Pathways to Sleep I: An Introduction

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Welcome to the Pathways to Sleep project. As part of this project, I have identified four components of an individualized strategy for you to achieve successful sleep. I know that this is a big order and that many other people (and many advertisements) are telling you that they can help you achieve successful sleep. Many voices are to be heard because this is a very important domain of health—and for many of us, a good night of sleep is hard to achieve. I can't personally promise you successful sleep, but I can identify the four components that you need to keep in mind when planning for your own sleep.

Most importantly, I have identified more than 70 pathways to sleep which cluster around these four components. Furthermore, I can provide you with a Pathway to Sleep Inventory that not only lists these pathways, but also tells you something about what experts say about each pathway, how your fellow sleepers judge the efficacy of each pathway, and how much each pathway costs and how accessible is it to you. That is quite a bit of information that you will be able to use in making your own decision about the pathways to follow or at least try out (I am inviting you to become your own personal sleep researcher).

I am offering this inventory and this set of essays because I (and my colleagues) at the Professional School of Psychology and the Institute for Professional Psychological Studies are fully committed to advancing an interdisciplinary field called *health psychology*—with the study of high quality sleep being a very important domain of health. There are also a couple of reasons why I am personally interested in this topic. Many years ago, when I was a doctoral student at the University of Oregon, I had the opportunity to help set up and work in one of the first dream laboratories in the Unites States.

Working with two young (but soon to be prominent) psychologists, Lou Breger and Les Davidson, I pasted electrodes on the scalp and around the eyes of volunteers (to record EEG patterns and eye movements) and then monitoring the sleep of these volunteers as they fell asleep and later had dreams (which we recorded after waking up the volunteer). This research project produced several books and journal articles and wetted my interest in dreams.

At the time, my interest in the broader issue regarding the nature and purpose of dreams was not increased. I left interest in sleep to our colleagues in the biological sciences and to Russian scientists, in

particular, who were apparently more interested in stages of sleep that were physically rejuvenating than in the more ephemeral topic of dreams and the stages of sleep when dreams were likely to occur.

We can now advance my personal history more than fifty years. I am conducting a program many miles away from Eugene Oregon. I am in Bali (located in the country of Indonesia). It is a beautiful—almost magical—region of the world. However, Bali is also prone to earthquakes. One of these geographic calamities hit while I was staying at a quite vulnerable villa in Bali. And more earthquakes (of high magnitude) were anticipated.

At this time, I was taking a sleep-enhancing drug called Ambien (generic name is Zolpidem). Having done a large amount of foreign travel for many years, I had received a prescription for Ambien that was to be taken occasionally when I was experiencing jet lag somewhere in the world. Like many users of Ambien (and related drugs), I had become addicted – now taking this drug every night (not just when I was traveling). I suddenly had to make a decision, while anticipating another earthquake. Do I take Ambien this evening and risk being drugged when the earthquake hits or do I refrain from taking this drug in preparation for the earthquake?

I chose to refrain from taking Ambien for the first time in more than a decade. I was going "cold turkey" – which you are never supposed to do (better to slowly wean yourself from this addictive drug). However, I had no choice. Cold turkey it was. These were not very easy days for me while remaining in Bali. Obviously, I found it very hard to sleep and my body was not happy about this withdrawal and let me know in many different ways. Yet, I survived this withdrawal and am very thankful to my body for coping with this profound biological change. Like members of AA, I can now say that I have been drug-free (of Ambien) for more than a year and are doing a good (though not great) job of falling to sleep and staying asleep.

After more than fifty years, I finally became interested in the psychology and biology of sleep with this experience of confronting withdrawal from a sleep-inducing drug, Suddenly, I was not only interested in dreams (about which I am also now writing several essays and a book), but also in sleep. I began to read about sleep and began to ask my friends and colleagues about their own experiences in seeking a high-quality night of sleep. I soon began to compile a list of various remedies offered by experts in the field, as well as advertisers (in abundance) and people around me. Within six months, I compiled a list of more than 70 remedies and called them *pathways.* I then came to recognize that these 70 plus pathways clustered around four broader strategies—which I began to call the *components* of high-quality sleep.

This leaves us at the start of this set of essays. They summarize what I know (and what researcher tell us) about sleep and provide guidance toward getting a good night of sleep. The first of these essays introduces the topic of sleep and provides important general information about the nature of sleep. The next four essays provide information about the pathways associated with the four components of high-quality sleep. I invite you to start reading about this fundamental domain of human health. I hope you will find this essay and the ones that follow to be helpful in your own quest for high-quality sleep.

The What and Why of Sleep

Human beings need sleep. This is fact of which we are all aware. Not all animals need sleep—a surprising fact and a fact that challenges us and forces us to ask a basic question: Why do we have to sleep? Why does evolution give up vigilance and consciousness in favor of a state of unconsciousness and the loss of vigilance when we are asleep? We are vulnerable to attack from other entities, including other people when we area sleep. Why risk the absence of consciousness and vigilance for the sake of sleep? This doesn't seem to be very adaptive. If some other species don't need to sleep, then why are humans saddled with the challenges of falling asleep and somehow surviving when asleep?

I will try to provide some preliminary answers, though research on the benefits of sleep for humans is still underway and we are likely to know more in another ten years than we do now. Before focusing on these benefits, I would like to set the stage by describing something about the unique way in which our brain lets us know that sleep offers such important benefits. Our brain, in fact, is willing to short-circuit all other functions of our body to demand that we fall asleep.

The Brain's Demands

Only the brain needs sleep. Other parts of our body are not in need of anything quite similar. It is interesting that we use the same word, "tired", when describing the conditions leading to both sleep and cessation of physical activity. We spend an hour working in the garden or completing a run of 5 miles – and we are "tired". Our body suggests that we take a little time off from physical labor and rest a bit. However, it is only a suggestion being made by our body. We can ignore the suggestion and continue to garden or run another five miles. Sometimes (at least in the logo of sports psychology) we "will" our body into doing a bit more work – and we ignore (at least temporarily) the signals emanating from our body regarding the value of reduced physical activity.

Such is not the case when we speak about being "tired" and needing to get some sleep. Our brain is not offering a suggestion. Rather, it is commanding that we fall asleep. It is very hard to ignore this command. We will tend to fall asleep – even if we are driving a car or trying to watch a movie. The demand for sleep can lead to the inconvenience of a missed movie or to the much more serious consequences of an automobile crash and the potential loss of lives. The chemicals involved in this demand for sleep are quite powerful and tend to override other chemicals that help to keep us awake.

It is also the case that when these chemicals are not present, it is very difficult to fall asleep. Our brain is doing a very good job of sustaining our vigilance and consciousness – even though we wish this were not so. We can do a few things to at least temporarily "trick" our mind (and body) into staying awake, whether this be ingesting caffeine or thinking about something that is filled with anxiety (what Robert Sapolsky describes as the human's ability to imagine attacking lions in the form of financial, work-related, family-related, etc. fears and apprehensions). Neither of these alternatives is very attractive or healthy over the long term. There should be other ways to stay awake – or we should attend to our brain's demands that we get some sleep.

Why Do We Need Sleep?

The benefits offered by sleep tend to circle around three important perspectives: (1) homeostatic regulation, (2) restoration and repair of bodily functions, and (3) storage and adjustment of mental functions. While these three perspectives are closely related, they do seem to arise from somewhat different sources of concern and interest. To borrow from an old adage, sleep is the elephant, but some of the blind men are touching the trunk, while others seem to be focusing on one of the elephant's legs. If you put together all of their limited perspectives, then you get an accurate sense and picture about the whole elephant.

First, the homeostatic perspective. This is the most general perspective – and it relates directly to the demands being made by the brain. Our entire body is devoted on an ongoing basis to remain in some balanced state. We don't want to be too warm or too cold and we don't want to be too active or too sedentary. Most importantly, we want to balance off the time we are alert and active with the time we are inactive and restorative. There is a rhythm to our daily life (that I will describe shortly) and this rhythm results in a cycle requiring a period of sleep. If we don't get enough sleep, then there is a sleep debt that accumulates—requiring that we fall asleep. This is the demand being made by our brain.

This first perspective is valuable in that it provides us with a compelling image of the demand for sleep—but it still doesn't tell us why we need this cycle. The second perspective provides at least part of the answer. The brain needs the sleep because it is working on behalf of the welfare of other parts of our body. Every part of our bodies requires long periods of sleep in order to restore and rejuvenate as well as develop. Our body needs time off from being active in order to grow muscle, repair tissue, and synthesize hormones. As I noted about, if the body can't demand that we rest when we are tired, then the brain can make the demand and produce the required rest provided by sleep.

This second perspective is very helpful, but it still isn't enough, for the brain is not just a self-less protector of our body's welfare – it also has its own specific reasons for demanding sleep. Let me turn to the words offered by Matthew Walker in his highly informative book, *Why We Sleep*:

> Within in the brain, sleep enriches a diversity of functions, including our ability to learn, memorize, and make logical decisions and choices. 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. (Walter, 2017, p. 7)

To offer one specific example of the critical role played by sleep in this functioning of the brain, researchers have recently begun to examine ways in which we reorganize our memory system during sleep. Information we have collected during the day, that are stored in a short-term memory system, are sorted, coded and selectively retained during sleep and moved to a long-term memory system. This is part of the reason why students can stay up all night to study for an exam held the next day and can pass this exam with flying colors – yet remember nothing the following day. They were able to use the information contained in short-term memory for the exam, but none of this information was transformed and placed in long-term member. Without sleep, the information is worthless, except for the exam grade.

The Damage of Sleep Debt

With these three perspectives in mind, we can turn briefly to the specific impacts that take place if we don't get enough sleep. The sleep debt accumulates, and, as a result, a lot of bad things can happen. There are many well-established relationships between sleep and physical health, mental health and cognitive functioning. The physical consequences of inadequate sleep and the accumulation of sleep debt include obesity, diabetes, vulnerability to infections, and cancer. The complete list is much, much

longer. We can also point to the accidents and performance decline that comes with lack of sleep. Remember falling asleep at the wheel?

When we turn to the consequences in terms of mental health, we can identify a list that is just as disturbing. First and foremost is the relationship between sleep debt and depression. There are many reasons to believe that the increase of depression in the United States is related to a reduction in the amount and quality of sleep among our citizens. Sleep debt also relates to our ability to manage anxiety, control our rage and remain emotionally stable and "emotionally intelligent" when relating to other people. Perhaps of greatest importance is the strong relationship between sleep debt and suicide attempts (and tragically successes). The bottom line: we can die from sleep debt.

What is High Quality Sleep?

The usual concern about quality of sleep centers on the number of hours needed between hopping in bed and bounding up in the morning. As we all know, this number usually hovers between six (at the low end) and eight (at the high end). We also know that most Americans (and those residing in many other countries) tend to get too little sleep – often 4-5 hours per night. The sleep debt accumulates, like the national financial debt, and the alarms periodically sound in the national media: "We need to get more sleep!"

To use a standard dramatic gesture: "Not so fast!" High quality sleep is defined not just by number of hours in bed, but also by two other factors: (1) depth of sleep, and (2) amount of sleep disruption. There is even a fourth factor (amount of "sleep" engaged at times other than at night) which I will introduce in my further essays. Let's briefly look at each of the two major factors.

Depth of Sleep

First there is depth of sleep. When I was working in the dream lab during my younger years, I directly witnessed the movement of our subjects through four stages of sleep. Typically, when we fall asleep, we move slowing down through what are called stage one, stage two and stage three sleep—to arrive at stage four. This stage is often called delta sleep because the brain waves (EEG recordings) resemble the Greek letter delta (slow upward spikes). This is the stage where our body seems to be doing a whole lot of physical restoration. It is sometimes called "the working man's sleep" because of this supposed physical restoration. Unfortunately, as we grow older, this fourth stage of sleep becomes less frequent

and will often vanish all together by the time we hit our 50s. My own 78 year old body hasn't been visited by stage four sleep for many years!

Usually after several hours (for younger people) a remarkable thing happens. We slide (or leap) up to a unique stage that is called REM sleep. This label is attached because it is during this stage that there are rapid eye movements (REMs). These eye movements rarely occur during the other sleep stages—that is why these other stages are given an additional label: NREM (non REM). It is also during the REM stage that dreams often occur. REM sleep is what I was waiting for and was willing to stay up late at night to detect in the lab. When we detected eye movements that were typically accompanied by much more rapid and low volume EEG patterns, we would wait a few minutes and then wake our subject and ask them: "What has been going through your mind." Typically, there were some vague and often not very colorful dreams to report during this first REM phase. Many times, it wasn't even clear if the subject was reporting a dream or just night-time ruminations (often wandering randomly through various thoughts).

If we are not sleeping in a dream lab and are not being rudely woken up, then we will soon slip back down to stage four – or more likely to stage three. This third stage, often called gamma sleep, is likely to last for a longer period than the previous delta sleep and is a bit more often found among older adults like myself. We don't know much about gamma sleep – it is often identified as the "least interesting" sleep stage. But we do know that this stage is just as important as the three more "glamorous" stages. Gamma sleep typically manifests brain waves that are shorter and with lower spikes than delta sleep.

After an hour or two we once again shift to REM sleep and experience more dreams – which are often more colorful and somewhat longer. We only know this is what occurs because we wake people up in a sleep lab when they have been in the REM state for several minutes (or sometimes at least 15-30 minutes). Typically, people do not recall dreams occurring during the middle of the night when they awake in the morning. They only recall these dreams from the middle of the night if the dream has awakened them (for example, a dream that is filled with anxiety) and the dreamer writes something down about the dream. Usually, the dream is not recalled in the morning even if it wakes us up. All we remember is that something disturbing, eventful or (sometimes) joyful occurred during the middle of the night.

Now we are entering the second half of our sleep night. It is common for us to slip back down to NREM sleep after we have been in bed for 3 or 4 hours. At this point, we are most likely to enter Stage Two (beta sleep), which is typified by shorter and even less-extreme peaks in EEG patterns. We also find

increases in the Stage One sleep which generates something called “sleep spindles” (bursts in electronic activity). This alpha state is often compared to the state of cortical activity found among people who meditate or engage in other forms of mindfulness.

It is during the last hours of sleep (when both the first and second stages are dominant) that we find the greatest amount of REM sleep. This was why I stayed up all night at the dream lab. I was always quite tired when these late-night dreams were being recorded—but I was always gratified. This was the “pot of gold” for dream researchers. These three stages (One, Two and REM) tend to interweave and many dreams of considerable length and colorful detail are produced. These later night dreams are often the ones we remember when we awake in the morning.

It is also important to note that this interweaving of these three stages is particularly prevalent as we grow older. Much of my own night of sleep involves stage one, stage two and REM. I experience an abundance of dreams – but not much of the restorative sleep of stages three and four. These are interesting tradeoffs as we age and may have significant implications for our own physical and mental health. What does all of this mean? The pattern of sleep stages is an important factor in determining quality of sleep – it is not just the amount of time we spend in bed.

Amount of Sleep Disruption

This third criterion of sleep quality is particularly important for those of us who are a bit (or a whole lot) older. It also is a criterion that is somewhat controversial—not as straight forward as the stages of sleep. Put simply, sleep disruption is about the number of times we wake up during the night and the amount of time we stay awake during the night. The critical questions to ask are: Is our sleep fragmented with many periods of wakefulness? Do we make infrequent (or frequent) decisions to get up out of bed and do something else – a midnight snack, a few minutes (or hours) or reading or watching TV, even getting a breath of fresh air by walking outside for a couple of minutes.

As we grow older, the tendency in our sleep pattern is to experience at least one major break. We sleep for part of the night and then wake up. We can’t fall back to sleep right away, but either lie in bed, frustrated by our inability to fall back asleep, or we get out of bed and perform our mid-evening ritual. Then, at some point we do return to our bed and fall asleep or we have remained in bed and eventually drift off to slumber land. The critical issue is often how we manage this bridge between the two sleep segments.

For many of us, the *sleep bridge* plays a central role in determining the quality of sleep. This bridge will be a focus in my discussion regarding the various pathways to sleep. Experts in the field of sleep improvement are still at a loss regarding how this bridge can be successfully crossed in the minimum amount of time. We hope eventually to find answers to this sleep bridge challenge, but at the present time can only offer some recommendations. These helpful suggestions are made by folks who have found their own unique way of crossing (or at least navigating) the bridge—be it by consuming certain foods, moving between hot and cold sleep environments, or engaging in certain kinds of visualization). So, stay tuned . . .

The broader issue regarding sleep disruption is identified as *sleep fragmentation*. We don't' just wake up once in the middle of the night; rather, we wake up many times and might even find ourselves sleeping "fitfully." Our night seems to be an ongoing dance between wakefulness and sleep. This might mean that we are spending most of our night in stage one, stage two and REM sleep. It might also mean that we are spending a large amount of time in the pre-sleep and post-sleep states of sleep limbo that are called hypnagogic (pre) and hypnopompic (post). These intermediate states are often filled with very loose (disorganized) thinking, vague images (such as our legs and feet seemingly to grow larger or smaller, our arms appearing to become numb), and/or a swirling of various feelings.

In general, these fragmented sleep conditions are judged to be negative and quite unhealthy. But this isn't the conclusions reached by all sleep specialists. Some of these experts point out that deep, uninterrupted sleep was not common among our ancient relatives. When our ancestors were living on the Savannah in Africa, it was important to remain alert to some extent in monitoring one's environment. So that a great night of sleep is not being interrupted by a lion who is eating us!

We either needed to be aware in some way of the potential dangers surrounding us on the Savannah or we needed to belong to a tribe in which one or more members remained fully awake during portions of the night, serving as watch guards—keeping alert to potential dangers from other tribes or human-eating animals. It is interesting to note that some animals can actually sleep half of their brain, while remaining awake with the other half. Unfortunately, humans have not been blessed with this capacity. Instead, we either need to remain somewhat wakeful or be the member of a well-organized tribe with an effective watch guard system in place.

How Does Sleep Fit into the Larger Biological Processes of Life?

There is something more than night and day when it comes to our biological cycle. We shift through multiple stages during the day as well as at night. As we all know, there are times during the day when we are less alert – perhaps even drowsy. These times are daytime equivalents to stage three and four sleep. There are other times when we are keenly alert and highly productive. These times are equivalent to our first and second order stages of sleep. We even have periods of time that are amenable to day-dreaming and creativity—perhaps these times are equivalent in some ways to our REM stage. There is much more to learn about the relationship between these daytime states of daydreaming, imagining and creating, on the one hand, and the rich, creative processes of the dream state.

We might not know much about how daydreams and night dreams relate to one another, but we do know what triggers the processes of wakefulness and sustains this wakefulness during the day. The key ingredient is obvious but critical: the sun. This warm and well-lit celestial entity sets the daytime cycle for all of us—whether we live in a sun-drenched region of the world or in a region of the world that is shrouded in clouds.

Formally called the *circadian clock*, this sun-directed rhythm of life dictates our stages during the daytime and encourages us to wake up in the morning. As Matthew Walker notes, mother nature has been very smart in establishing the sun as our primary monitor of wakefulness:

> Daylight is the most reliable, repeating signal that we have in our environment. Since the birth of our planet, and every single day thereafter without fail, the sun has always risen in the morning and set in the evening. Indeed, the reason most living species likely adopted circadian rhythm is to synchronize themselves and their activities, both internal (e.g temperature) and external (e.g. feeding) with the daily orbital mechanics of planet Earth spinning on its axis, resulting in regular phases of light (sun facing) and dark (sun hiding). (Walker, 2017, pp. 17-18)

While we all march to the same drummer (our sun), there are a few important variants in this march. First, we know that many of us try to influence the circadian clock by ingesting various stimulants. There is the mandatory morning coffee or tea. There might also be the midafternoon shot of a caffeinated drink. We vary in our reliance on these clock modifiers. Second, we know from studies of people spending time completely outside the influence of the sun (e.g. living for several days in a cave) that the circadian clock isn't quite geared to 24 hours. It is a bit longer if the sun isn't around to dictate the daily rhythm.

Third, and more importantly, some of us live with cycles that favor high levels of wakefulness during the early hours of the day—we are "morning birds." Other folks tend to find the highest levels of wakefulness during the afternoon or evening—they are "night owls." Furthermore, as we grow older there is a tendency for us to become morning birds. The typical teenager (as many of us parents painfully know) tend to be night owls. Their circadian rhythm does not remotely fit with the requirement that they get up early for school. The school schedule was clearly not set up to maximize the teenager's performance – it was set up for the convenience of parents who must get on with their workday.

What does all of this have to do with pathways to sleep? The primary lesson to be taken from our knowledge about circadian variability is that there is no one pathway that works best for everyone. I have identified multiple pathways in this project because we vary in our cycles and in our proclivity to remain awake and active at various times of the day.

I will be introducing many different strategies—including the value for some people of taking a nap during the day, as well as strategies related to living with (and wanting to sleep with) someone who has a different circadian clock from the one that is guiding our own life (can there ever be love among night owls and morning birds – stay tuned . . .)

How Does Sleep Get Generated?

Having briefly described the way in which sleep and wakefulness dance with one another, let's turn to the tune that determines the nature of this dance. In essence, there are three key ingredients that determine when we fall asleep and how long we remain asleep. The first of these three mechanism was just identified: the circadian clock. We fall asleep when our clock chimes a certain hour. For most of us, this hour is somewhere between 8pm (we older folks) and midnight (the younger folks). Two other ingredients that are chemical in nature also determine the tune. These two ingredients are melatonin and adenosine.

Most of us have heard of the first ingredient and might even take a pill every night that is a synthetic of this chemical. While there is some controversy regarding the effectiveness of a melatonin pill, there is no doubt that the melatonin we naturally product in our body is critical to moving from the state of wakefulness to the state of sleep. What occurs each evening is a gradual accumulation of melatonin in our brain and a gradual drop in melatonin levels as we near the end of our sleep in the morning. Unfortunately, many of us become less proficient in producing melatonin as we add more years to our life – hence the challenge of falling asleep and remaining asleep for many of us old folks.

We now know that melatonin is not sufficient to create high quality sleep. The band can-t play the sleepy-time tune with only the chemical instrumentation of melatonin. We turn again to the insights offered by Matthew Walker:

> . . . melatonin helps regulate the *timing* of when sleep occurs by systematically signaling darkness throughout the organism. But melatonin has little influence on the *generation* of sleep itself. . . . Melatonin corrals [the]sleep-generating regions of the brain to the starting line of bedtime. . . . (Walker, 2017, p. 23)

The circadian clock itself is an important companion with Melatonin in getting us to the starting line (I apologize for the missing of metaphors between Walter and myself—I actually like the bedtime tune metaphor – it reminds me of the lullabies that helped me fall asleep for many years). Still there is the need for additional assistance. This is where the much more mysterious chemical called adenosine comes into the picture. Walker offers us a useful description of the role played by this chemical:

> . . . a chemical called adenosine is building up in your brain [as you become sleepy]. 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. (Walker, 2017, p. 27)

If I can reintroduce my own metaphor, adenosine is a clock that signals how long the band has been on break (often signaled by the growing restlessness of the crowd) or more accurately how many hours since the band last played (usually the night before). The crowd grows restless or at the start of the evening, the crowd begins to line up at the door. Biologically, this is known as an increase in *sleep pressure*. We all know what this sleep pressure feels like—it is that increasing demand of our body and brain to fall asleep. Many of the pathways to sleep I will be identifying help to either stimulate this pressure or respond to the pressure once it builds up.

There we have it: the circadian clock and melatonin provide us with the band and the tune, while the chemical adenosine is building up and demanding that the sleepy time tune is played. Officially, the circadian clock and the melatonin produce what is known as *Process-C*, while adenosine produces something called *Process-S*. When the two processes meet, we get sleep; but as the night goes on the circadian clock will produce variations in level of sleep (the sleep stages I identified earlier) while adenosine is gradually expended. By the end of the night and the first burst of sunshine, there is very

little sleep pressure and we are ready to gain consciousness once again (or at least that is what is supposed to happen if we get high quality, non-fragmented and interrupted sleep).

Conclusions

Hopefully, this is enough information about sleep for us to get started on identification of pathways to sleep. As you have already seen, there is a wonderful book about sleep that provides detailed, up-to-date information about sleep. This book is Matthew Walker's *Why We Sleep*. I would also recommend the Teaching Company lecture course called *Secrets of Sleep Science* presented by H. Craig Heller (I have made use of this lecture series, as well as the Walker book, in preparing this brief introduction). We are now ready, in the next essay, to move further in setting the stage by turning specifically to the challenge of "managing" sleep.

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Reference

Matthew Walker (2017) *Why We Sleep*. New York: Scribner.