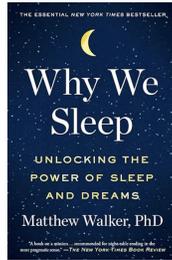


## Your Kindle Notes For:



### **Why We Sleep: Unlocking the Power of Sleep and Dreams**

**Matthew Walker**

144 Highlight(s) | 0 Note(s)

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Routinely sleeping less than six or seven hours a night demolishes your immune system, more than doubling your risk of cancer.

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Too little sleep swells concentrations of a hormone that makes you feel hungry while suppressing a companion hormone that otherwise signals food satisfaction.

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Add the above health consequences up, and a proven link becomes easier to accept: the shorter your sleep, the shorter your life span. The old maxim “I’ll sleep when I’m dead” is therefore unfortunate. Adopt this mind-set, and you will be dead sooner and the quality of that (shorter) life will be worse.

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in the body, sleep restocks the armory of our immune system, helping fight malignancy, preventing infection, and warding off all manner of sickness. Sleep reforms the body’s metabolic state by fine-tuning the balance of insulin and circulating glucose. Sleep further regulates our appetite, helping control body weight through healthy food selection rather than rash impulsivity. Plentiful sleep maintains a flourishing microbiome within your gut from which we know so much of our nutritional health begins.

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Emerging from this research renaissance is an unequivocal message: sleep is the single most effective thing we can do to reset our brain and body health each day—Mother Nature’s best effort yet at contra-death.

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Hard problems care little about what motivates their interrogators; they meter out their lessons of difficulty all the same.

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heliotropism: when a plant’s leaves or flowers track the trajectory of the sun as it moves across the sky during the day.

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Any signal that the brain uses for the purpose of clock resetting is termed a zeitgeber, from the German “time giver” or “synchronizer.” Thus, while light is the most reliable and thus the primary zeitgeber, there are many factors that can be used in addition to, or in the absence of, daylight.

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The twenty-four-hour biological clock sitting in the middle of your brain is called the suprachiasmatic (pronounced soo-pra-kai-as-MAT-ik) nucleus. As with much of anatomical language, the name, while far from easy to pronounce, is instructional: supra, meaning above, and chiasm, meaning a crossing point.

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This is especially true of a region called the prefrontal cortex, which sits above the eyes, and can be thought of as the head office of the brain. The prefrontal cortex controls high-level thought and logical reasoning, and helps keep our emotions in check. When a night owl is forced to wake up too early, their prefrontal cortex remains in a disabled, “offline” state. Like a cold engine after an early-morning start, it takes a long time before it warms up to operating temperature, and before that will not function efficiently.

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However, night owls are not owls by choice. They are bound to a delayed schedule by unavoidable DNA hardwiring. It is not their conscious fault, but rather their genetic fate.

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Owls are thus often forced to burn the proverbial candle at both ends. Greater ill health caused by a lack of sleep therefore befalls owls, including higher rates of depression, anxiety, diabetes, cancer, heart attack, and stroke.

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Melatonin has other names, too. These include “the hormone of darkness” and “the vampire hormone.” Not because it is sinister, but simply because melatonin is released at night.

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Melatonin simply provides the official instruction to commence the event of sleep, but does not participate in the sleep race itself.

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That said, there is a significant sleep placebo effect of melatonin, which should not be underestimated: the placebo effect is, after all, the most reliable effect in all of pharmacology.

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But it's a slow process. For every day you are in a different time zone, your suprachiasmatic nucleus can only readjust by about one hour.

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At this very moment, a chemical called adenosine is building up in your brain. It will continue to increase in concentration with every waking minute that elapses. The longer you are awake, the more adenosine will accumulate. Think of adenosine as a chemical barometer that continuously registers the amount of elapsed time since you woke up this morning.

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As a result of that chemical sleep pressure, when adenosine concentrations peak, an irresistible urge for slumber will take hold. VII It happens to most people after twelve to sixteen hours of being awake.

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Caffeine has an average half-life of five to seven hours. Let's say that you have a cup of coffee after your evening dinner, around 7:30 p.m. This means that by 1:30 a.m., 50 percent of that caffeine may still be active and circulating throughout your brain tissue.

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One cup of tea or coffee in the morning will last much of the day, and should they have a second cup, even early in the afternoon, they will find it difficult to fall asleep in the evening. Aging also alters the speed of caffeine clearance: the older we are, the longer it takes our brain and body to remove caffeine, and thus the more sensitive we become in later life to caffeine's sleep-disrupting influence.

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They are two distinct and separate systems that are ignorant of each other. They are not coupled; though, they are usually aligned.

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arising from three different regions: (1) brainwave activity, (2) eye movement activity, and (3) muscle activity. Collectively, these signals are grouped together under the blanket term “polysomnography” (PSG), meaning a readout (graph) of sleep (somnus) that is made up of multiple signals (poly).

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What you are hearing is a sleep spindle—a punchy burst of brainwave activity that often festoons the tail end of each individual slow wave. Sleep spindles occur during both the deep and the lighter stages of NREM sleep, even before the slow, powerful brainwaves of deep sleep start to rise up and dominate. One of their many functions is to operate like nocturnal soldiers who protect sleep by shielding the brain from external noises.

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Now slide it up your forehead about two inches. When you go to bed tonight, this is where most of your deep-sleep brainwaves will be generated: right in the middle of your frontal lobes. It is the epicenter, or hot spot, from which most of your deep, slow-wave sleep emerges.

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What you are actually experiencing during deep NREM sleep is one of the most epic displays of neural collaboration that we know of. Through an astonishing act of self-organization, many thousands of brain cells have all decided to unite and “sing,” or fire, in time. Every time I watch this stunning act of neural synchrony occurring at night in my own research laboratory, I am humbled: sleep is truly an object of awe.

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For these reasons, REM sleep has also been called paradoxical sleep: a brain that appears awake, yet a body that is clearly asleep.

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Each and every night, REM sleep ushers you into a preposterous theater wherein you are treated to a bizarre, highly associative carnival of autobiographical themes.

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This feature, termed “atonia” (an absence of tone, referring here to the muscles), is instigated by a powerful disabling signal that is transmitted down the full length of your spinal cord from your brain stem.

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The brain paralyzes the body so the mind can dream safely.

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and we can pose a very different theory: sleep was the first state of life on this planet, and it was from sleep that wakefulness emerged. It may be a preposterous hypothesis, and one that nobody is taking seriously or exploring, but personally I do not think it to be entirely unreasonable.

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Elephants need half as much sleep as humans, requiring just four hours of slumber each day. Tigers and lions devour fifteen hours of daily sleep. The brown bat outperforms all other mammals, being awake for just five hours each day while sleeping nineteen hours.

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After all, absence of evidence is not evidence of absence.

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When a theme repeats in evolution, and independently across unrelated lineages, it often signals a fundamental need.

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REM-sleep dreaming came into being, what vital needs it supports in the warm-blooded world of birds and mammals (e.g., cardiovascular health, emotional restoration, memory association, creativity, body-temperature regulation), and whether other species dream. As we will later discuss, it seems they do.

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This is true for total sleep time, just as it is for NREM sleep and for REM sleep. That humans (and all other species) can never “sleep back” that which we have previously lost is one of the most important take-homes of this book, the saddening consequences of which I will describe in chapters 7 and 8.

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and which remains measurable in all human beings to date—is one consisting of a longer bout of continuous sleep at night, followed by a shorter midafternoon nap.

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we have discovered that REM sleep exquisitely recalibrates and fine-tunes the emotional circuits of the human brain

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It is only when the fetus enters the final trimester that the glimmers of real wakefulness emerge. Far less than you would probably imagine, though—just two to three hours of each day are spent awake in the womb.

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REM sleep acts as an electrical fertilizer during this critical phase of early life. Dazzling bursts of electrical activity during REM sleep stimulate the lush growth of neural pathways all over the developing brain, and then furnish each with a healthy bouquet of connecting ends, or synaptic terminals.

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An infant brain without sleep will be a brain ever underconstructed.

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If you are now wondering whether or not epidemiological studies have linked alcohol use during pregnancy and an increased likelihood of neuropsychiatric illness in the mother's child, including autism, the answer is yes.

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What emerges from all of these studies is that REM sleep is not optional during early human life, but obligatory. Every hour of REM sleep appears to count, as evidenced by the desperate attempt by a fetus or newborn to regain any REM sleep when it is lost.<sup>XI</sup>

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Taking a closer look at the timing of this relationship, you see something even more interesting. The changes in deep NREM sleep always precede the cognitive and developmental milestones within the brain by several weeks or months, implying a direction of influence: deep sleep may be a driving force of brain maturation, not the other way around.

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When your children finally reach their mid-twenties and your car insurance premium drops, you can thank sleep for the savings. The relationship between deep-sleep intensity and brain maturation that Feinberg described has now been observed in many different populations of children and adolescents around the world.

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Adolescents face two other harmful challenges in their struggle to obtain sufficient sleep as their brains continue to develop. The first is a change in their circadian rhythm. The second is early school start times. I will address the harmful and life-threatening effects of the latter in a later chapter; however, the complications of early school start times are inextricably linked with the first issue—a shift in circadian rhythm.

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Sadly, neither society nor our parental attitudes are well designed to appreciate or accept that teenagers need more sleep than adults, and that they are biologically wired to obtain that sleep at a different time from their parents. It's very understandable for parents to feel frustrated in this way, since they believe that their teenager's sleep patterns reflect a conscious choice and not a biological edict. But non-volitional, non-negotiable, and strongly biological they are. We parents would be wise to accept this fact, and to embrace it, encourage it, and praise it, lest we wish our own children to suffer developmental brain abnormalities or force a raised risk of mental illness upon them.

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However, a strong case can already be made for defending sleep time in our adolescent youth, rather than denigrating sleep as a sign of laziness.

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Once again, I urge an elderly individual who may be concerned about their sleep not to seek a sleeping pill prescription. Instead, I recommend you first explore the effective and scientifically proven non-pharmacological interventions that a doctor who is board certified in sleep medicine can provide.

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considering the importance of deep sleep for learning and memory, not to mention all branches of bodily health, from cardiovascular and respiratory, to metabolic, energy balance, and immune function.

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Poor memory and poor sleep in old age are therefore not coincidental, but rather significantly interrelated.

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More generally, these and similar studies have confirmed that poor sleep is one of the most underappreciated factors contributing to cognitive and medical ill health in the elderly, including issues of diabetes, depression, chronic pain, stroke, cardiovascular disease, and Alzheimer's disease.

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Of course, the ad is not describing some miracle new tincture or a cure-all wonder drug, but rather the proven benefits of a full night of sleep. The evidence supporting these claims has been documented in more than 17,000 well-scrutinized scientific reports to date. As for the prescription cost, well, there isn't one. It's free. Yet all too often, we shun the nightly invitation to receive our full dose of this all-natural remedy—with terrible consequences.

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Unfortunately, the hippocampus has a limited storage capacity, almost like a camera roll or, to use a more modern-day analogy, a USB memory stick. Exceed its capacity and you run the risk of not being able to add more information or, equally bad, overwriting one memory with another: a mishap called interference forgetting.

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In that moment, we had just become privy to an electrical transaction occurring in the quiet secrecy of sleep: one that was shifting fact-based memories from the temporary storage depot (the hippocampus) to a long-term secure vault (the cortex). In doing so, sleep had delightfully cleared out the hippocampus, replenishing this short-term information repository with plentiful free space. Participants awoke with a refreshed capacity to absorb new information within the hippocampus, having relocated yesterday's imprinted experiences to a more permanent safe hold. The learning of new facts could begin again, anew, the following day.

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Sleep six hours or less and you are shortchanging the brain of a learning restoration benefit that is normally performed by sleep spindles.

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**SLEEP-THE-NIGHT-AFTER LEARNING** The second benefit of sleep for memory comes after learning, one that effectively clicks the "save" button on those newly created files. In doing so, sleep protects newly acquired information, affording immunity against forgetting: an operation called consolidation. That sleep sets in motion the process of memory consolidation was recognized long ago, and may be one of the oldest proposed functions of sleep. The first such claim in the written human record appears to be by the prophetic Roman rhetorician Quintilian (AD 35–100), who stated: It is a curious fact, of which the reason is not obvious, that the interval

of a single night will greatly increase the strength of the memory. . . . Whatever the cause, things which could not be recalled on the spot are easily coordinated the next day, and time itself, which is generally accounted one of the causes of forgetfulness, actually serves to strengthen the memory.III

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The stage was set for a battle royal between the two types of sleep. The question: Which sleep period would confer a greater memory savings benefit—that filled with deep NREM, or that packed with abundant REM sleep? For fact-based, textbook-like memory, the result was clear. It was early-night sleep, rich in deep NREM, that won out in terms of providing superior memory retention savings relative to late-night, REM-rich sleep.

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Indeed, if you were a participant in such a study, and the only information I had was the amount of deep NREM sleep you had obtained that night, I could predict with high accuracy how much you would remember in the upcoming memory test upon awakening, even before you took it. That's how deterministic the link between sleep and memory consolidation can be.

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Fitting the notion of a long-wave radio signal that carries information across large geographical distances, the slow brainwaves of deep NREM had served as a courier service, transporting memory packets from a temporary storage hold (hippocampus) to a more secure, permanent home (the cortex). In doing so, sleep had helped future-proof those memories.

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At every stage of human life, the relationship between NREM sleep and memory solidification is therefore observed. It's not just humans, either.

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but it will even salvage those that appeared to have been lost soon after learning. In other words, following a night of sleep you regain access to memories that you could not retrieve before sleep. Like a computer hard drive where some files have become corrupted and inaccessible, sleep offers a recovery service at night.

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Success has come in two forms: sleep stimulation, and targeted memory reactivation. The clinical ramifications of both will become clear when considered in the context of psychiatric illness and neurological disorders, including dementia.

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You have, as a consequence, selectively enhanced only those individual memories that you want to keep. It all sounds like the stuff of science fiction, but it is now science fact: the method is called targeted memory reactivation. And as is so often the case, the true story turns out to be far more fascinating than the fictional one.

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Muscle memory is, in fact, brain memory. Training and strengthening muscles can help you better execute a skilled memory routine. But the routine itself—the memory program—resides firmly and exclusively within the brain.

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realizing that this gentleman had just told me something that violated the most repeated and entrusted teaching edict: practice makes perfect. Not so, it seemed. Perhaps it was practice, with sleep, that makes perfect?

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Those who remained awake across the day showed no evidence of a significant improvement in performance. However, fitting with the pianist's original description, those who were tested after the very same time delay of twelve hours, but that spanned a night of sleep, showed a striking 20 percent jump in performance speed and a near 35 percent improvement in accuracy. Importantly, those participants who learned the motor skill in the morning—and who showed no improvement that evening—did go on to show an identical bump up in performance when retested after a further twelve hours, now after they, too, had had a full night's sleep.

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Practice does not make perfect. It is practice, followed by a night of sleep, that leads to perfection.

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Their typing, post-sleep, was now fluid and unbroken. Gone was the staccato performance, replaced by seamless automaticity, which is the ultimate goal of motor learning: 4-1-3-2-4, 4-1-3-2-4, 4-1-3-2-4, rapid and nearly perfect. Sleep had systematically identified where the difficult transitions were in the motor memory and smoothed them out.

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Which is to say that sleep helped the brain automate the movement routines, making them second nature—effortless—precisely

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Many other groups have found a similar “local-sleep”-and-learning effect. When it comes to motor-skill memories, the brainwaves of sleep were acting like a good masseuse—you still get a full body massage, but they will place special focus on areas of the body that need the most help. In the same way, sleep spindles bathe all parts of the brain, but a disproportionate emphasis will be placed on those parts of the brain that have been worked hardest with learning during the day.

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Standing in front of the manager, staff, and players, I tell them about one of the most sophisticated, potent, and powerful—not to mention legal—performance enhancers that has real game-winning potential: sleep. I back up these claims with examples from the more than 750 scientific studies that have investigated the relationship between sleep and human performance, many of which have studied professional and elite athletes specifically.

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A final benefit of sleep for memory is arguably the most remarkable of all: creativity.

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will learn precisely why and how sleep loss inflicts such devastating effects on the brain, linking it to numerous neurological and psychiatric conditions (e.g., Alzheimer’s disease, anxiety, depression, bipolar disorder, suicide, stroke, and chronic pain), and on every physiological system of the body, further contributing to countless disorders and disease (e.g., cancer, diabetes, heart attacks, infertility, weight gain, obesity, and immune deficiency).

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With chronic sleep restriction over months or years, an individual will actually acclimate to their impaired performance, lower alertness, and reduced energy levels. That low-level exhaustion becomes their accepted norm, or baseline.

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Based on epidemiological studies of average sleep time, millions of individuals unwittingly spend years of their life in a sub-optimal state of psychological and physiological functioning, never maximizing their potential of mind or body due to their blind persistence in sleeping too little.

Pink highlight | Page: 137

Sixty years of scientific research prevent me from accepting anyone who tells me that he or she can “get by on just four or five hours of sleep a night just fine.”

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The heady cocktail of sleep loss and alcohol was not additive, but instead multiplicative.

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After thirty years of intensive research, we can now answer many of the questions posed earlier. The recycle rate of a human being is around sixteen hours. After sixteen hours of being awake, the brain begins to fail. Humans need more than seven hours of sleep each night to maintain cognitive performance.

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After ten days of just seven hours of sleep, the brain is as dysfunctional as it would be after going without sleep for twenty-four hours. Three full nights of recovery sleep (i.e., more nights than a weekend) are insufficient to restore performance back to normal levels after a week of short sleeping. Finally, the human mind cannot accurately sense how sleep-deprived it is when sleep-deprived.

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Drowsy driving alone is worse than driving drunk.

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Drowsy-driving deaths are neither chance, nor without cause. They are predictable and the direct result of not obtaining sufficient sleep. As such, they are unnecessary and preventable. Shamefully, governments of most developed countries spend less than 1 percent of their budget educating the public on the dangers of drowsy driving relative to what they invest in combating drunk driving.

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There are many things that I hope readers take away from this book. This is one of the most important: if you are drowsy while driving, please, please stop. It is lethal.

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No matter what you may have heard or read in the popular media, there is no scientific evidence we have suggesting that a drug, a device, or any amount of psychological willpower can replace sleep.

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explanation appears to lie in their genetics, specifically a sub-variant of a gene called BHLHE41. III Scientists are now trying to understand what this gene does, and how it confers resilience to such little sleep.

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Instead, we have demonstrated that otherwise healthy people can experience a neurological pattern of brain activity similar to that observed in many of these psychiatric conditions simply by having their sleep disrupted or blocked.

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Therefore, the sleep-deprivation manipulation was only in effect during the act of learning, and not during the later act of recall. When we compared the effectiveness of learning between the two groups, the result was clear: there was a 40 percent deficit in the ability of the sleep-deprived group to cram new facts into the brain (i.e., to make new memories), relative to the group that obtained a full night of sleep. To put that in context, it would be the difference between acing an exam and failing it miserably!

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Memories formed without sleep are weaker memories, evaporating rapidly. Studies in rats have found that it is almost impossible to strengthen the synaptic connections between individual neurons that normally forge a new memory circuit in the animals that have been sleep-deprived.

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It was also the last piece I was invited to write. In the article, I described the above studies and their relevance, returning time and again to the pandemic of sleep deprivation that was sweeping through the student body. However, rather than lambaste the students for these practices, I pointed a scolding finger directly at the faculty, myself included. I suggested that if we, as teachers, strive to accomplish just that purpose—to teach—then end-loading exams in the final days of the semester was an asinine decision. It forced a behavior in our students—that of short sleeping or pulling all-nighters leading up to the exam—that was in direct opposition to the goals of nurturing young scholarly minds. I argued that logic, backed by scientific fact, must prevail, and that it was long past the time for us to rethink our evaluation methods, their contra-educational impact, and the unhealthy behavior it coerced from our students.

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In terms of memory, then, sleep is not like the bank. You cannot accumulate a debt and hope to pay it off at a later point in time. Sleep for memory consolidation is an all-or-nothing event. It is a concerning result in our 24/7, hurry-up, don't-wait society. I feel another op-ed coming on . . .

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Phrased differently, and perhaps more simply, wakefulness is low-level brain damage, while sleep is neurological sanitation.

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Insufficient sleep is only one among several risk factors associated with Alzheimer's disease. Sleep alone will not be the magic bullet that eradicates dementia. Nevertheless, prioritizing sleep across the life span is clearly becoming a significant factor for lowering Alzheimer's disease risk.

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Widening the lens of focus, there are more than twenty large-scale epidemiological studies that have tracked millions of people over many decades, all of which report the same clear relationship: the shorter your sleep, the shorter your life. The leading causes of disease and death in developed nations—diseases that are crippling health-care systems, such as heart disease, obesity, dementia, diabetes, and cancer—all have recognized causal links to a lack of sleep.

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Unhealthy sleep, unhealthy heart. Simple and true.

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Adults forty-five years or older who sleep fewer than six hours a night are 200 percent more likely to have a heart attack or stroke during their lifetime, as compared with those sleeping seven to eight hours a night.

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The less you sleep, the more you are likely to eat. In addition, your body becomes unable to manage those calories effectively, especially the concentrations of sugar in your blood. In these two ways, sleeping less than seven or eight hours a night will increase your probability of gaining weight, being overweight, or being obese, and significantly increases your likelihood of developing type 2 diabetes.

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Beyond the average treatment cost of more than \$85,000 per patient (which contributes to higher medical insurance premiums), diabetes lops ten years off an individual's life expectancy. Chronic sleep deprivation is now recognized as one of the major contributors to the escalation of type 2 diabetes throughout first-world countries. It's a preventable contribution.

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When your sleep becomes short, you will gain weight.

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As Van Cauter has elegantly described to me, a sleep-deprived body will cry famine in the midst of plenty.

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Some argue that we eat more when we are sleep-deprived because we burn extra calories when we stay awake. Sadly, this is not true. In the sleep-restriction experiments described above, there are no differences in caloric expenditure between the two conditions.

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Sleep's role in redressing the balance of the body's nervous system, especially its calming of the fight-or-flight sympathetic branch, improves the bacterial community known as your microbiome, which is located in your gut (also known as the enteric nervous system). As we learned about earlier, when you do not get enough sleep, and the body's stress-related, fight-or-flight nervous system is revved up, this triggers an excess of circulating cortisol that cultivates "bad bacteria" to fester throughout your microbiome. As a result, insufficient sleep will prevent the meaningful absorption of all food nutrients and cause gastrointestinal problems.III

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The upshot of all this work can be summarized as follows: short sleep (of the type that many adults in first-world countries commonly and routinely report) will increase hunger and appetite, compromise impulse control within the brain, increase food consumption (especially of high-calorie foods), decrease feelings of food satisfaction after eating, and prevent effective weight loss when dieting.

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An intimate and bidirectional association exists between your sleep and your immune system.

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Neglect sleep, and you are deciding to perform a genetic engineering manipulation on yourself each night, tampering with the nucleic alphabet that spells out your daily health story. Permit the same in your children and teenagers, and you are imposing a similar genetic engineering experiment on them as well.

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Discussed in chapter 7, the prefrontal cortex acts like the CEO of the brain. This region, especially the left and right sides, manages rational thought and logical decision-making, sending "top-down" instructions to your more primitive deep-brain centers, such as those instigating emotions. And it is this CEO region of your brain, which otherwise maintains your cognitive capacity for ordered, logical thought, that is temporarily ousted each time you enter into the dreaming state of REM sleep.

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If there is a red-thread narrative that runs from our waking lives into our dreaming lives, it is that of emotional concerns.

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Heat is not the function of the lightbulb, nor is it the reason we originally fashioned it. Instead, heat is simply what happens when light is generated in this way. It is an unintended by-product of the operation, not the true function. Heat is an epiphenomenon in this case.

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In this different and additional role, we can think of REM sleep like a master piano tuner, one that readjusts the brain's emotional instrumentation at night to pitch-perfect precision, so that when you wake up the next morning, you can discern overt and subtly covert micro-expressions with exactitude.

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Through this platinum-grade nocturnal service, better REM-sleep quality at night provided superior comprehension of the social world the next day.

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The brain's emotional navigation system had lost its true magnetic north of directionality and sensitivity: a compass that otherwise guides us toward numerous evolutionary advantages. With the absence of such emotional acuity, normally gifted by the re-tuning skills of REM sleep at night, the sleep-deprived participants slipped into a default of fear bias, believing even gentle- or somewhat friendly looking faces were menacing. The outside world had become a more threatening and aversive place when the brain lacked REM sleep—untruthfully so. Reality and perceived reality were no longer the same in the “eyes” of the sleepless brain. By removing REM sleep, we had, quite literally, removed participants' levelheaded ability to read the social world around them.

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We shall return to this topic in the penultimate chapter when we discuss the damage that early school start times are having on our teenagers. Most significant is the issue of sunrise school bus schedules that selectively deprive our teenagers of that early-morning slumber, just at the moment in their sleep cycle when their developing brains are about to drink in most of their much-needed REM sleep. We are bankrupting their dreams, in so many different ways.

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John Steinbeck wrote, “A problem difficult at night is resolved in the morning after the committee of sleep has worked on it.” Should he have prefaced “committee” with the word “dream”? It appears so.

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Simply put, the insomnia patients could not disengage from a pattern of altering, worrisome, ruminative brain activity. Think of a time when you closed the lid of a laptop to put it to sleep, but came back later to find that the screen was still on, the cooling fans were still running, and the computer was still active, despite the closed lid. Normally this is because programs and routines are still running, and the computer cannot make the transition into sleep mode.

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Emotions make us do things, as the name suggests (remove the first letter from the word).

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Lights off, lights on, lights off, lights on—this is the neurobiological job of the sleep-wake switch in the hypothalamus, controlled by orexin.

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But it is telling that, based on epidemiological data, any adult sleeping an average of 6.75 hours a night would be predicted to live only into their early sixties: very close to the median life span of these tribespeople.

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five key factors have powerfully changed how much and how well we sleep: (1) constant electric light as well as LED light, (2) regularized temperature, (3) caffeine (discussed in chapter 2), (4) alcohol, and (5) a legacy of punching time cards. It is this set of societally engineered forces that are responsible for many an individual's mistaken belief that they are suffering from medical insomnia.

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More than a third of our brain is devoted to processing visual information, far exceeding that given over to sounds or smells, or those supporting language and movement. For early Homo sapiens, most of our activities would have ceased after the sun set.

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The hands, feet, and head are therefore remarkably efficient radiating devices that, just prior to sleep onset, jettison body heat in a massive thermal venting session so as to drop your core body temperature. Warm hands and feet help your body's core cool, inducing inviting sleep quickly and efficiently.

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A bedroom temperature of around 65 degrees Fahrenheit (18.3°C) is ideal for the sleep of most people, assuming standard bedding and clothing. This surprises many, as it sounds just a little too cold for comfort. Of course, that specific temperature will vary depending on the individual in question and their unique physiology, gender, and age. But like calorie recommendations, it's a good target for the average human being.

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but caused a 50 percent weakening (unwiring) of the brain-cell connections originally formed during learning. In doing so, Ambien-laced sleep became a memory eraser, rather than engraver.

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pharmaceutical companies may have to acknowledge that, although users of sleeping pills may fall asleep nominally faster at night, they should expect to wake up with few(er) memories of yesterday. This is of special concern considering the average age for those receiving sleep medication prescriptions is decreasing, as sleep complaints and incidents of pediatric insomnia increase.

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Perhaps the most conservative and least litigious conclusion one can make about all of this evidence is that no study to date has shown that sleeping pills save lives. And after all, isn't that the goal of medicine and drug treatments? In my scientific, though non-medical, opinion, I believe that the existing evidence warrants far more transparent medical education of any patient who is considering taking a sleeping pill, at the very least. This way, individuals can appreciate the risks and make informed choices. Do you, for example, feel differently about using or continuing to use sleeping pills having learned about this evidence?

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The obvious methods involve reducing caffeine and alcohol intake, removing screen technology from the bedroom, and having a cool bedroom. In addition, patients must (1) establish a regular bedtime and wake-up time, even on weekends, (2) go to bed only when sleepy and avoid sleeping on the couch early/mid-evenings, (3) never lie awake in bed for a significant time period; rather, get out of bed and do something quiet and relaxing until the urge to sleep returns, (4) avoid daytime napping if you are having difficulty sleeping at night, (5) reduce anxiety-provoking thoughts and worries by learning to mentally decelerate before bed, and (6) remove visible clockfaces from view in the bedroom, preventing clock-watching anxiety at night.

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You can find more resources on CBT-I, and a list of qualified therapists, from the National Sleep Foundation's website.<sup>IX</sup> If you have, or think you have, insomnia, please make use of these resources before turning to sleeping pills.

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All twelve suggestions are superb advice, but if you can only adhere to one of these each and every day, make it: going to bed and waking up at the same time of day no matter what. It is perhaps the single most effective way of helping improve your sleep, even though it involves the use of an alarm clock.

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As we have learned time and again throughout the course of this book, sleep is not like a credit system or the bank. The brain can never recover all the sleep it has been deprived of. We cannot accumulate a debt without penalty, nor can we repay that sleep debt at a later time.

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Just think, if we eliminated the national sleep debt, we could almost double the GDP percentage that is devoted to the education of our children.

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That is, sleepy employees are unproductive employees. Sleep-deprived individuals also generate fewer and less accurate solutions to work-relevant problems they are challenged with. III

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Under-slept employees are not only less productive, less motivated, less creative, less happy, and lazier, but they are also more unethical.

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Ounces of sleep offer pounds of business in return.

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Employees also win financially when sleep times increase. Those who sleep more earn more money, on average, as economists Matthew Gibson and Jeffrey Shrader discovered when analyzing workers and their pay across the United States.

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Inadequate sleep further cultivates the disabling and non-transient conditions of depression and anxiety. Physically, prolonged sleep deprivation increases the likelihood of a cardiovascular event, such as a heart attack or stroke, weakens the immune system in ways that encourage cancer and infection, and renders genitals infertile.

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Only then did scientists realize the rather profound conclusions of the experiment: REM sleep is what stands between rationality and insanity.

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It is clear that a tired, under-slept brain is little more than a leaky memory sieve, in no state to receive, absorb, or efficiently retain an education. To persist in this way is to handicap our children with partial amnesia.

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Later school start times are clearly, and literally, the smart choice.

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When the Mahtomedi School District of Minnesota pushed their school start time from 7:30 to 8:00 a.m., there was a 60 percent reduction in traffic accidents in drivers sixteen to eighteen years of age. Teton County in Wyoming enacted an even more dramatic change in school start time, shifting from a 7:35 a.m. bell to a far more biologically reasonable one of 8:55 a.m. The result was astonishing—a 70 percent reduction in traffic accidents in sixteen- to eighteen-year-old drivers.

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When sleep is abundant, minds flourish. When it is deficient, they don't.

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One in twenty residents will kill a patient due to a lack of sleep. Since there are over 100,000 residents currently in training in US medical programs, this means that many hundreds of people—sons, daughters, husbands, wives, grandparents, brothers, sisters—are needlessly losing their lives every year because residents are not allowed to get the sleep they need.

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Furthermore, residents made 400 to 600 percent fewer diagnostic errors to begin with. There's simply no evidence-based argument for persisting with the current sleep-anemic model of medical training, one that cripples the learning, health, and safety of young doctors and patients alike. That it remains this way in the stoic grip of senior medical officials appears to be a clear case of "my mind is made up, don't confuse me with the facts."

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we show each individual how their own sleep is a direct predictor of their own physical and mental health. It's likely that, if you wore such a device, you would find out that on the nights you slept more you ate less food the next day, and of a healthy kind; felt brighter, happier, and more positive; had better relationship interactions; and accomplished more in less time at work.

Moreover, you would discover that during months of the year when you were averaging more sleep, you were sick less; your weight, blood pressure, and medication use were all lower; and your relationship or marriage satisfaction, as well as sex life, were better.

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As Aetna chairman and CEO Mark Bertolini described, “Being present in the workplace and making better decisions has a lot to do with our business fundamentals.” He further noted, “You can’t be prepared if you’re half asleep.” If workers string together twenty seven-hour nights of sleep or more in a row, they receive a twenty-five-dollar-per-night bonus, for a (capped) total of five hundred dollars.

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Insomnia treatment could be incentivized with the same credit benefits, further improving individual health and productivity, creativity, and business success.

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In just the last few months, we have preliminary research findings from several NICUs that have implemented dim-lighting conditions during the day and near-blackout conditions at night. Under these conditions, infant sleep stability, time, and quality all improved. Consequentially, 50 to 60 percent improvements in neonate weight gain and significantly higher oxygen saturation levels in blood were observed, relative to those preterms who did not have their sleep prioritized and thus regularized. Better still, these well-slept preterm babies were also discharged from the hospital five weeks earlier!

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Even with lower insurance paid by the individual, health insurance companies would still gain, as it would significantly decrease the cost burden of their insured individuals, allowing for greater profit margins. Everyone wins. Of course, just like a gym membership, some people will start off adhering to the regime but then stop, and some may look for ways to bend or play the system regarding accurate sleep assessment. However, even if only 50 to 60 percent of individuals truly increase their sleep amount, it could save tens or hundreds of millions of dollars in terms of health costs—not to mention hundreds of thousands of lives.