these emails for inappropriateness, such as making fun of the sender, cursing, or making racial or ethnic remarks.

Participants from the sleep-deprivation condition were significantly more likely to include negative and inappropriate language in their responses, suggesting that they were having more difficulty controlling their emotions than the well-rested participants.

In the same lab experiment, participants had an opportunity to cheat for small amounts of money. First, they took a short pretest measuring reasoning. They then received a similar test and learned that they'd earn \$1 for each correct response. Importantly, the participants graded their own tests and rewarded themselves for their correct responses by taking cash out of an envelope in the room.

The findings revealed that the sleep-deprived participants were more likely to cheat, taking more cash than they'd actually earned compared with the well-rested group.

Importantly, these results suggest that sleepiness has serious consequences for jobs where regulating emotions are important, such as customer service. Sleep-deprived employees who have difficulty regulating and hiding their negative emotions may be more likely to lash out at an irate customer than their well-rested counterparts.

In another study, Barnes and an international team of researchers revealed the effects that sleep deprivation can have on bosses in the workplace. The research team had supervisors complete a daily sleep survey at the beginning of each day for 10 consecutive workdays. The supervisors' subordinates completed surveys evaluating abusive behavior across this same period of time.

When supervisors slept badly, their staff noticed more abusive behavior. In turn, this created a negative atmosphere in the office, potentially harming the team's productivity.

"In conclusion, our study connects leader sleep quality to daily abusive supervisor behavior, which ultimately results in deleterious outcomes for subordinates," Barnes and colleagues write.

Legal Costs

In addition to its economic impact, science has identified the impacts of insufficient sleep on another societal cornerstone: criminal justice. That research takes advantage of a natural experiment: the annual conversion to daylight saving time (DST) in North America, Europe, and some parts of the Middle East.

The seemingly small amount of lost sleep (an average of 40 minutes) that most people incur when they advance their clocks an hour had already been linked to an increase in workplace injuries and auto accidents. But a 2016 study showed that the shortened sleep associated with the switch to DST might also affect the severity of sentences doled out by judges.

“We find that the sentences given to those convicted of crimes may be partially polluted by the sleep of those giving the punishments,” says researcher Kyoungmin Cho of the University of Washington, first author on the study. “Sleep is a factor that should not play a role in their sentences, but does.”

Cho conducted the research with the University of Washington’s Barnes and Cristiano L. Guarana (Indiana University Bloomington). The researchers tapped into data on legal sentences handed down between 1992 and 2003 and collected by the US Sentencing Commission. They examined data within each judicial district to account for variation across districts and looked at the length of the sentence given, not including any other types of sentences including community confinement or probation.

To isolate the unique impact of DST, Cho and colleagues took other potential influences, including the yearly trend in sentencing decisions and various characteristics related to both the trial and the offender, into account.

Across multiple analyses, the researchers found a consistent trend: Sentences given on the Monday after the switch to DST were longer than those given on other days. Specifically, Cho and colleagues found that sentences on the so-called “Sleepy Monday” were approximately 5% longer than those given on the previous Monday and the following Monday.

Additional analyses showed that legal sentences handed out on Sleepy Monday were longer than those given on all other Mondays combined, and they were also longer than those doled out on all other days of the year combined.

Importantly, the effect was specific to Sleepy Monday: Sentences given on the other weekdays following the transition to DST did not differ from sentences given 1 week before or 1 week after. Cho and colleagues found that the return to standard time in the fall, when people gain an hour, had no effect on legal sentencing.

To be sure, there are many variables that influence a judge’s sentencing decisions, and the average amount of sleep lost due to DST is less than an hour. And yet the data still showed a clear relationship between the time change and sentencing:

“We were surprised at how clearly we were able to detect the hypothesized effect,” says Cho. “Across many alternative analyses and robustness checks, the effect was still quite clear and meaningful.”

The findings have clear implications for those involved in the legal system, but may also extend to the many other contexts in which people give or receive punishment, Cho said.

“Bosses punish employees who break work rules, parents punish children who engage in bad behavior, teachers punish students who disrupt the classroom environment, and sports referees punish players and athletes who violate the rules of the game,” she noted. “Many of the people making these punishment decisions will do so while short on sleep, and the same logic explored in our research will likely apply in those contexts, as well.”

Cho plans next to investigate the causal mechanisms that link sleep and punishment decisions, as well as potential strategies for mitigating these effects.

What’s Next

Recognizing the need for more and better sleep research, Gordon, Mendes, and others are urging psychological scientists to take a much closer look at the role that sleep — or a lack of it — plays in our emotional and social functioning, and in our societal structure as a whole. Critical to this effort will be going beyond participant self-reports and lab-based studies to actually measure people and their sleep under more naturalistic conditions. The recent availability of wearable technologies such as fitness trackers offers one promising avenue for more precisely measuring participants’ sleep.

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