

Pathways to Sleep IB: From Health to Sleep

The Exercise Pathway

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Exercise is the perfect pathway to identify first. Of all the pathways we have identified in this Pathways to Sleep project, this is the one most consistently rated as very important by both experts and users. Furthermore, this pathway can be inexpensive and accessible. Many research projects have been conducted that yield positive results regarding the relationship between exercise and sleep—they are often mentioned together as two of the most important components of health. I can link you to two summaries of one highly credible study conducted at the Feinberg School of Medicine at Northwestern University:

<https://www.psychologytoday.com/us/blog/sleep-newzzzz/201309/better-sleep-found-exercising-regular-basis>

<https://www.webmd.com/sleep-disorders/news/20100917/exercise-helps-you-sleep?print=true>

This first component one pathway is clearly much more than an easily overlooked trail or side road—it is a freeway leading to sleep. Yet, many of us don't direct out body and mind to this freeway on-ramp. We don't take time to exercise every day, even though we find it a real challenge to manage quality sleep. Why don't we exercise? And why is exercise so important in the facilitation of sleep quality?

The Impact of Exercise on Sleep Quality

I will answer the second question first—for it provides some of the critical reasons for plotting a route to this freeway to sleep. Four ways have been identified as to how exercise helps us manage high quality sleep. I'm sure there are other important ways in which exercise enables high quality sleep – but this is a good start regarding the impact of exercise.

Immediate Impact: "I'm tired"

The body want to restore itself. We have many physiological indices and mechanisms that are governed by the basic principle of homeostasis: our body wants to restore its many resources and can best do this by resting. And the best long-term mode of rest is sleep. In general, what I have identified is a shift in many physical processes in our body from what is called the *sympathetic nervous system* to what is called the *parasympathetic nervous system*.

These two technical terms are very important to keep in mind when considering the conditions needed for high quality sleep, so I will devote several sentences to describing these two systems. First, it should be noted that the term "nervous system" can be misleading, for both the sympathetic and parasympathetic systems involve a whole lot more than the transmission of information between neurons. This term is used, I suspect, because it is our nerves that are the leading mechanism for triggering many different bodily functions.

In essence, the sympathetic system is about action, whereas the parasympathetic system is about rest and restoration. The sympathetic system is activated when we are moving through the world (including when we are exercising). This system requires that we expend energy—we burn calories. The sympathetic system is particularly important when we are seeking to escape something (or someone) that would like to hurt or even kill us. I will have much more to say about these external threats a little later. Conversely, the parasympathetic system is engaged when we are not threatened and can therefore attend to other important physiological functions such as digestion of food, elimination of bodily waste, procreation (the production of sperms for males)—and preparing for and falling asleep. The parasympathetic system is replenishing the calories we burned off when the sympathetic system was in charge.

The important role played by exercise in the preparation for sleep becomes evident when we combine the fundamental principle of homeostasis with the shifting between sympathetic/parasympathetic. The key to optimal health resides in the balance between sympathetic and parasympathetic operations. The human body (and the body of all “higher-order” animals) requires time spent every day in both systems. If the sympathetic system is always in operation then we become chronically stressed, find it hard to eat – and can’t readily fall sleep.

This is the very unhealthy status to be found among many citizens of our post-industrial world. If the parasympathetic system is dominant (a rare state for most of us), then there might be bliss, but also the danger of prolonged inactivity—leading eventually to death (or at least over-reliance on the “kindness of strangers”). The condition of prolonged inactivity can be misleading. We are often in a state of “freeze” (to be discussed shortly), which is when the sympathetic system is fully activated but there is no action (think of simultaneously pushing on the gas pedal and the brake – not very healthy for the car).

We of the 21st Century are challenged in achieving the balance between sympathetic and parasympathetic, given that most of us, living in a world of technological convenience do not have to hand wash three tubs of dirty laundry, broom-sweep three rooms, hunt or forage for food, cultivate twenty acres, extract minerals from the earth, extract fish from the sea, or cut down trees in the forest. The temptation is to sit back, watch TV or surf the Internet, and munch on some junk food (or perhaps a healthier substitute).

Exercise becomes an important substitute for physical labor. After a one-mile jog, 40 minutes on the treadmill or 45 minutes of handball, we are “tired” and want to rest: our parasympathetic system kicks in to balance off the sympathetic functions inherent in our exercise. This is all good and very healthy. We can fall asleep right away or wait until the evening to draw the blankets over our weary body and fall asleep. The latter condition leads us to the second impact and the challenge of explaining how exercise can have a delayed impact.

Delayed Impact: From morning to evening

Here is the question: why is there a delayed impact of early morning exercise on our ability to sleep in the evening? It is like what occurs in the bouncing of a billiard ball off several walls and into the pocket. First (and most importantly), exercise in the morning strengthens the circadian cycle. The rhythm of day activity and night sleep is reinforced, leading to a more strongly enforced command for sleep in the evening. This strengthening is particularly strong if we have the chance to exercise outdoors (wouldn’t it be nice if we could all exercise on the Waikiki beach as portrayed in many of the old exercise videos!

Outdoor exercise enables natural stimulants to be absorbed which reinforced the circadian rhythms. With exercise, the circadian drum is beating loud and clear. The band is marching on. You need to start marching in order to keep in time with the circadian rhythm. To be a bit less poetic, exercise during the day promotes alertness and raises the body temperature slightly, so that in the evening, homeostasis kicks in to reduce the body temperature a bit (which induces sleep).

Another important source of delayed input relates to the fourth impact I will soon identify—this is stress-reduction. Exercise tends to lift one's mood and enables one to reduce tension in their body (especially the body's musculature). When there is greater relaxation coupled with circadian alertness during the day, then we are more likely to remain relaxed during the evening. In a relaxed state, we can more easily shut off worrisome thoughts—which relates to the third impact I will be identifying.

It all fits together—sleep (and wakefulness) requires systemic attunement of various bodily functions. It might even be that sleep has a greater impact on the physiological benefits of exercise than the other way around. The relationship is bi-directional (as are many of the relationships between various bodily functions). No one thing does the trick regarding either sleep or exercise— that is why I have identified multiple pathways (not only regarding component one).

Several other changes occur when we exercise in the morning that impact less directly on our evening capacity to fall asleep. First, there is a change in metabolism when we exercise that seems to prepare us later for sleep. Second, there is the matter of weight management: we are more likely to find quality sleep when we are trim. In several different ways, excess weight leads to disrupted sleep (for example, greater chance of snoring) and we know that exercise can provide some assistance in our management of weight (though not as much assistance as most of us wish were the case – it is hard to burn off those extra pounds!).

Third, as we all know, exercise contributes to cardiovascular health and a healthy heart certainly doesn't hurt us when we are trying to fall asleep: high blood pressure, for instance, is associated with our sensitivity to stress (it works both ways: high levels of stress contributes to high blood pressure and the reverse is also the case). Once again, we see the body operating as a complex organic machine with many highly interdependent parts. Midst all of this complexity there is one simple fact: we sleep better when all parts are working effectively.

There is one final point to make about the timing of exercise. Morning exercise is good, as is exercise engaged throughout the day -- up until 2-3 hours prior to bedtime. When we are active just before trying to fall asleep then the physiological outcome is not good. We might be tired, but our body is usually not primed for sleep if we were just on a tread mill. Like alcohol, the pre-sleep exercise might help us fall asleep for a brief period of time – but not for a long period of time.

Indirect Mental Impact: Recalibrating our brain

Exercise helps to modify, “lubricate”, facilitate – and even recalibrate—mental functions. There are two important questions to ask about this indirect impact. First, how does exercise help to recalibrate our brain? Second, what difference does this recalibration make regarding our quality of sleep? I will try to answer both of these very challenging questions in an over-simplified manner (I remind all of us that this is not a neurobiological essay and I am definitely not an expert in this scientific domain). We can begin

with the role played by exercise in the strengthening of memory. Recent research suggests that there is a boost in the size of the hippocampus when one is consistently engaged in exercise.

The hippocampus happens to be the major site for storage of memory – hence the impact of exercise on mental functioning. We also know that exercise improves brain health through accelerating the growth of new blood vessels in the brain, as well as enhancing the abundance and survival of these cells once they are born. Finally, it seems that consistent exercise has a particularly beneficial impact on the prefrontal cortex and medial temporal cortex—the “biggies” when it comes to higher order thinking and problem-solving capacities.

This is all well and good. We would all like to have bigger and better brains. But what does this have to do with better sleep quality? The immediate answer is a return to the point I have already made: everything works together. What helps one part of our body helps everything else. Nice try – but let’s try to get more specific. First, we can try a billiard shot that is banking off two walls before dropping in the pocket. We know that effective mental functioning improves our ability to live a successful life. It seems that the medial temporal cortex (along with the hippocampus through its role in operating our memory functions) plays an important role in our decision-making and problem-solving processes—as a companion to the prefrontal cortex (our center for rational thought).

If we can do a better job of making decisions and solving problems, then our interpersonal relationships are better, and we can do better work. As Sigmund Freud noted many years ago, successful living is all about two things: love and work. An effectively functioning brain helps us be better at achieving both of these life purposes. This in turn means that we are likely to be less anxious and stressed when we attempt to fall asleep – hence the two-wall bank shot into the sleep quality pocket.

We can get even more precise and offer a one wall bank shot analysis. It seems that the prefrontal cortex plays a major role in generating the slow waves found in stage three and stage four sleep. It is interesting to note that the prefrontal cortex tends to be deactivated during REM sleep (when dreams are likely to occur). This gets us into the regressive dynamics of dreams – but this analysis will have to wait until I turn to the nature and function of dreams in a later set of essays. The key point to be made here is that exercise plays an important role in the enhancement of prefrontal cortex functioning, which in turns enhances our ability to sleep deeply (stages three and four). Given that we often find it difficult to find stage three and four sleep as we grow older, it would seem to be particularly important that we engage in exercise as we grow older and seek high quality sleep.

This is the case to be made for the impact of exercise on mental functioning which, in turn, impacts sleep quality both indirectly (the two-bank shot) and directly (the one-bank shot). Once again, I remind all of us that everything links with everything else when it comes to health and physical/mental wellbeing.

Indirect Physical/Mental Impact: Stress-Reduction

As I have already noted, this fourth impact closely relates to several of the other component one pathways—specifically mindfulness/meditation and the pathway that I have directly labeled “stress-reduction.” I will spend a bit of time here describing the nature of stress and the way in which exercise can be engaged to reduce stress. When I turn specifically to stress-reduction, I will identify other ways in which we can reduce stress.

I begin by noting that stress is perhaps the easiest of the four impacts for us non-experts to comprehend: when we are under stress it is hard to fall asleep and stay asleep. Instead of counting sheep, we are counting how much we owe on our credit card or adding up all the injustices done to us by our incompetent boss. As Robert Sapolsky (2004) has so insightfully noted, we human beings are very adept at imagining lions of many varieties that threaten to attack us. This is one of the major conundrums of human existence. We are wonderfully adept at imagining and planning for a desirable future, as well as imaging and inventing new tools and societal structures and strategies; however, we are also adept at imagining horrible outcomes---and our body is not very good at distinguishing between real outcomes and those that are only imagined. Thus, we are once again living on the African savannah and easily imagine lions attaching us from all sides.

Unfortunately, the news is even worse. We are not very strong or very fast. A few years ago, I had the wonderful opportunity to spend a bit of time in one of the game parks in South Africa. One of our guides noted that human beings are among the slowest and weakest species to be found on the African plains. It is only our intelligence and proclivity to collaborate with fellow human beings that enables us to survive in this sometimes-hostile environment. This means that when we are alone (such as when we are attempting to fall asleep), the lion (imagined or real) is a source of major anxiety.

How do other species (especially mammals) deal with “real” lions? Big animals like elephants and hippos can threaten to fight the attacking lion (and often win the battle if it occasionally does occur). Zebras and other fleet four-legged mammals on the African savannah can engage their sympathetic system in an effort to flee the attacking lion. We human beings operate more like the less-fleet and much smaller mammals on the savannah—those animals that can’t fight the attacking lion nor flee from it. Both we and our small furry friends adopt a quite different strategy. We freeze. We don’t move a muscle, hoping that the lion either will not see us or will ignore us while searching for something more appetizing or perhaps more challenging (are lions driven by lofting ambitions?). Thus, freeze is much more likely to be our *modus operandi* than is either fight or flight.

The issue then becomes: how do we deal with freeze (especially when compared to the ways other mammals deal with freeze)? Let’s cut to the chase: we don’t manage freeze very well at all and this leads to major health complications – including the inability to fall and remain asleep. What other small and slow mammals do is shake off the freeze after a very short period of time. They tremble and may even dance around a bit. All of this helps to drain off the adrenaline (sympathetic system) that has been coursing through their body during the freeze phase.

Unfortunately, we humans tend to do two things that are very bad. First, we remain in the freeze state for a lengthy time period. Our imagined lion doesn’t easily move away: it stays right there in front of us growling and snarling with those big sharp teeth gleaming off the African sun. Since the lion never seems to go away, we remain in a state of freeze for many minutes or hours—not good at all for our body or specifically our ability to prepare for sleep.

Second, we rarely do anything to drain off the adrenaline once we disengage from freeze. We might do a bit of trembling (there is a great deal of truth in the phrase “trembling from fear”). However, this isn’t enough—especially if we have been in freeze for a long time. This is where exercise comes into the picture. If we can run, dance, swing a bat or climb a rock wall, then we are draining off the adrenaline. If, instead, we just sit there and reflect on the hard times, the adrenaline is not drained off and we are

likely to experience negative physiological and psychological outcomes (such as heart attacks and depression)—and we are likely to experience problems in achieving a good night of sleep.

Motivating the Movement

What is the primary reason why we engage in physical activity – other than getting a good night sleep. It is often not discussed --- but very important when it comes to becoming motivated to engage in exercise. I can identify four reasons why we are motivated to move.

Health

The first reason is the most obvious and probably most frequently comes to mind. It is certainly the reason most often touted in public forums. We exercise primarily for health reasons. We are told that exercising at least twenty to thirty minutes per day will yield many wonderful health-related benefits ranging from heart health to weight loss (or at least weight control). We hop on our tread mill or take our 1 mile walk each day because it is “good for us.” The big problem concerns our consistent and sustained adherence to this exercise regime.

We don't really enjoy the treadmilling (even if we can view the morning news on our expensive exercise device). Our walk down the street by our home is very nice during some seasons of the year, but not so great during the snowy winter or during summer hot spells. We are not too keen on waking one hour early to exercise and then shower before going to work. The evenings should be devoted to the family, not pumping away on our stationary bike. We are exercise devotees for about two months and then it fades away, despite our best intentions.

Recreation

How then do we sustain our commitment to physical activity? This often involves a second reason. Exercise occurs as an outcome of recreational activities you enjoy. For example, you play tennis once a week, go ice skating with your kids, or take in a round of golf with your dear friends (without hoping on a cart). You go hiking with members of your family or jog during the summer on your nearby beach. Your recreation might even involve participating in a team sport: the women's baseball league or more informal pickup games at the local basketball court. For some of us, recreation takes the form of much more challenging enterprises –such as rock climbing, crewing or marathon running. How about signing up for a swing dancing class with your spouse? It is all about finding an enjoyable activity that gets you moving.

There is a fancy word that can be applied to this second reason: we engage in activities that are *autotelic* (meaning that the activity contains its own reward). There is also a theory which accounts for some (or most) of the motivating properties of these recreational activities. A noted psychologist with an impossible name to spell, Michel Csikszentmihalyi, has done extensive research on something that he calls the *flow* experience (Csikszentmihalyi, 1990). We find flow when we do something located in the threshold between boredom and anxiety. It is an activity in which we can be successful, but it is also an activity in which at some level we can fail. We know that it can be done, but still find it challenging.

This is the baseball game in which we participate after work: we often win, but sometimes lose. We climb a rock face that is difficult but not impossible given our skill-level and strength. The ballet class requires me to engage in new moves that take a bit of time to learn—but I can learn and my body can

adjust. Csikszentmihalyi notes that flow yields a remarkable sense of well-being: we feel like we are truly alive, and time seems to pass without us even noticing that this has occurred. In other words, the flow experience is sublime and timeless. We will do almost anything and go almost anywhere to find flow. Most importantly, if our exercise sometimes yields flow, then we have found the secret formula for sustained exercise! We are re-created while thoroughly enjoyed this unique experience—even if the flow doesn't occur every time we engage in this activity.

Avocation

The third reason somewhat resembles the second in that it typically occurs outside our regular work life—that is why it is called avocational. However, unlike the autotelic activities of the second form of recreation, the avocational activities in which people engage have an external goal or purpose. We engage in these activities in order to achieve something that is important for us. There is a certain outcome related to an important project you are undertaking such as gardening or building a new tree house for your kids. One of my clients many years ago was a prestigious research firm in the San Francisco Bay Area. This organization conducted a survey of its employees to determine what type of training program they would find most desirable. The winner was a write-in suggestion: the respondents (mostly scientists) wanted woodworking classes. Their avocational interests (wood crafting) trumped their vocational interests (doing science).

While many avocational (and recreational) activities don't require much physical movement, there certainly are activities that provide the health benefits of exercise along with the achievement of other non-health related goals. The beautiful flower bed and handsome handcrafted stool are sources of great pride and aesthetic enjoyment—and they require us to exert some physical energy. Other kinds of avocational activities require even more movement. We can volunteer to manage our daughter's soccer team or teach a class on the martial arts. The project we have undertaken to repaint our living room walls or build a shed to house our riding mower requires important (though temporary) physical action. It is all about finding something to do that provides exercise while yielding an outcome that is important for us to achieve.

Vocation

The fourth reason takes us back to where we began: some of us still must be physically active in the job for which we are being paid (or produces income if we are independent contractors and are working in a skillful and efficient manner). The outcome of our physical activity is not just something that is important for us—it is the work we are doing to make a living as someone who hauls up lobster, mends dresses, repairs heating systems, cleans homes, lays rugs or installs new kitchen counters. We engage in the business of commercial fishing, the occupation of farming, or the profession of plumbing. As one of the commentators on television put it several years ago, these are the folks that shower at the end of a day of hard work rather than in the morning before work begins.

For the men and women who do this kind of “exercise”, the prospect of purchasing and making extensive use of an exercise machine or paying for membership in a gym may seem to be a bit silly or elitist: if you were doing “real work” then you wouldn't need to pay for your physical labor. It must seem strange to agricultural workers that there is a Zen-based retreat site in California where people pay quite a bit of money to tend the extensive gardens located at this site (the produce from these gardens being featured at a noted vegetarian restaurant in San Francisco). What might be overlooked is the probability

that the weekend tending of Zen gardens is an avocational choice for these gardeners – and might even yield some “flow” for those working in the gardens.

Conclusions

I have now spent a bit of time with you introducing the first component. In a previous essay, I suggested that this component is probably the most important yet elusive of the four components. I turn to exercise as the first component one pathway to sleep. This pathway is particularly important—yet is elusive like many of the other component one pathways. Exercise is not always easily engaged for those of us who are leading demanding (but physically passive) lives. I have identified some of the reasons why exercise impacts on quality of sleep (either directly, in delayed fashion or indirectly). I have also pointed to several ways in which exercise can be sustainable through the achievement of both intrinsic (autotelic) and extrinsic (avocational and vocational) rewards.

I would suggest that you consider visiting a website that has been recommended by AARP if you are interested in exploring various exercise options: the ACE Exercise Library of the American Council on Exercise (go to AceFitness.org and click on Education, then under For All, select Exercise Library). Meanwhile, I should stop writing and you should stop reading—we both need to engage in a bit of physical activity.

References

- Csikszentmihalyi, M. (1990) *Flow: The Psychology of Optimal Experience*. New York: Harper Collins.
- Sapolsky, R. (2004) *Why Zebras Don't Get Ulcers* (3rd Ed). New York: Holt.