Good sleep, good learning, good life

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Foreword

I have for years been interested in sleep research due to my professional involvement in memory and learning. This article attempts to produce a synthesis of what is known about sleep with a view to practical applications, esp. in people who need top-quality sleep for their learning or creative achievements. Neurophysiology of sleep is an explosively growing branch of science. Many theories that are currently contested will soon be forgotten as a result of new findings. Consequently, this text is likely to grow old very quickly. Yet some basic truths about sleep are well-established, and practical conclusions can be drawn with the benefit to human creativity and intellectual accomplishment. In this text, I provide some links to research papers and popular-scientific articles that advocate disparate and contradictory theories. Please consult other sources to be certain you do not to get a one-sided view! This article includes some indications on how to use free running sleep in the treatment of insomnia, hypersomnia, advanced and delayed phase shift syndromes, and some other sleep disorders. If your own experience can contribute to the ideas presented herein, I will gladly hear from you (esp. in the context of learning and creativity)

Contents:

Sleep deprivation in society

Few people realize how important sleep is! The alarm clock is an often-used fixture in an overwhelming majority of homes of the modern world. By using the electric lighting, alarm clocks, sleeping pills, and shift-work, we have wreaked havoc on the process of sleep. Over the last hundred years of the twentieth century, we have intruded upon a delicate and finely regulated process perfected by several hundred million years of evolution. Yet only recently have we truly become aware that this intrusion may belong to the most important preventable factors that are slowing the societal growth in industrial nations! In a couple of years from now, we may look at alarm clocks and "sleep regulation", in the same way as we look today at other "great" human inventions in the league of cigarettes, asbestos materials or radioactive cosmetics

Check this list below and see which applies to you:

- I often have problems with falling asleep at the right time
- I often find it painful to get up in the morning due to sleepiness
- I am often awfully drowsy at school or at work
- I regularly cut my sleep by 2-3 hours as compared with what my body seems to need

- I use the alarm clock and truly hate it
- I drink buckets of coffee or coke
- I often take 2-4 hour naps in the evening
- one of the above is a source of regular stress or reduced productivity

The chances are around 90% you could subscribe to one of the above. It is also highly likely you have already learned to accept the status quo, and you do not believe you can do much about it. This article may hint at some remedies; however, the bad news is that for a real solution you would probably need to change your family life, your work, your boss, or some of hard-to-change social rules!

Sleep isn't just a form of rest! Sleep plays a critical physiological function, and is indispensable for your intellectual development! Those who do not respect their sleep are not likely to live to their full mental potential!

Yet modern society has developed well-entrenched rules that keep sleep in utmost disregard. This has been driven to pathological levels in American society. Here are some bad rules that hurt sleep:

- it is ok to use alarm clock to cut sleep short
- it is ok to work in shifts
- it is ok to travel people around the world without much notice of the jet lag problem
- it is ok to save time by sleeping less and working more
- it is ok to pull kids out of bed in time for school
- it is ok to skip nights before important exams, etc.

Cutting down on sleep does not make people die (at least not immediately). It does make them feel miserable but the ease with which we recover by getting just one good night of sleep seems to make sleep look cheap. Even the reports from the Guinness Record attempt at sleeplessness (Randy Gardner's awakathon in 1964 lasted 11 days [1]) trivialized the effects of sleeplessness. Many books on psychiatry and psychology still state that there aren't any significant side effects to prolonged sleeplessness! This is false!

In 1992, when Bill Clinton was running for president, he proudly admitted that he went 48 hours without sleep because he really wanted to become the next president. Former Senator Bob Dole "improved" the record in 1996 presidential campaign: We have been going 78 hours. We've got to go 96. We have been going around the clock for America. Dole's feat was matched by Vice President Albert Gore jr. who kept campaigning for three days before the election of November 7, 2000. After the election, Gore still kept on his feet by going into extra hours of the concede-retract cycle of his cliffhanger contest against Governor George W. Bush of Texas.

The bad example of disrespect for sleep comes from the most important people in the nation!

Yet some dramatic facts related to sleep deprivation slowly come into light. Each year sleep disorders add $16 billion to national health-care costs (e.g. by contributing to high blood pressure and heart disease). That does not include accidents and lost productivity at work. For this, the National Commission on Sleep Disorders estimates that sleep deprivation costs $150 billion a year in higher stress and reduced workplace productivity (US, 1999). 40% of truck accidents are attributable to fatigue and drowsiness, and there is an 800% increase in single vehicle commercial truck accidents between midnight and 8 am. Major industrial disasters have been attributed to sleep deprivation (among these, at least in part, Three Mile Island, Chernobyl, the gas leak at Bhopal, Zeebrugge disaster, and the Exxon Valdez oil spill).

It has been known since the 1920s that sleep improves recall in learning. However, only recently, research by Dr Robert Stickgold, assistant professor of psychiatry at Massachusetts Mental Health Center, has made international headlines. Dr Stickgold demonstrated a fact that has long been known yet little appreciated: **sleep is necessary for learning!** Without sleep we reduce the retention of facts we have learned the previous day (and not only). Studying nights before an exam may be sufficient for passing the exam, yet it will leave few useful traces in long-term memory. The exam on its own replaces knowledge as the main purpose of studying!

By cutting down on sleep we learn less, we develop less, we are less bright, we make worse decisions, we accomplish less, we are less productive, we are more prone to errors, and we undermine our true intellectual potential!

A change in societal sleep habits can spell a social revolution in learning, health, and productivity on a scale that few imagine! "*Judging from history, it would seem that fundamental changes in the way we think about sleep will be required for policy changes that would protect society from sleepy people who make catastrophic errors in industry and transportation*" (Merrill Mitler, PhD)

I have studied student personalities among users of SuperMemo for over ten years now. There are a couple of determinants that make a good, efficient and persistent student. Here are some characteristics of a person who is likely to be successful in learning:

- highly optimistic
- sleeps well
- knowledge hungry
- stress-tolerant
- energetic but able to slow down at the time of learning

Here are some unfortunate characteristics that do not correlate well with the ability to study effectively (esp. in the context of SuperMemo):

- depressive
- problems with sleep (esp. insomnia)
- high levels of stress
- overexcited
- low stress tolerance (smokers, people with a drinking problem, abusers of mood altering substances, etc.)

Sleeping well appears to be one of the most important factors underlying the success in learning!

The physiological function of sleep

For long, the physiological function of sleep has not been clear. In most people's mind, sleep is associated with rest and time for mental regeneration. Restorative, protective and energy-conserving theories of sleep have been quite popular until quite recently when it became apparent that one long-lasting sleep episode with suppression of consciousness does not seem to be the right way for the evolution to tackle depleted resources, toxic wastes or energy conservation (e.g. your muscles do not shut off completely to get rest). The critical function of sleep is dramatically illustrated in experiments in which rats chronically deprived of sleep eventually die (usually within 2.5 weeks). See: Is REM involved in memory formation?

In evolutionary terms, sleep is a very old phenomenon and it clearly must play a role that is critical to survival. Only quite recently, it has been proven beyond doubt that the function of sleep is related to learning! ([2] not all scientists agree!)

Researchers have long known the particular importance of the hippocampus, a small brain organ, for memory formation. Yet it has always been difficult to find out what is special about the hippocampus that distinguishes it from other areas of the cerebral cortex that also show synaptic plasticity, i.e. the ability to store memories.

Ground-breaking theories of Dr György Buzsáki and his two-stage model of memory trace formation have inspired further research that sheds new light on what is actually happening during sleep [Buzsáki, 1989] (do not confuse this two-stage model with the two-component model of memory or with the two-component model of sleep regulation below). Using his knowledge of neural networks, ingenuous experiments on neuronal firing, and sophisticated mathematical analysis of spatiotemporal firing patterns, Buzsáki provided an good model explaining how the two components of sleep, REM and non-REM sleep, work together to consolidate memories. The hippocampus acts as the central switchboard for the brain that can easily store short-term memory patterns. However, these patterns have to be encoded in the neocortex to provide space for coding new short-term memories. This complex process of rebuilding the neural network of the brain takes place during sleep. Unlike rest or conservation of energy, this highest feat of evolutionary neural mathematics, requires the brain to be shut off entirely from environmental input! This automatic rewiring is the main reason for which we sleep and why there is no conscious processing involved! During sleep, the brain works as hard as during SAT or GRE exams. It rewires its circuits to make sure that all newly gained knowledge is optimally stored for future use. If you have some basic understanding of neurophysiology and neural networks, here is an article that makes an excellent reading about the neural functions of sleep: Slow wave sleep contribution to memory consolidation.

Two component model of sleep regulation

Electric lighting and stress are the two chief culprits that have converted the natural process of sleep into a daily struggle for millions. In the new millennium, we can rarely hope to get a good night sleep without understanding the science and the art of sleep. Currently, the societal understanding of sleep and its functions is as dismal as the understanding of the health risks of cigarettes in the 1920s. A majority of the population inflict pain, misery and mental torture on themselves and their children by trying to regulate their sleep with alarm clocks, irrational shift-work patterns, sleeping pills, alcohol, caffeine, etc.

For a chance to break out from unhealthy sleep habits, you need to understand the two-component model of sleep regulation:

There are two components of sleepiness that drive you to bed:

- **circadian component** - sleepiness comes back to us in cycles which are usually about one day long
- **homeostatic component** - sleepiness increases with the length of time we stay awake

Only the superposition of these two components determines the optimum time for sleep. Most importantly, you should remember that even strong sleepiness resulting from the homeostatic component may not be sufficient to get good sleep if the timing goes against the sleep-high in the circadian component:

Circadian component - there are around hundred known body functions that oscillate between maximum and minimum values in a day-long cycle. Because these function take about a day's time to complete, the term circadian rhythm was coined by Dr Franz Halberg of Germany in 1959 (in Latin *circadian* means *about a day*). The overall tendency to maintain sleep is also subject to such a circadian rhythm. In an average case, the maximum sleepiness comes in the middle of the night, reaches the minimum at awakening, and again increases slightly at siesta time in the afternoon. However, the circadian sleepiness is often shifted in phase as compared with your desired sleep time. Consequently, if your maximum sleepiness comes in the morning, you may find it difficult to fall asleep late in the evening, even if you missed a lot of sleep on the preceding day. In other words, the optimum timing of your sleep should take into consideration your circadian rhythm.

Homeostatic component - homeostasis is the term that refers to maintaining equilibrium or balance in physiological and metabolic functions. If you drink liquids containing lots of calcium, homeostatic mechanisms will make sure that you excrete calcium with urine or deposit it in the bones. This is used to make sure your blood levels of calcium remain the same. Similar mechanisms are used to regulate overall sleepiness and its multiple subcomponents. The longer you stay awake, the more you learn, the more you think, the higher your tendency to fall asleep. On the other hand, caffeine, stress, exercise and other factors may temporarily reduce your sleepiness. The homeostatic mechanism prepares you for sleep after a long day of intellectual work. At the same time it prevents you from falling asleep in emergencies.

Let us now formulate the fundamental theorem of good sleep:

To get high quality night sleep that maximizes your learning effects your sleep onset should meet these two criteria:

- **strong homeostatic sleepiness**: this usually means going to sleep not earlier than 15-19 hours after awakening from the previous night sleep
- **ascending circadian sleepiness**: this means going to sleep at a time of day when you usually experience a rapid increase in drowsiness. Not earlier and not later! Knowing the timing of your circadian rhythm is critical for good night sleep (see below for more hints)

Additionally, you should be aware that using the circadian component will only work when all its physiological subcomponents run in synch (as it is the case in free running sleep). People with irregular sleep hours and highly stressful lives may simply be unable to locate the point of ascending circadian sleepiness as this point may not exist!
For a visual illustration of circadian and homeostatic components see Fig. 5.

Later in the article, we will convert this theoretical formula into the more practical recommendations. Before that you may want to understand factors that greatly complicate the two-component model presented above.

Most of all, you may be surprised to find out that your internal circadian oscillation is based on a period that is closer to 25 hours than to 24 hours! To be exact, it varies between individuals, seasons, and other daily factors such as stress, timing of sleep, timing of the light period, intensity of light, exercise, and many more. Usually it falls into the range from 24.5 hours to 25.5 hours.

Most of us are able to entrain this 25 circadian rhythm into a 24-hour cycle by using factors that reset the oscillation. These factors include intense morning light, work, exercise, etc. German scientists have named these factors *zeitgebers* (i.e. factors that *give time*). As a result of the influence of zeitgebers, in a well-adjusted individual, the cycle can be set back by 30-60 minutes each day. However, the entrainment to the 24-hour cycle may come with difficulty to many individuals due to factors such as:

- blindness (i.e. the inability to use the main zeitgeber: light)
- short-sightedness (i.e. reduced sensitivity to light zeitgeber)
- increased demand for sleep (e.g. as a result of intense learning, highly creative job position, etc.)
- stress
- endocrine disorders
- sleep disorders
- adolescence

Important! A great deal of sleep disorders can be explained by **entrainment failure** (i.e. the failure to reset the 25-hour circadian rhythm to the 24-hour daylight cycle). In other words, in the interdependence between sleep disorders and entrainment failure, the cause-effect relationship will often be reversed!

Due to the physiological function of sleep, which is the rewiring of the neural network of the brain at the synapse level, we can naturally expect that the demand for sleep be associated with the amount of learning on the preceding days. This link may also explain a decreased demand for sleep in retirement due to a decrease in intellectual activity. This age-related drop in the demand for sleep is less likely to be observed in highly active individuals. For similar reasons, the entrainment failure can often be found among students during exams. It is not clear how much of this failure can be attributed to stress, or to the desire to do more on a given day, or to the actual increase in the demand for sleep.

To find out more about the circadian component see: Biological Clock Tutorial

Free running sleep

There is a little-publicized formula that acts as a perfect cure for people who experience continual or seasonal problems with sleep entrainment. This formula is **free running sleep**!

Free running sleep is a sleep that comes naturally at the time when it is internally triggered by the combination of your homeostatic and circadian components. In other words, free running sleep occurs when you go to sleep only then when you are truly sleepy (independent of the relationship of this moment to the actual time of day).

The greatest shortcoming of free running sleep is that it will often result in cycles longer than 24 hours. This eliminates free running sleep from a wider use in society. However, if you would like to try free running sleep, you could hopefully do it on vacation. You may need a vacation that lasts longer than two weeks before you understand your circadian cycle. Even if you cannot afford free running sleep in non-vacation setting, trying it once will greatly increase your knowledge about natural sleep cycles and your own cycle in particular.

Free running sleep algorithm:

1. Start with a meticulous log in which you will record the hours in which you go to sleep and wake up in the morning. If you take a nap during the day, put it in the log as well (even if the nap takes as little as 1-3 minutes). The log will help you predict the optimum sleeping hours and improve the quality of sleep. With some experience, you will need the log no longer; however, you will need it at the beginning to better understand your rhythms
2. Go to sleep only then when you are really tired. You should be able to sense that your sleep latency is likely to be less than 10-20 minutes (sleep latency is the time between going to bed and falling asleep). If you do not feel confident you will fall asleep with 10-20 minutes latency, do not go to sleep! If this requires you to stay up until early in the morning, so be it!
3. Be sure nothing disturbs your sleep! Do not use an alarm clock! If possible, sleep without a bed partner. Keep yourself well isolated from sources of noise and from rapid changes in lighting

4. Avoid stress during the day. Stress hormones have a powerful impact on the timing of sleep. Stressful situations are also likely to keep you up at the time when you shall be falling asleep
5. After a couple of days, try to figure out the length of your circadian cycle. If you arrive at a number that is greater than 24 hours, your free running sleep will result in going to sleep later on each successive day. This will ultimately make you sleep during the day at times. This is why you may need a vacation to give free running sleep an honest test
6. Once you know how much time you spend awake on average, make a daily calculation of the expected hour at which you will go to sleep (we will use the term **expected hour** later on). This calculation will help you predict the sleep onset. On some days you may feel sleepy before the expected hour. Do not fight sleepiness, go to sleep even if this falls 2-3 hours before your expected time. Similarly, if you do not feel sleepy at the expected hour, stay up, keep busy and go to sleep later, even if this falls 2-4 hours after your expected time
7. Here is the list of **cardinal mistakes** to watch for:
    - do not go to sleep before you are sleepy enough - this may result in falling asleep for 10-30 minutes, and then waking up for 2-4 hours. Ultimately you can experience an artificial shift forward in the entire cycle!
    - unless for natural reasons (no sleepiness), do not go to sleep well after the expected hour. This will result in missing the period of maximum circadian sleepiness . Your sleep will be shorter and less refreshing. Your measurements will be less regular and you will find it harder to predict the optimum timing of sleep in following days
    - do not take a nap later than 6-7 hours before the expected hour. Such a nap is likely to affect the expected hour and disrupt your cycle. If you feel sleepy in the evening, you will have to wait for the moment when you believe you will be able to sleep throughout the night
    - try to avoid taking a nap longer than 30-60 minutes. Except for conditions of major physical or mental exhaustion (e.g. heavy exercise, illness, dehydration, etc.), such a nap is a likely result of not sticking to other rules of free running sleep and is also likely to disrupt the cycle

In free running conditions, it should not be difficult to record the actual hours of sleep. In conditions of entrainment failure, you may find it hard to fall asleep, or wake up slowly "in stages". In free running sleep, you should be able to quickly arrive to the point when you fall asleep in less than 10 minutes and wake up immediately (i.e. without a period of fading drowsiness). In other words, you can remember the hour you go to bed, add 10-15 minutes and record it as the hour you fell asleep. As soon as you open your eyes in the morning, you should record the waking hour. Usually you should not have any doubts if you have already awakened for good (as opposed to temporarily), and you should not fall asleep again (as it may be a frequent case in non-free running sleep). Fig. 1 shows an exemplary free running sleep log in a graphic form:

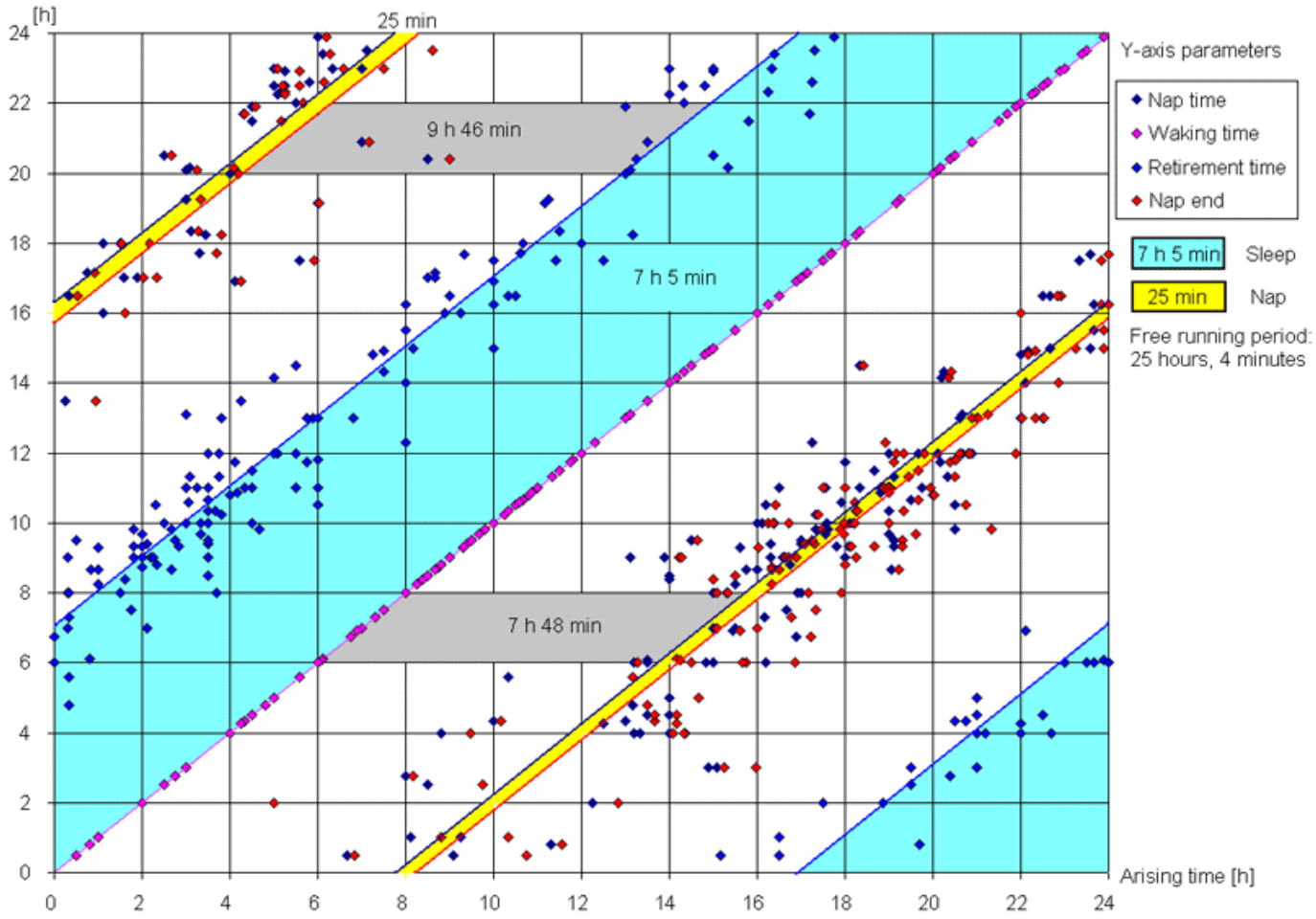

Fig 1. An exemplary 5-months free running sleep cycle graph in conditions of negligible isolation from standard zeitgebers. In the picture, the average time of night sleep is 7 h 5 min, time before the midday nap is 7 h 48 min, the average nap takes 25 minutes and the time before the nap and the night sleep is 9 h 46 min. The whole cycle adds up to 25 hours and 4 minutes. Note that the distance between nap and sleep in the graph is less than 9 h 46 minutes due to the fact that the blue retirement-line refers to the previous day sleep as compared with the red nap-line. Consequently, the nap-to-sleep band is horizontally shortened by 64 minutes, i.e. exactly as much as the daily time-shift in the cycle.

If you have collected your own free-running sleep data, please contact the author (even data from periods as short as one week are of value).

Sleeping against your natural rhythm

If you sleep against your natural rhythm you will often experience tiredness or drowsiness that can be resolved by adjusting your sleeping hours. In healthy individuals, the daytime alertness is primarily determined by:

1. circadian phase and homeostatic sleepiness
2. total sleep time the night before
3. amount of slow-wave sleep sleep the night before (see Physiology of sleep below)
4. regularity of the sleep-wake schedule

Free-running sleep provides the best way to satisfy all above criteria

Free-running sleep is likely to shift the minimum temperature point from the early morning closer to the beginning of your sleep. You should notice increased sleepiness before going to sleep and reduced sleep inertia upon awakening!

If you cannot free-run your sleep, it is very important to understand the relationship of your homeostatic and circadian sleep drive as compiled in the table below. In the course of the day, you should move in synch between the yellow areas of the table, i.e. from perfect alertness to maximum sleepiness, and then back to perfect alertness. The gray areas illustrate when your sleep falls out of synch:

	High circadian sleepiness	Low circadian sleepiness
High homeostatic sleepiness	**Peak of the night:** You are very drowsy and fall into refreshing sleep with latency of less than five minutes	**Insomnia**: You are tossing and turning in bed. You are very tired but you cannot fall asleep. Your temperature, blood pressure and pulse are raised. Your thoughts are racing **Solution:** Wait for the arrival of the circadian phase. Delay going to sleep by 3-6 hours
Low homeostatic sleepiness	**Hypersomnia:** You are drowsy throughout the day despite long sleep hours. Napping does not help. You show minimum energy levels. Your muscles are weak and atonic **Solution**: Adjust your sleep phase to your circadian (e.g. try to go to sleep 3-6 hours later)	**Peak of the day**: You are alert, energetic, and full of new ideas

Should we free run our sleep?

As it will be discussed later, free running sleep can be used to solve a number of sleep disorders except those where there is an underlying organic disorder that disrupts the natural sleeping mechanisms.

However, you will often hear two arguments against adopting the use of free running sleep:

- **Argument 1** - free running sleep will often result in a day that is longer than 24 hours. This ultimately leads to sleeping in atypical hours. This seems to go against the natural 24-hour cycle of light and darkness. Less often, the cycle will be less than 24 hours
- **Argument 2** - sleep can be compared to eating. Your body will always try to get more than it actually needs. This will result in spending more time in sleep than necessary. In other words, free running sleep is time-inefficient

Let us consider the validity of these two arguments:

Argument 1 - It is true that free running sleep will often run against the natural cycle of light-and-darkness. However, the departure from the natural rhythm is a direct consequence of electric lighting and modern lifestyle. Our ancestors could expect little but darkness and boredom past sunset. Darkness and boredom are quite efficient in lulling us to sleep. If we stubbornly refuse to use electric lighting beyond a certain hour, we will still find it difficult to run away from the excitement of modern lifestyle. To shut your brain to sleep efficiently in the early evening your would probably need to quit your current job and pick some uninspiring one, give up your intense family life, give up your hobbies and interests, give up the Internet, evening TV, etc. We live more exciting and more stressful lives than our grandparents. Turning the lights off in the early evening would probably only be wasteful. Additionally, shortsightedness, the ailment of the information age, makes us less sensitive to light zeitgebers and artificially prolongs the circadian cycle. There are a number of downsides to free running sleep. The worst shortcoming is a difficulty in establishing an activity cycle that could be well synchronized with the rest of the world. Later in the article we will discuss the positive aspects of free running sleep. Ultimately, everyone needs to balance pros and cons to make the ultimate decision: to free run or not to free run

Argument 2 - It is true that people who try to free run their sleep may find themselves sleeping outrageously long in the beginning. This, however, is not likely to last and may be a body's counter-reaction to prolonged sleep deprivation. Unlike in the case of foods, there does not seem to be any evolutionary advantage to getting extra sleep on days we can afford to sleep longer. In the course of evolution, we have developed a tendency to overeat. This is a protection against periods when food is scarce. Adipose tissue works as a survival kit for bad times. However, considering the function of sleep, the demand for sleep should be somewhat proportional to the amount of new learning received on preceding days. In ancient times, we did not have exam days as opposed to lazy days. Consequently, the link between learning and demand for sleep is quite weak. The body clock will still make us sleep 7-8 hours on nights following the days of total inaction. Secondly, every extra minute of sleep might improve the quality of neural wiring in the brain. Sleep would better be compared to drinking rather than eating. We do not have much capacity to survive without drinking due to our poor water storage ability. Similarly, we cannot sleep in advance in preparation for a double all-nighter before an exam or important deadline

The claim that free running sleep increases the natural need for sleep is false! If you happen to sleep longer in free running sleep, it indicates that you had been sleep deprived before running free. This longer sleep stage is transient.

On the other extreme of free running sleep debate is the argument for changing the way society works by ... introducing the 28-hour day. To read more about this concept see A New Clock for A New Age. Although a 28-hour day sounds today more like a legislative science fiction, the free running sleep argument actually significantly bolsters the proposition. It is not difficult to imagine that in the newly emerging cyber-society, people will find it easier to adopt 28-hour schedule. Even if the average free running circadian cycle lasts 25 hours, it seems physiologically easier and less damaging to prolong the cycle by three hours than to shorten it by one!

Kill the alarm clock!

Few upwardly mobile people in the modern rat-race society can live without an alarm clock. Increasingly, time becomes the most precious commodity in society where achievement is often associated with speed and perfect time-management. However, alarm clocks introduce two harmful side effects: stress and sleep deprivation.

The art of time-management makes it possible to live at high speed with the alarm clock on your side and actually be free from stress. However, the societal damage inflicted by alarm clocks used to regulate sleep is unforgivable. An alarm clock that interrupts your sleep damages your memory, your ability to learn, your mood and temper, your relationships with other people, your ability to focus and your overall intellectual performance!

Dr Robert Stickgold has showed that people who learn a skill during the day, do not show significant improvement until they get a sound 7-8 hours of properly structured sleep. There was a noticeable correlation between the degree of improvement and the quantity of sleep received. Forgetting is so painless that we rarely notice its effects. In a natural way, forgetting will proceed even if you get as much sleep as you need, and it is difficult to point to specific memories lost as a result of not sleeping enough. Moreover, sleep deprivation may leave your memories intact while their storage will be sub-optimum. The difference may be impossible to spot without measurement. We are more likely to notice sleepiness, reduced mental agility or bad mood. Yet societal respect for sleep is dismal (esp. in America and other highly industrialized nations).

Men's Health's Dan Vergano writing for *ABC News* in "No More Rude Awakenings" suggests a seven-day system for fighting sleepiness: "*The secret is to fuel that arousal system so it can **beat the pants off the sleep system**. By creating the kind of feel-good expectations that trigger hormones to wake the brain, you'll override the need to sleep and be able to jump out of bed like a man on fire*".

The article capitalizes on the fact that stress hormones help keep you alert. However, there is a simple and the only rational remedy for "*rude awakenings*": **get enough sleep!** Jumping *like a man on fire* is not likely to have a positive effect on your creative potential!

You may often notice that waking up with an alarm clock gives you a quick start into a day. You may then come to believe that using the alarm clock might help you keep alert later during the day. This is not the case. The alarm signal simply scares your brain into wakefulness disrupting the carefully planned system for memory consolidation. As a result, you get an immediate injection of adrenaline and your levels of ACTH and cortisol also increase. This is cortisol that peaks at awakening in natural sleeping rhythm that provides you with the fresh-mind impression. With passing time, this cheaply gained alertness will wear thin unless you continue abusing your physiology with more "remedies". You may use more scare tactics for keeping yourself alert, abuse caffeine, or even get a more profound effect with cocaine. **Alertness should be achieved via sufficient sleep, not despite the lack of sleep!** Apart from your reduced ability to learn new things, all unnatural anti-drowsiness methods will produce a great deal of side effects that can be pretty damaging to your health in the long run.

If your life without an alarm clock may seem like an impossibility, you will probably need to use all methods in the book to be sure you get enough sleep and minimize the damage. However, you can at least start from changing your mindset about the importance of sleep and ensure you do not impose wrong habits on your children. Perhaps the young ones will be lucky enough to work in a flex-time system that will make it possible to get sufficient amount of undisturbed sleep. At least, do not set a bad example! President Bill Clinton was woken up twice by telephone during the night of April 22, 2000 before the infamous I.N.S. raid on the home of Miami relatives of the young Cuban exile Elian Gonzales. In all likelihood, the memories the president had built from his previous day experience were affected! This could influence his performance on the next day and the quality of his decisions! Has anybody thought of a rule: *Do not wake up the president?* A rule that could only be revoked in national emergency?

Physiology of sleep
This inset has been provided to deepen your understanding of sleep, its dynamics and functions. It requires some basic understanding of biology. You may skip this section without missing on practical aspects of this article. Many aspects of sleep physiology are hotly debated and highly hypothetical. Thus this short compilation may soon appear outdated as new research data sheds light on disputed areas
Human brain looks like the highest achievement of biological evolution. It all started from a simple ability to conduct impulses. Then the genius concept of neural network was developed. The brain of primitive vertebrates started adding new structures as well as new mechanisms for optimizing the jungle of neural connections. Sleep is a relatively old invention used to consolidate memories via predominantly molecular mechanisms. Circadian rhythms are known in plants and in animals independent of the need for sleep. The evolution has, however, conveniently hooked sleep to circadian rhythms to efficiently alternate between the explorative state (i.e. the use of the brain for learning new things) and the consolidation state (i.e. sleep). The circadian cycle has been associated with around a hundred known physiological functions and parameters that change in concert during the day. The most important, and most closely related to sleep are cycles in the level of hormones such as serotonin and melatonin, ACTH and cortisol, acetylcholine, adenosine, and growth hormone. There is a circadian function that we can observe on our own without complex measurements: changes in temperature (see Fig 2):

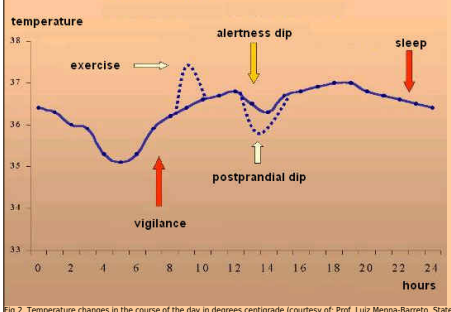

Fig 2. Temperature changes in the course of the day in degrees centigrade (courtesy of: Prof. Luiz Menna-Barreto, State University of Campinas, Brazil)
At the time when we usually go to sleep, there is a substantial circadian increase in melatonin released from the pineal gland. Melatonin is one of strong contributors to drowsiness. However, it is possible to sleep against the melatonin-serotonin cycle, which clearly indicates it is not the only sleep regulator. At the same time, there is a significant drop in ACTH and cortisol, which are our alertness hormones. Similarly, the levels of serotonin drop and so does the body temperature. At the same time there is a increase in firing in brain sleep inducing nuclei, esp. the ventrolateral preoptic nucleus (VLPO). These have an inhibitory impact on the ascending reticular activating system (RAS) which is a group of neural structures that keep our cerebral cortex in the active waking state. Before retirement, the basal forebrain, the chief NREM-inducing organ, begins a firing pattern that is characteristic to initial stages of sleep. With the depression in the activity of the RAS, we quickly lose interest in demanding intellectual activities. Soon the only thing we can think of is sleep. Once we rest in an undisturbed place, we drift into the dreamland. Actually, this is only the case in a well regulated sleeping cycle. People who cannot succumb to natural body rhythms will often be unable to follow the above scenario. You are quite likely to belong to this group -- after all, the majority of industrial nations' population suffers from a varying degree of a number of sleep disorders!
In the course of the night, we alternately enter two phases of sleep (see Fig 3):

- NREM sleep (named for non-Rapid Eye Movement)
- REM sleep (named for Rapid Eye Movement)

Using EEG measurements, scientists are able to distinguish four phases of NREM sleep, which correspond to progressively deeper sleep. As we close our eyes, it takes 3-15 minutes to enter Stage 1 NREM sleep (in a healthy and well-regulated individual). In this stage we will often experience little jerks associated with the impression of falling. Minor disturbances will wake us up and often we will even deny we were asleep! Once State 1 NREM solidifies, we move towards Stage 2 NREM sleep which is still relatively light. After that we move to Stage 3 and Stage 4 NREM (also called slow-wave sleep or deep sleep). In those last stages, SPW bursts (sharp wave bursts) can be recorded in the central memory switchboard of the brain: the hippocampus. Scientists believe that this may be the critical moment of memory consolidation in which the hippocampus works as the neural trainer for the neocortex in which long-term memories will be stored. During SPW bursts, the experience of the day will optimally be transferred to neocortical networks via neural training. This will be followed by the initiation of gene expression and protein synthesis. Both these processes are needed for modifying long-term synaptic weights (for more details see: Gorzelanczyk, Wozniak, Molecular correlates of the two-component model of long-term memory). Protein synthesis makes up the beginning of memories that will last for months and years (if sustained by repetition, e.g. with SuperMemo). Those long-term memories cannot be formed without entering appropriate stages of the sleep cycle! You cannot learn effectively if your sleep gets cut short in the morning. Or if it gets interrupted during the night. Even if you try to sleep 15 hours per day in short pieces of interrupted sleep, your learning results will be dismal! (see: the cruel myth of polyphasic sleep)

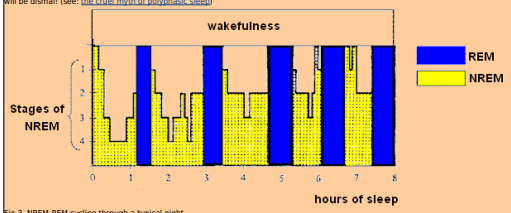

Fig 3. NREM-REM cycling through a typical night
After 60-90 minutes of NREM sleep, there is a gradual increase in the activity of cells in the pontine tegmentum which is responsible for triggering REM sleep. A small pontine structure called the pedunculopontine tegmental nucleus (PPN) is highly active at that stage and is considered the internal REM trigger. PPN sends acetylcholinergic signals to the thalamus and the brain behaves as if it woke up internally! Injections of acetylcholine into the pons during an ongoing NREM episode may trigger REM sleep, which illustrates the importance of this neurotransmitter in sleep cycle regulation. During REM sleep, the cortex behaves as if you were awake. You experience dreams that seem to be generated by random impulsation sent from the brainstem to the cortex. The cortex produces best possible and most coherent imagery it can. You experience connected events, real people, realistic scenery all put together in most improbable configurations. Yet you cannot act upon your dreams (except for people with disorder called *violent sleeping*). Your pontine structures make sure your cerebral output gets cut off from motor nuclei that move your muscles. You often want to act in sleep (e.g. to escape a ferocious dog) yet you remain motionless. You feel as if mired in molasses. Only your eyes move rapidly and the muscles in your middle ear twitch. REM sleep is philogenetically younger than NREM sleep. Fish, amphibians or perhaps most reptiles do not show typical REM sleep. Yet interestingly REM sleep is present in both mammals and birds. This made some evolutionists hypothesize that REM sleep has been invented twice by the evolution! The conclusion is that REM sleep plays a role critical for survival of creatures with bird-mammal IQ levels (see: How much do animals sleep)
REM sleep is characterized by intense neural activity, increase in blood circulation and the use of oxygen, as well as an increase in the uptake of amino acids by the brain tissue. The brain in REM sleep is a hard-working brain that has little to do with the notion of energy-conservation and rest in sleep.
During REM sleep, acetylcholine supplies in the PPN get gradually exhausted and this may be the main regulatory factor that drives you back towards NREM sleep. As the activity of the PPN decreased, the activity in the noradrenergic locus ceruleus (LC) increases. LC is considered to be the REM-off switch.
A typical night will see you go five times through NREM-REM cycles with each cycle lasting around 90 minutes and getting slightly shorter as the night progresses (cf. Fig 3). The sleep regulatory system might act as an infinite seesaw were it not for the circadian component. Towards the end of sleep, the circadian component strongly regulated by the suprachiasmatic nucleus (SCN) will produce decline in sleep propensity, and you will wake up from one of your REM episodes. It is the SCN which provides the link between the strongest zeitgeber, the light, and the circadian cycle. SCN generates the rhythm endogenously, but is able to be reset by light. Light impulses from the retina travel to the hypothalamus and SCN to produce a stop signal for the release of melatonin. Instead, another neurohormone is released: serotonin. A high level of serotonin is what you feel as the morning sunshine happiness. It is also serotonin that is boosted by the popular antidepressant: Prozac. Unless you suffer from sleep phase advancement, always make sure the sunshine streams into your sleeping room in the morning to wake you up.
There are many theories on the functions of REM sleep. It has long been known that dreams occur mostly in REM sleep, yet some scientists see dreams and REM sleep as separate though temporally overlapping phenomena. It has been found in a number of experiments that REM sleep is important for learning, yet some scientist question those findings pointing to experimental errors or to the fact that antidepressants do not damage memory even thought they are potent REM suppressants. Some scientists believe REM is needed to reinforce little used synaptic connections, others that REM optimizes the memory storage, other that REM helps the brain recover from slow wave sleep, and yet other believe that REM evolved just to fine-tune bifocal vision or to prevent corneal anoxia (eye movement stirs aqueous humor and provides nourishment for the cornea). Even advocates of the old psychoanalytical interpretation of dreams originated by Sigmund Freud can be sparsely found among scientific community. Some researchers believe learning is possible during REM, others contest it, and yet others insist that REM has nothing to do with memory. On one hand, the percentage of REM sleep decreases with age which might indicate a correlation with the demand for learning. On the other, the percentage of REM during the night increases. Some researchers believe that if REM was to be involved in memory, it should rather begin quickly as we fall asleep.
The best ground for questioning many of these theories is evolutionary! We need to point to the evolutionary value of a particular function REM is postulated to fulfill. For example:

- **reactivation of infrequently used circuits** - if activation of infrequently used memories was necessary to prevent forgetting, evolution might have simply employed molecular mechanisms in which once synapses were potentiated, they would spontaneously build up synaptic strength in time without secondary activation. Naturally, this would abolish a valuable evolutionary mechanism of forgetting. Similarly, random REM activation for the purpose of memory fixation would simply be wasteful. Forgetting played a specific evolutionary function and the increase in synaptic strength should only result from a repeated exposure to a specific experience (for example, a repetition in SuperMemo serves exactly this purpose)
- **recovery from slow-wave sleep** - if REM was a recovery stage, why should it happen several times during the night. Would it not just better come at the arrival of zeitgebers indicating the end of the sleep period? Or is slow-wave sleep that deadly?
- **corneal anoxia** - if REM was to nourish the corneas, would not just waking up do the job (if eyeball movement was the only purpose of REM)?
- **consolidation of memory** - if memories get consolidated in REM, what is the purpose of NREM? How can this be that antidepressants do not damage learning even if they are strong REM suppressants? Why does the REM brain behave like a waking brain?
- **restoration theories** - why would restoration require cutting off sensory input if the brain is actually as active as in the waking state

Only one group of REM theories provides plausible answer to its evolutionary function among intelligent creatures! These theories originated in the head of one of the greatest scientific geniuses still walking this planet. Born in 1916, Francis H.C. Crick, together with James Watson unraveled the mystery of the DNA double-helix for which they were awarded a Nobel Prize in 1963. In 1983, Crick and his colleague from Salk Institute, Graeme Mitchison argued in Nature [Crick, 1983] that human memory can get overloaded and REM sleep is used to run a garbage collection process on memories. They called this process *reverse learning*, and originally attributed it only one purpose: forgetting the unnecessary memory ballast. Crick's seminal 1983 article was taken further by many researchers who have ultimately concluded that REM sleep must serve optimization of memories expressed by synaptic weights of the neural network of the brain! If REM sleep was only to be used for forgetting the excess information, Crick's theories would run into the same evolutionary trouble as other theories listed above. After all, spontaneous loss of synaptic information with passing time would be a metabolically much cheaper solution. However, the value of the network optimization goes far beyond forgetting. Rewiring of the network might bring some of the following advantages:

- converting poorly associative memories into highly associative memories (the origin of the ancient phrase: *let me consult my pillow*)
- eliminating knowledge interference; a REM bout should help you avoid confusing two similar concepts
- extracting common properties of objects and building models (pictorially: instead of holding 100 pictures of someone's face and searching on each encounter, recognize all common model characteristics are execute recognition in milliseconds)
- optimizing procedural reflexes (some researchers even proposed that REM is mostly targeted on consolidation of procedural skills which seem to suffer most from REM deprivation, while NREM sleep indeed mostly serves consolidation of declarative skills)
- transferring memories from overloaded circuits (e.g. the hippocampus) to spacious areas of the neocortex

According to Buzsáki, the optimization may be executed with the mediation of the hippocampus that would work in (1) explorative mode during the REM sleep (in which neocortical information is used to train hippocampal circuitry), and (2) in consummatory mode during the NREM sleep (in which the hippocampus is used to train neocortical circuits).
The network optimization hypothesis explains why it is hard to detect rote learning deterioration in REM deprivation. REM defined as above should have less bearing on the output generated by same inputs in reference to low-level associations (such as stimulus pairing). To detect the damage induced by REM deprivation (REMD) more complex tests should be used. Indeed some research by Dr Carlyle Smith has already been able to show the difference in the impact of REMD on paired associate learning (which suffers little damage in REMD) and complex logic tasks which are most affected by REM sleep deprivation [Smith, 1993]. Dr Georgi Buzsáki's two-stage model presents a computational approach to explaining the role of REM in retraining the neocortex through the hippocampal activity: A two-stage computational model training long-term memories in the entorhinal-hippocampal region (to understand this article you will need some rudimentary knowledge of neural nets and the hippocampal anatomy).
In the same way as sleep in general, REM is controlled via homeostatic and circadian components. Slow-wave sleep builds homeostatic REM propensity, and the best REM comes from the combination of slow-wave "exhaustion" and the circadian REM peak which comes in the last hours of sleep. There is also a strong homeostatic link between learning and the demand for REM sleep. The more you learn, the stronger the drive towards REM. There is an increase in both the number of minutes of REM sleep and the density of REM sleep following intensive learning [DeKoninck et al., 1989].
It is not clear if learning affects REM demand directly or via NREM demand; however, it is more than clear that heavy learners should be heavy sleepers!
Sleep deprivation increases both NREM 4 and REM sleep propensity. Short sleepers have less NREM 2, but there is little data on their actual quality and effectiveness of sleep. Thomas Edison or Nicola Tesla on one hand are well-known for sleeping relatively little, while Einstein is a well-known long sleeper (well over nine hours per night). Interestingly, they all belonged to notable nappers. It is true that by getting less sleep you compress the less critical NREM 2 sleep, but there is no evidence this can become your regular habit without hurting the quality of your NREM4-REM combination. With the currently available sleep data the conclusion is: do not try to compress NREM 2 by sleeping less. You are likely to hurt your memory consolidation and optimization!
Further reading: an excellent all-inclusive on-line sleep physiology manual: Sleep Syllabus

Lark-owl misconception

Research shows that 15% of people would classify themselves as "morning type" or lark. Another 20% would call themselves "evening type" or owl. The remaining 65% are indifferent or "mid-range". What is your type? See: Lark-owl test

Few people know that they can easily adapt to a completely different schedule by means of chronotherapy (e.g. by shifting their sleeping hours by 30-45 minutes per day). If you ask a typical owl to go to sleep 30-45 minutes later each day, the owl will initially sleep during the day and soon will find itself going to sleep in the very early evening just to get up before the larks! Surprisingly, even the most committed owl can then comfortably stick to the early waking hours for quite long! There seems to be no natural preference as to the sleeping time of the day!

However, there is a factor that drives people into believing they are of a given sleep-time preference type. This is the length of the circadian cycle and their ability to entrain it to 24 hours. As mentioned earlier, typical circadian period lasts about 25 hours. Those who cycle is particularly long, tend to go to sleep later each day. They push the limit of morning hours up to the point when their compulsory wake-up time results in unbearable sleepiness. In other words, people will long cycles will tend to work during the night and sleep in the morning as long as it is only possible.

Larks and owls do not differ in their preferred timing of sleep in reference to daytime! The difference comes from the length of the circadian cycle and sensitivity to zeitgebers. You can easily make a lark work comfortably late into the night and make an owl get up at 3 am. This can be done by chronotherapy (cycle adjustment)! (consequently, lark-owl test is substantially flawed as it asks for specific time ranges that will only apply to people with normal working schedules!)

A smaller proportion of people, will experience short circadian periods and experience extreme sleepiness in early evening. This is the lark type. Life forces larks to go to sleep slightly later than their natural preference (family, work, light, etc.). This keeps larks in line with time and they will often claim that the quiet of the morning, the singing of birds or the beauty of the sunrise that keeps them getting up early. Yet it is still possible to forcibly

push a lark to gradually shift sleeping hours and behave like an owl!

As for "indifferent type", these are people with a steady 24.5-25 hours circadian cycle and healthy sensitivity to zeitgebers, or, rarely, people with a nearly perfect 24 hour clock. Those people tend to sleep in "normal hours" and can also easily be shifted to getting up early or to going to bed late.

Unlike the "indifferent type", owls shifted to a morning schedule will gradually tend to advance to their standard late-night rhythm. Similarly, larks will quickly shift back to getting up with the birds.

Some correlation studies showed that owls (as defined by the timing of melatonin release) exhibit slightly higher IQs than larks.

Delayed Sleep Phase Syndrome

When a tendency to go to sleep later each day is strongly pronounced, it may become a serious problem. People with particularly long circadian cycle or with insufficient sensitivity to zeitgebers are classified as suffering from Delayed Sleep Phase Syndrome (DSPS for short). The term *non 24-hour sleep/wake syndrome* or *hypernychthemeral syndrome* is occasionally used to refer to the most severe cases. Research shows that DSPS is very frequent in adolescence [Carskadon, 1995; Dahl & Carskadon, 1995]. Teenagers with DSPS will often find it difficult to adapt to normal school time. They will experience maximum daytime sleepiness at 10 am (in the middle of the school day) and a peak in alertness right after the school. For many teenagers with a natural tendency to go to sleep late, school becomes a torture and a true waste of time! Educators have already taken on this subject; however, students dozing off during classes are still a norm! Sleepy students learn little, and may naturally develop a strong negative feelings for the school in general. This is a problem of colossal proportions! If you are a parent of a teenager who finds it difficult to wake up for school, you will need to act now! Otherwise young man's school years will be a monumentally wasted time! It won't be enough to demand an early hour for going to bed. If you ban the late evening Internet surfing, you will just swap a dose of evening education for an idle tossing and turning in bed. Actually, there is only one simple solution, let the kids get up at their natural time but ... this may not be realistic in most cases. Your sleep therapist may not be able to help either. The whole school system might need to be changed to accommodate the prevalence of DSPS among adolescents. There have been positive results noted in schools that decided to start classes 1-2 hours later. However, long circadian cycles may result in students staying up yet later in the long-run. Researchers suggest schedule stabilization and gradual realignment. Those measures may still be largely ineffective.

For a discussion of this subject see: School Start Time Study. For a popular scientific article see: Sorry, I'm late ... it's my circadian rhythm

Insomnia

50% of Americans have problems with falling asleep! Except for various underlying organic reasons, the overwhelming majority of these are problems resulting from entrainment failure. In other words:

Most of otherwise healthy people who cannot fall asleep in the evening suffer from the combination of two chief factors:

- going to sleep too early in reference to the natural circadian rhythm
- suffering from the associated stress: *if I do not fall asleep immediately, I will be totally wasted in the morning*

If the same people were allowed to sleep as much as they wanted and go to sleep only then when they are really tired (perhaps 2-5 hours later), the problem would likely not exist! Psychophysiological insomnia can often persist for years, and result in untold damage to a person's life. If this is your case, you might benefit by trying to increase the time you stay awake. Naturally this may collide with your work schedule as the net result will often be a sleep-wake cycle lasting longer than 24 hours.

There are tons of lengthy books written about sleep onset insomnia and there are a zillion tricks that people use to be sure they fall asleep "in time". The sad truth is that all those tricks only fight the inevitable: the natural sleep mechanism. They are based on slowing down the brain at the time when it simply does not want to slow down. Yet these tricks rather tend to blow the problem of insomnia out of proportion by adding to the sleeper's stress: *so much effort, so many tricks in use, it still does not work ... I probably just have to live with this!*

Some typical sleep expert's or grandma's **unworkable** advice (see example):

- Count sheep - this is nothing else than trying to slow neural firing in the brain. This will often work but there is an increased risk of waking up after 20-60 minutes of sleep. As a result, the chances for early slumber may be gone for good. The slowdown in firing can come naturally. However, it can only come at the right circadian time which may be 2-5 hours later than you would want
- Thought dispersion - by trying to "think about nothing" you can indeed increase the chances of falling asleep; however, this may be of value only for a limited length of time before the ascending circadian slope. If you try it early, you will likely hover in superficial sleep with substantial chances of awakening spontaneously. It is the circadian sleepiness that stands for your ability to maintain sleep
- Cut down on sleep - this has some power to reset the circadian cycle, however, you will feel more tired, your insomniac's stress factor will triple, and most of all ... you will not benefit from the last REM-rich hours of sleep! Cutting down on sleep may be an unavoidable solution among those who experience DSPS and cannot free run their sleep

- Sleeping pills - pills change the sleep physiology and may affect the quality of sleep. As they often have little impact on modifying your actual circadian cycle, they can quickly become a serious addiction. Additionally, they will affect your short-term memory and reaction time. These are major enemies of a creative individual!

- Warm bath, quiet room, rituals, cup of milk, etc. - all these work to reduce the stress factor and slow down the brain. However, again that won't work well against the circadian cycle

- Drink milk, tryptophan is used in the synthesis of serotonin - this is again a method for a mild slow down with negligible effectiveness

- Do not nap - short naps have little influence on the circadian cycle and not napping may only have a residual homeostatic influence at the cost of evening alertness. It may help slightly but will not solve the problem

Few things can produce so much wasted time in highly effective people as trying to fall asleep at a time when your body does not want to! Do not listen to sleep advice based solely on methods for slowing down in the evening or making you mentally or physically tired! Do not go to bed until your body slows down on its own! Go to bed only then when you are really sleepy!

The real culprit in insomnia is the relationship of working hours to your circadian rhythm! This is magnified manifold by the associated stress factor. For many, insomnia produces an unsolvable vicious circle that just has to be lived with. However, everyone with a chance for a flex-time work system or telecommuting should realize that the greatest benefit of these may come from increased productivity as a result of better sleep that complies with natural body rhythms

A very specific degree of *morning misery* is needed to reset the clock sufficiently in people with DSPS. In the equilibrium state in which misery is sufficient to keep a regular schedule, the whole night sleep is cut substantially. Daily sleep deficit and daily struggle with tiredness results. In such circumstances, it is best to go to sleep right before the expected sleep hour! This way you can reduce stress, on one hand, and help your homeostatic component on the other (by making yourself tired for sleep).

If you cannot free run your sleep -- make your *morning misery* as regular as possible to reach the equilibrium state. Once you know the equilibrium, stick to your standard bedtime hour. *Morning misery* solution should only be used as a last resort!

There is yet a big question of weekends. Many people catch up on lost sleep during weekends. This naturally unbalances the system and results in the Monday Morning Blues. Sleeping it out on weekends, you should weigh up your pros and cons:

- on one hand you entrain your sleeping cycle to later hours and make it harder to stick to your *misery equilibrium*

- on the other, this is your only chance for quality sleep

There is no simple answer to the weekend dilemma! If you want to maximize the effects of sleep on learning, skills and experience, you would need to quantify how much you lose as a result on never actually getting enough sleep (the losses could be dramatic!) and how much you lose as a result of departing from the misery equilibrium on weekends thus tripling sleep disturbances early in the week

The most effective solution for people with persistent insomnia or work-schedule-related sleep deprivation is free running sleep! (see above)

Hypersomnia

Hypersomnia is excessive sleepiness in conditions of getting physiologically sufficient sleep. Hypersomnia may be related to serious health problems. If you suspect hypersomnia, consult your physician! There is a simple home-grown diagnostic method for the cause of your hypersomnia: try to free run your sleep for a week or so. Very often, the phase adjustment will resolve hypersomnia! Quite frequently, sleep initiated too early in reference to the circadian sleepiness will last very long and paradoxically result in the feeling of not being refreshed in the morning. If the circadian low comes in the middle of your day, you may experience overwhelming drowsiness, yet you will not be able to fall asleep for longer than 20-30 minutes and you will still wake up unrefreshed. Even buckets of coffee may not help in such circumstances. If you do not notice a significant improvement in the quality of sleep after 1-2 weeks of free running sleep, you may have a problem that will require a professional consultation. The most frequent cause of poor quality sleep is Obstructive Sleep Apnea (OSA) which affects up to 10% of male population (it is about half less frequent in women). OSA involves a loss of muscle tone in the throat and tongue areas. These structures tend to collapse during sleep and block the flow of air. As a result, the patient will wake up temporarily (often a hundred times in a single night) without completing the natural NREM-REM cycle. Patients with OSA wake up feeling unrefreshed. The simplest way to check for OSA is to ask one's bed partner for signs of interrupted breathing during the night. You can also videotape yourself when sleeping. Most often, OSA affects obese and heavily-snoring males. There are multiple support sites for OSA on the web (including recordings of snoring patients and typical signs of interrupted breathing)

Siesta and catnapping

The natural sleep cycle makes you feel less alert in mid-day. This period can easily be visualized using EEG measurements. In tropical countries this is the time for siesta. The drop in alertness is magnified by a rich meal and a short nap is likely to quickly bring you back to full alertness. However,

the industrial nations do not seem ready to adopt a healthy habit of postprandial nap. Just the opposite, when the Mexican parliament debated the law on statutory nap, politicians and comedians north of the border had a good laugh on "lazy Latin Americans". Even the self-improvement guru, Tony Robbins, blunders when providing his advice: *replace a nap urge with press-ups*. Press ups will improve circulation and raise the level of catecholamines, yet they won't budge the homeostatic sleepiness that can only be cleared effectively with a temporary transition to the sleep state!

There are few theories on the physiological purpose of the mid-day dip in alertness. Most people believe that humans, as all other highly developed tropical animals, have developed a siesta habit as a way of getting around the midday heat. This explanation has also some cultural background as napping is by far less popular in moderate and cold climate. However, the alertness dip can be resolved by a short nap in minutes. This can make us active again long before the mid-day heat is over.

Another explanation is that the alertness dip is an atavistic remainder of the polyphasic sleeping mode that might have characterized human ancestors. Many animals and young babies sleep many times during the day. This would seem quite advantageous considering the natural memory consolidation sequence. However, consolidating sleep into a single night rest period might have offered some evolutionary advantage. Early humans might have been less efficient in hunting and gathering activities at nighttime. This is why it might be advantageous to spend that time on memory consolidation while being awake in daylight. However, the circadian control system needed new variables that would enable the consolidation of sleep phases into a single period. Possibly, the consolidation went gradually from polyphasic sleep, through biphasic sleep to monophasic sleep in modern humans. Actually, similar consolidation can be observed as we get older. By the time of adulthood we are more or less monophasic with a clear dip in alertness that may be resolved with a nap. However, giving up the afternoon nap has not been documented as detrimental to learning. In a healthy individual who is not sleep deprived, the nap will usually last from 10 to 30 minutes, which may not be sufficient for any advantage to memory consolidation. There is naturally a substantial alertness boost which by itself my increase your learning performance in the evening. As we near retirement, we again seem to tend to be biphasic. This may be a result of the fact that working people are forced to suppress their biphasic tendency (not much data exists to support this hypothesis). In other words, it is possible that we remain strongly biphasic throughout the lifetime, and the monophasic model has been imposed as an industrial habit.

Here is a short summary of pros and cons of afternoon napping:

Pros:

- Siesta naps, rich in NREM sleep, result in a significant increase in alertness that will be highly appreciated by people in creative professions
- Napping may play a role in memory consolidation (this has not be proved one way or the other)
- Napping may be a way of combating severe sleep deprivation. Some people even prefer to sleep in two four hour portions throughout their lives!

Cons:

- Late naps may worsen insomnia and as such are often discouraged (see notes on insomnia above)
- Long naps (above 60 minutes) may result in temporary grogginess typical of awakening from Stage 4 NREM (so called *sleep inertia*). As a result, non-nappers and sleep-deprived people will often notice a decline in mental performance after a nap
- Long naps (above 60 minutes) can severely worsen insomnia. This is why so many sleep experts counter-recommend naps
- Napping requires good rest conditions, as well as solid napping skills and habits that may be difficult to develop for most people in industrial nations

Important! All the cons listed above do not apply to people with free running sleep except for the fact that naps may increase the tendency of the sleep phase to drift

Notable nappers include Winston Churchill, Napoleon, and J. F. Kennedy. Interestingly, this group also includes a famous long-sleeper, Albert Einstein and a famous short-sleeper Thomas Edison. Even Bill Gates admitted to taking naps under his desk in his creative programming years. You should not confuse the healthy concept of siesta with a very unhealthy idea of polyphasic sleep.

Dr. D. F. Dinges has spent many years investigating the problem of alertness at workplace and has shown substantial benefits, which napping can bring to professions where the alertness may be the difference between life and death. His research showed a substantial alertness boost coming from a nap [Dinges 1989]. He has also noticed relatively little impact of napping on the night-time sleep in regular nappers (see Fig 4):

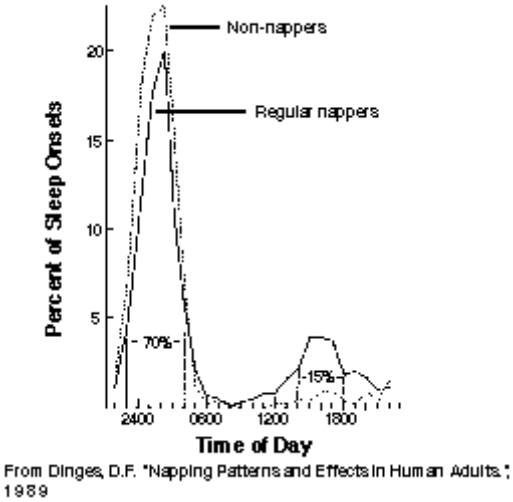

Fig. 4. Sleep onset times among nappers an non-nappers (percentage)

More and more companies in the US have already decided to make a switch from a coffee break to a napping break with special cubicles designed for nappers. In the future, this trend is likely to become more prominent as caffeine is not a fraction as effective as a nap in combating fatigue. Coffee, doughnuts, press-ups, and other methods taken together will never prove as efficient in mental restoration as a nap. At the same time, our society drifts strongly towards information processing where alertness is central to productivity. And when the productivity comes into the equation, US companies will definitely avail of the up-to-date research on napping.

Napping advice:

- Do not use the alarm clock! Contrary to popular belief, well-scheduled nap will not last longer than 20-30 minutes (at least in people with free running sleep)
- Measure exactly the optimum length of the period between the natural awakening and the nap to maximize the effectiveness of a nap (see Fig. 1). The nap should come at the nadir of alertness. Napping beginners often miss the right timing!
- Drink coffee or other caffeine drinks only **after** the nap
- You can drink alcohol in only very subtle doses, and the best timing is shortly before the nap (see below for more)
- If you nap for more than 40-50 minutes, you probably need more sleep in the night (check free running sleep section above!)
- Avoid stress 2-3 hours before your nap. Even things you love can make you excited and make it harder to avail of the benefits of napping
- Exercise is good. Try to finish your exercise at least 30-60 minutes before the nap
- Meal before the nap is recommended. Your main meal of the day should actually come right before the nap! This is usually 5-9 hours after awakening
- Sex before the nap is recommended
- Stick to your ritual (e.g. stick to your best sequence: exercise, bath, meal, beer, quiet place, nap, music, or similar)
- If the above advice does not work, you may need a month or so of training. Mental slow-down is critical here! Many people do not discover the

benefit of napping until some circumstances put them into the routine (e.g. heart condition diagnosis). Even if you cannot fall asleep, you may still need a nap! It may only be a result of habit or your inability to forget the worries of the day

- If it all won't make you fall asleep in 10 minutes even after a month of trying, you can probably safely give up napping for good

Learning during sleep

You may have heard of sleep tapes that offer effortless learning during sleep. Your investment in such tapes will not be money well spent. Learning during sleep should be discouraged! It is possible to occasionally recall a fraction of the material presented during sleep (probably only then when it enters your brain during short periods of transition from REM to temporary waking). There is also ample evidence that some circuits in the brain can be conditioned during REM sleep; however, the connection between the senses and the brain in sleep is rather focused on awakening in danger rather than on processing complex information.

Whatever you might gain from your sleep tapes will by far be offset by damage to the quality of sleep. If the learning stimuli do not reach a certain threshold, they will simply be ignored. However, past a certain value they may prevent the progression of NREM sleep toward stages 3 and 4. They can also shorten REM sleep.

Interestingly, memories acquired minutes before falling asleep do not get consolidated! Even a few minutes of sleep leave a short window of waking time with a complete memory erasure. Luckily, we rarely learn mission-critical information shortly before dozing off.

Counter-recommendation for learning during sleep, does not imply that falling asleep with TV or radio turned on should be discouraged. If you would like to get a dose of education yet before falling asleep, be sure your tapes, TV or radio meet these conditions:

- they turn off automatically no later than in 30 minutes

- they have no ability to wake you up from a properly timed sleep. If you wake up from initial minutes of sleep you may experience a dramatic shift in the homeostatic component that would delay the sleep onset (awakening may also indicate that you went to sleep too early in reference to your circadian cycle)

- they do not include highly emotional content, distressing messages, shrill sounds (doorbells, phones, timers and alarm clocks; these have all been designed to produce sounds that tend to most effectively rouse the central nervous system)

Moreover, if you find it difficult to fall asleep due to stresses of the day, subtle news channel may actually help you fall asleep by keeping your mind away from the thoughts that might trigger the release of ACTH, cortisol, catecholamines or other alertness transmitters.

TV, radio or tapes in the morning are OK too, on condition you turn them on manually (i.e. they should not work as an alarm clock substitute). If you wake up slightly ahead of your expected waking time, turn on the news and stay in bed. Test your brain for signs of sleepiness. Occasionally, you may still be able to fall asleep and go through one cycle of sleep that will be beneficial to your intellectual performance. Be sure that this does not become a routine, esp. if you are awakened early due to the pressure in the bladder[3]. Unless your urologist recommends otherwise, you should avoid drinking water and other liquids 2-3 hours before going to sleep

Alcohol

Alcohol is a major enemy of a creative individual! In excess it is highly toxic to the brain! Even small doses can reduce the quality and the total length your REM sleep. Alcohol also suppresses deep sleep, produces sleep fragmentation, and relaxes the upper airway muscles, which worsens snoring and severity of obstructive sleep apnea.

Apart from its negative impact on sleep, alcohol reduces your intellectual performance, and should be avoided at times of highly creative effort!

On the other hand, lots of research indicates that small doses of alcohol may benefit your health. Actually, a drink a day may be the simplest known method of preventing arteriosclerosis, heart attack and cerebrovascular disease. There are reports that moderate beer drinking may reduce the incidence of Alzheimer's. Some physicians recommend daily alcohol in very small quantities (not more than a drink per day).

To a highly creative individual, alcohol poses then a health-vs-brain dilemma. Certainly it should be avoided 3-5 hours before sleep and should be avoided 3-5 hours before intellectual work. This would leave place only for very moderate drinking at siesta time (assuming that this is the time you take a break from intellectual effort to take a nap or rest).

If you drink yourself to sleep (e.g. after a stressful day), you should remember that alcohol is quickly metabolized, and will produce an acetaldehyde rebound effect that will greatly increase chances of waking up during the night. This effect keeps alcoholics up at nights, deprives them from REM sleep, and may actually be responsible for delirium tremens (and perhaps even Korsakhof psychosis).

Assuming that a nap taken at siesta time does not play any significant physiological function, and only serves you as a springboard to higher evening alertness, a small drink before a nap may actually appear beneficial by producing the rebound effect at the time when you get up from the nap.

Caffeine

Caffeine is the number one drug used against sleepiness! 90% of Americans use it in some form. It can be found in coffee and coke, as well as in smaller quantities in chocolate and tea. It is addictive and acts via similar channels as amphetamines and cocaine.

As it has a profound effect on the central nervous system by blocking adenosine receptors, caffeine is widely used to tackle drowsiness. However, majority of people little realize that it works well in your struggle with the adenosine-related homeostatic component of sleepiness, while it is quite inefficient in overcoming circadian sleepiness! Moreover, used against the latter, it can actually be quite unhealthy!

If you abuse caffeine or use it at the time when your body clock tells you bedtime, you will only experience the symptoms that gave caffeine all that bad rap. These include: heart arrhythmia, irritability, overwhelming tiredness, depression, and a typical coffee abuser's "sickness in the stomach". No wonder the popular myth says that coffee is bad for health and can contribute to a heart disease.

The research on the health effects of caffeine does not seem to confirm its harmfulness. The link between coffee and heart disorders is very weak and may be attributed to caffeine abuse. Recent research has even found that 3-5 cups of coffee per day may maximize your lifespan (the same research was criticized for failing to notice that coffee is more popular in well-to-do households that favor longevity). You can assume that caffeine is harmless in smaller quantities 200-400 mg/day (equivalent of 2-4 cups of coffee). Note that 50% of Americans take more than that. **For caffeine to be truly harmless, it must be taken at the right time!**

As an arousal drug, caffeine may induce insomnia. This is why it should never be taken later than 6-7 hours before sleep. Caffeine half-life is about 6 hours for a healthy individual, but can vary substantially from person to person! Taken too late, caffeine will suppress REM sleep with detriment to memory consolidation. At the same time, when taken regularly early in the day, it may actually produce mild withdrawal effects and promote sleep!

The only time when coffee can be recommended is upon awakening!
Never drink coffee to overcome circadian sleepiness!

You can use coffee to accelerate your transition from sleep to full mental alertness. Current knowledge about caffeine supports the recommendation for a cup of coffee in the morning in otherwise healthy individuals (as black coffee can be harmful to the stomach lining, coffee should rather be drank with milk or with cream).

In regular nappers, the circadian rhythm should yet permit drinking coffee immediately upon waking up from an afternoon nap. For this, the following conditions should be met:

1. nap is taken at its natural timing (not later!)
2. the gap between nap time and night sleep is at least 7 hours long
3. there are no signs of sleep onset insomnia

Drinking coffee at times other than immediately upon awakening should be highly discouraged! Caffeine cannot serve as a weapon against sleep deprivation. Only sufficient night sleep can play that role. Caffeine should also not be used against the circadian sleep component. As argued throughout this article, circadian rhythm should best be left alone to run its course!

Caffeine tends to drive many people into a vicious circle: you drink it, you get a boost in adrenaline, you feel more energetic, you get a boost in dopamine, you feel better, you feel you can stay up late, you sleep less, you are more sleepy on the next day, so you need more caffeine, due to down-regulation you get less boost per cup, you increase the dosage, etc. etc.

Coffee drinkers may occasionally experience migraine-like headaches. These are caused by an increased activity of adenosine receptors on days when the supply of caffeine is less. This results in the dilation of blood vessels in the brain. Vasodilation or activation of purine receptors on sensory neurons produce the headaches. Half a normal dose of caffeine should help. Conclusion: if you want to go straight on coffee, do not go cold turkey. Allow of 3-4 days for your body to gradually fight off the addiction.

A rational approach to caffeine is: use it as a circadian enhancer! Small dose in the morning will shoot your alertness slope up and the regular intake will produce mild addiction that should help you fall asleep in the evening through mild withdrawal effect. This approach should be neutral to your health and positive to your alertness. **Never use caffeine to cover up for insufficient sleep!**

See also:

- How caffeine works (at howstuffworks.com)
- Behind the Buzz (caffeine at student.com)

- All you want to know about caffeine

- Caffeine FAQ

Sexuality

Sex before sleep is highly recommended! Sex works as a powerful hypnotic. If you practice sex without procreative intentions, positive influence of sex on sleep may be your number one excuse for sticking faithfully to your conjugal duties. Here is also a recommendation to stick with a single partner. Longevity studies show that healthy stable monogamous sex life is one of powerful life expectancy determinants. On the other hand, sex with your new great love is likely to disrupt sleep. Apart from a healthy dose of endorphins, it will also raise your catecholamines that may fragment sleep cycles. For the same reasons, promiscuous sex may also fail to play the expected hypnotic role.

Cigarettes

If you are a smoker, quit reading this article and jump to: QuitNet.org (do not miss: QuitNet Guide!).

Do you know that only 4% of users of SuperMemo are smokers (source)? Additionally, users who smoke spend much less time on learning with SuperMemo (an average of about 10 minutes per day as compared with the usual average of around 30 minutes). This is more related to the hormonal balance in the brain of a smoker than to smoking itself. Smokers simply do not have patience for SuperMemo and are less likely to be in-depth learners. Yet there are strong indications that those who quit smoking show improvement in their perseverance in repetitions! Yet one more reason to take a quitting step!

If you still cannot live without nicotine, *Nicorette* chewing gum may be the simplest over-the-counter way to tackle the addiction without the carcinogenic action of cigarettes. Still *Nicorette* may even be more addictive than cigarettes, and the short half-time of nicotine may result in overnight craving that disrupts sleep! (see: QuitNet.org)

Exercise

Aerobic exercise is a blessing for sleep. It may increase your demand for sleep even more than learning. The only downside of sports may come if these are overly exhaustive. Dehydration, stress, exhaustion, injuries and the like may reduce the quality of sleep. You must also remember to exercise no later than 30-60 minutes before siesta time and 3-4 hours before the night sleep. Exercise temporarily increases the level of catecholamines which makes you more alert and may keep you up at bedtime, esp. if you go to sleep early in reference to your circadian low. Later on, though, it will make your metabolism and body temperature drop below the baseline. This will promote sleep.

Exercise may be used as a strong zeitgeber. If you find it difficult to fall asleep in the evening, try early morning exercise in bright light (esp. sunshine). In ASPS, exercise in the evening may bring some relief too.

Exercise is known to enhance deep sleep and promote the nocturnal release of growth hormone, which has been found to stimulate memory consolidation via its impact on protein synthesis.

Exercise is likely to help you relieve snoring and obstructive sleep apnea (not only by promoting weight loss).

20 minutes of physical effort per day is considered a healthy minimum for everyone who wants to keep fit, sleep well, and show good long-term learning results.

Myths and facts

1. **Myth: Since we feel rested after sleep, sleep must be for resting.** Ask anyone, even a student of medicine: *What is the role of sleep*? Nearly everyone will tell you: *Sleep is for rest*. **Fact:** Sleep is for optimizing the structure of memories. If it was for rest or energy saving, we would cover the saving by consuming just one apple per night. To effectively encode memories, mammals, birds and even reptiles need to turn off the thinking and do some housekeeping in their brains. This is vital for survival. This is why the evolution produced a defense mechanisms against skipping sleep. If we do not get sleep, we feel miserable. We are not actually as wasted as we feel, the damage can be quickly repaired by getting a good night sleep. It is our brain dishing punishment for not sticking to the rules of intelligent life-form: let the memory do restructuring in its programmed time

2. **Myth: Sleep before midnight is more valuable. Fact:** Sleep is most valuable if it comes at the time planned by your own body clock mechanisms. If you are not sleepy before midnight, forcing yourself can actually ruin your night if you wake up early

3. **Myth: Sleeping pills can help you sleep better. Fact:** Sleeping pills can help you sleep, but this sleep is of far less quality than naturally induced sleep. Sleeping pills can be useful in circumstances where sleep is medically vital and cannot be achieved by other means. Otherwise, avoid sleeping pills whenever possible

4. **Myth: Avoid naps. Fact:** Naps may indeed worsen insomnia in people suffering from DSPS, esp. if taken too late in the day. Otherwise, naps

are highly beneficial to intellectual performance. It is possible to take naps early in the day without affecting one's sleeping rhythm. Those naps must fall before or inside the so-called *dead zone* where a nap does not produce a *phase response* (i.e. shift in the circadian rhythm)

5. **Myth: A nap is a sign of weakness. Fact:** Nap is not a sign of weakness, ill-health, laziness or lack of vigor. It is a philogenetic remnant of a biphasic sleeping rhythm. Not all people experience a significant mid-day slump in mental performance. It may be well masked by activity, stress, contact with people, sport, etc. However, if you experience a slump around the 5th to 8th hour of your day, taking a nap can dramatically boost your performance in the second half of the day

6. **Myth: People are of morning or evening type. Fact:** This is more of a misnomer than a myth. Evening type people can easily be made wake up with the sun by means of chronotherapy. What people really differ in is the period of their body clock and its sensitivity to zeitgebers (e.g. light, activity, stress, etc.). People with an unusually long natural day and low sensitivity to resetting stimuli will tend to work late and wake up late. Hence the tendency to call them "evening type". Those people do not actually prefer evening, they simply prefer longer working days

7. **Myth: People who sleep less live longer.** In 2002, Dr Kripke compared the length of sleep with longevity (1982 data from a cancer risk survey). He figured out that those who sleep 6-7 hours live longer than those who sleep 8 hours and more. No wonder that a message started spreading that those who sleep less live longer. **Fact:** The best longevity prognosis is ensured by sleeping in compliance with one's natural body rhythm. Those who stick to their own good rhythm often sleep less because their sleep is better structured (and thus more refreshing). "Naturally sleeping" people live longer. Those who sleep against their body call, often need to clock more hours and still do not feel refreshed. Moreover, disease is often correlated with increased demand for sleep. Infectious diseases are renowned for a dramatic change in sleep patterns. When in coma, you are not likely to be adding years to your life. Correlation is not causation

8. **Myth: Alarm clock can help regulate sleep rhythm. Fact:** Alarm clock can help you push your sleeping rhythm into your desired framework, but it will rarely help you accomplish a healthy sleeping rhythm. The only tried-and-true way to accomplish a healthy sleep and a healthy sleep rhythm is to go to sleep only then when you are really sleepy, and wake up naturally without external intervention

9. **Myth: Night shifts are unhealthy. Fact:** People working in night shifts are often forced out of work by various ailments such as a heart condition. However, it is not night shifts that are harmful. It is the constant switching of the sleep rhythm from day to night and vice versa. It would be far healthier to let night shift people develop their own regular rhythm in which they would stay awake throughout the night. It is not night wakefulness that is harmful. It is the way we force our body do things it does not want to do

10. **Myth: Being late for school is bad. Fact:** Kids who persistently cannot wake up for school should he left alone. Their fresh mind and health are far more important. Parents who regularly punish their kids for being late for school should immediately consult a sleep expert as well as seek help in attenuating the psychological effects of the trauma resulting from the never ending cycle of stress, sleepiness and punishment

11. **Myth: Being late for school is a sign of laziness. Fact:** If a young person suffers from DSPS, it may have perpetual problems with getting up for school in time. Those kids are often actually brighter than average and are by no means lazy. However, their optimum circadian time for intellectual work comes after the school or even late into the evening. At school they are drowsy and slow and simply waste their time. If chronotherapy does not help, parents should consider later school hours or even home-schooling

12. **Myth: We can sleep 3 hours per day.** Many people enviously read about Tesla's or Edison's sleeping habits and hope they could train themselves to sleep only 3 hours per day having far more time for other activities. **Fact:** This might work if you plan to party all the time. And if your health is not a consideration. And if your intellectual capacity is not at stake. You can sleep 3 hours and survive. However, if your aspirations go beyond that, you should rather sleep exactly as much as your body wants. That is an intelligent man's optimum. With your improved health and intellectual performance, your lifetime gains will be immense

13. **Myth: We can adapt to polyphasic sleep.** Looking at the life of sailors, many people believe they can adopt polyphasic sleep and save many hours per day. In polyphasic sleep you take only 4-5 short naps during the day totaling less than 4 hours. There are many "systems" differing in the arrangement of naps. There are also many young people ready to suffer the pains to see it work. Although a vast majority will drop out, a small circle of the most stubborn ones who survive a few months and will perpetuate the myth with a detriment to public health. **Fact:** We are basically biphasic and all attempts to change the inbuilt rhythm will result in loss of health, time, and mental capacity. A simple rule is: when sleepy, go to sleep; while asleep, continue uninterrupted. See: The myth of polyphasic sleep

14. **Myth: Going to bed at the same time is good for you. Fact:** Many sleep experts recommend going to sleep at the same time every day. Regular rhythm is indeed a form of chronotherapy recommended in many circadian rhythm problems. However, people will severe DSPS may simply find it impossible to go to sleep at the same time everyday. Such forced attempts will only result in a self-feeding cycle of stress and insomnia. In such cases, the struggle with one's own rhythm is simply unhealthy. Unfortunately, people suffering from DSPS are often forced into a "natural" rhythm by their professional and family obligations

15. **Myth: Silence and darkness are vital for sleep.** This may be the number one advice for insomniacs: use your sleeping room for sleep only, keep it dark and quiet. **Fact:** Silence and darkness may indeed make it easier to fall asleep. They may also help maintain sleep when it is superficial. However, they are not vital. The most important factor that makes us sleep well, assuming good health, is the natural circadian rhythm. People who go to sleep along their natural rhythm can often sleep well in bright sunshine. They can also show remarkable tolerance to a variety of noises (e.g. loud TV, family chatter, outside the window noise, etc.). If you suffer from insomnia, focus on understanding your natural sleep rhythm. Peaceful sleeping place is secondary. Insomniacs running their daily ritual of perfect darkness, quiet, stresslessness and ship-counting are like a stranded driver hoping for fair winds instead of looking for the nearest gas station

16. **Myth: People who sleep less live longer.** Not so long ago, Dr Kripke compared the length of sleep with longevity. He figured out that those who sleep 6-7 hours live longer than those who sleep 8 hours and more. No wonder that a message started spreading that those who sleep less live longer. **Fact:** The best longevity prognosis is ensured by sleeping in compliance with one's natural body rhythm. Those who stick to their own good rhythm often sleep less as their sleep is better structured and more refreshing. No wonder they live longer. Those who sleep against their nature, often need to clock more hours and still do not feel refreshed. Moreover, disease if often correlated with increased demand for sleep. When in coma, you are not likely to be adding years to your life

17. **Myth: The body will always crave excess sleep as it craves excess food.** Some people draw a parallel between our tendency to overeat with sleep. They believe that if we let the body dictate the amount of sleep, it will always ask for more than needed. As a result, they prefer to cut sleep short with alarm clock to "optimize" the amount of sleep they get. **Fact:** Unlike storage of fat, there seems to be little evolutionary benefit to extra sleep. Probably, our typical 6-8 hours of sleep are just enough to do all "neural housekeeping". People with sleep deficit may indeed tend to sleep obscenely long. However, once they catch up and get into the rhythm, the length of their sleep is actually likely to decrease

18. **Myth: Magnesium, folates, and other supplements can help you sleep better. Fact:** Nutrients needed for good health are also good for sleep. However, supplementation is not likely to play a significant role in resolving your sleep problems. Vitamins may help if you are in deficit, but a vast majority of sleep disorders in the society come from the lack of respect or understanding of the circadian rhythm. If you are having problems with sleep, stick to the rules presented in this article. As for food, stick to a standard healthy diet. That should suffice

19. **Myth: It is best to wake up with the sun. Fact:** You should wake up at the time when your body decides it got enough of sleep. If this happens to be midday, a curtain over the window will prevent you from being woken up by the sun. At the same time sun may help you reset your body clock and help you wake up earlier. People who wake up naturally with the sun are indeed among the healthiest creatures on the planet. However, if you do not wake up naturally before 4 am, trying to do so with the help of alarm clock will only add misery to your life

20. **Myth: Sleeping little makes you more competitive.** Many people are so busy with their lives that they sleep only 3-4 hours per night. Moreover, they believe that sleeping little makes them more competitive. Many try to train themselves for minimum sleep. Donald Trump, in his newest book, tells you: "*If you want to be a billionaire, sleep as little as possible*". **Fact:** It is true that many geniuses slept little. Many business sharks slept even less. However, the only good formula for maximum long-term competitiveness is via maximum health and maximum creativity. If Trump sleeps 3 hours per night and enjoys his work, he is likely to run it on alertness hormones (ACTH, cortisol, adrenaline, etc.). His sleep is probably structured very well and he may extract more neural benefit per hour of sleep than an average 8-hours-per-night sleeper. Yet that should not make you try to beat yourself to action with an alarm clock. You will get shortest and maximum quality sleep only then when you perfectly hit your circadian low-time, i.e. when your body tells you "now it is time to sleep". Sleep in wrong hours, or sleep interrupted with an alarm clock is bound to undermine your intellectual performance and creativity. Occasionally, you may think that a loss on intellectual side will be counterbalanced with the gain on the action side (e.g. clinching this vital deal). Remember though, that you also need to factor in the long-term health consequences. Unless, of course, you think a heart attack at 45 is a good price to pay for becoming a billionaire

21. **Myth: You cannot change the inherent period length of your body clock. Fact:** With various chronotherapeutic tricks it is possible to change the period of the clock slightly. It can be reset or advanced harmlessly by means of melatonin, bright light, exercise, meal timing, etc. It can also be reset in a less healthy way: with an alarm clock. However, significant lifestyle changes may be needed to resolve severe cases of DSPS or ASPS. The therapy may be stressful, and the slightest deviation from the therapeutic regimen may result in the relapse to an undesirable rhythm. Those who employ free-running sleep may take the easiest way out of the period length problem: stick to the period that is the natural outcome of your current lifestyle

Summary

- Sleep is important for learning! Sleep deprivation results in intellectual deprivation!

- Sleep as much as you feel you need (why?)

- Avoid alarm clocks (why?)
- Forget about trying to fall asleep at pre-planned time! Let your body decide! (why?)
- Forget about trying to fall asleep quickly! If your body decides it is the right time, it will come naturally! (why?)
- Do not try to make yourself sleepy! It is enough you stay awake and keep on working/learning long enough! (why?)
- It is much better to eliminate the source of stress rather than to try to forget stressful situations right before the bedtime!
- Learn the details of your sleep timing (how many hours you sleep, how many hours before you need to take a nap or go to sleep again, etc.). Use this knowledge to optimize your schedule (why?)
- Adjust the timing of intellectual work to your circadian cycle (see Fig. 5)
- Stick with good people! The bad lot will often ruin your slumber
- Be careful with caffeine. Drink coffee only upon awakening (or after a nap if you take one)
- Do not go beyond a single drink of alcohol per day. Drink it at siesta time
- Quit smoking!
- Use siesta time for a nap if you find it helpful
- If you cannot fall asleep in 30 minutes, get up! You are not yet ready for sleep! (why?)
- If you experience racing thoughts at the time when your body calls for sleep, the best method is: get up and use ... SuperMemo for 30 minutes! Few other activities can be equally taxing to your tired brain (do not expect this to work before your circadian timing though)
- If you sleep it out and still not feel refreshed, be sure you do not sleep against your circadian rhythm. Try free running sleep. Remember that you may need 1-2 weeks to synchronize all bodily functions before this starts working!
- If you cannot get refreshing sleep even in free-running conditions after at least a month of trying, consult a sleep specialist (see: Sleep Disorders). Remember, however, that a bad night is a factor of life. Few can avoid it. Do not get alarmed even if it happens weekly

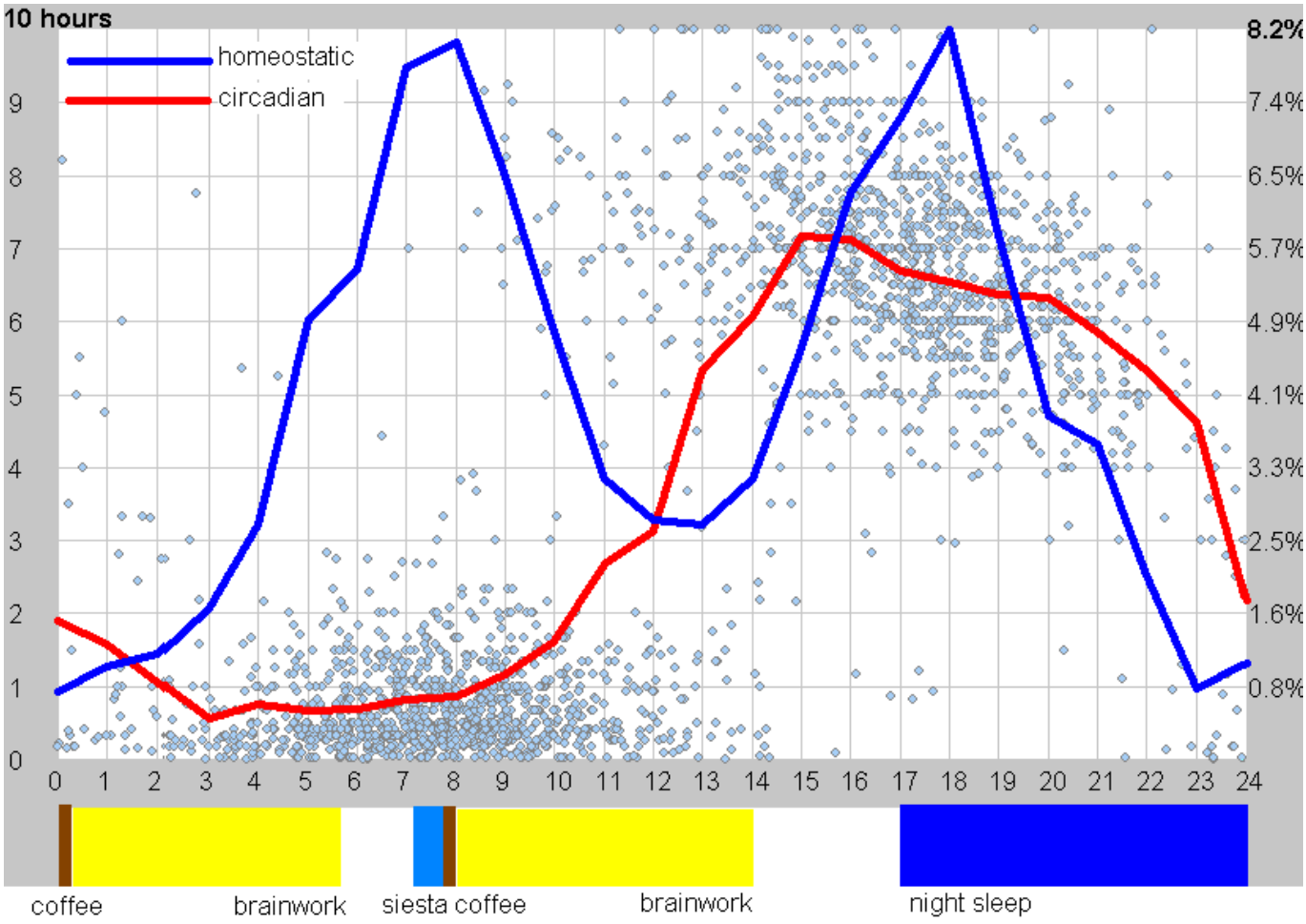

Fig.5. **Optimizing the timing of brainwork with respect to the circadian cycle**. This exemplary graph was generated with the help of *SleepChart* on the basis of 3-year-long daily measurements of a free-running sleep rhythm. The horizontal axis expresses the number of hours from awakening (note that the free running rhythm period is often longer than 24 hours). **Homeostatic** sleepiness can roughly be expressed as the ability to initiate sleep. Percent of initiated sleep blocks is painted as a thick blue line (right-side calibrations of the vertical axis). **Circadian** sleepiness can roughly be expressed as the ability to maintain sleep. Average length of initiated sleep blocks in painted as a thick red line (left-side calibrations of the vertical axis). Adenosine-related **homeostatic** sleep propensity increases in proportion to mental effort and can be partially cleared by caffeine, stress, etc.. **Circadian** component correlates (1) negatively with temperature, ACTH, cortisol, and catecholamines, and (2) positively with melatonin and NREM propensity. Optimum timing of brainwork requires both low homeostatic and circadian sleepiness. There are two quality alertness blocks during the day: first after the awakening and second after the siesta. Both are marked yellow in the graph. For best learning and best creative results use these yellow blocks. Caffeine can only be used to enhance alertness early in this optimum window (brown color). Later use will affect sleep (caffeine half-life is about six hours). Optimum timing of exercise is not marked as it may vary depending on the optimum timing of zeitgebers (e.g. early morning for DSPS people and evening for ASPS people). Gray dots are actual sleep block measurements with timing on the horizontal, and the length on the vertical axis.

Important! This data refer solely to free running sleep. If you use an alarm clock to regulate your sleep timing, this measurements may not apply! In addition, timing and the amplitude of changes differ between individuals.

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Footnotes

1. one of the visitors to this site reported having a string of sleepless nights that lasted five weeks and ended in hospitalization as a result of going cold turkey on Paxil - a popular antidepressant
2. there are reputable researchers who find it difficult to reconcile learning with unconscious states. See Dr Robert Vertes 2000:"there appears to be little evidence to support a role for memory consolidation in sleep" and "A review of REM deprivation studies shows these reports to be equally divided in showing that REMD does, or does not, disrupt learning". See also: Prof. Jerome M. Siegel website
3. some sources claim that it is only an illusion that bladder pressure wakes us up in adulthood. In reality, only upon waking we start perceiving the pressure (which seems as the pressure had to be the reason for waking up)

Links

- A culture of sleep bulimia
- Sleep-dependent memory consolidation by Robert Stickgold (Nature, Oct 2005)
- Optimization of shift-work scheduling
- The Medical Basis of Stress, Depression, Anxiety, Sleep Problems, and Drug Use
- Sleep and Dreaming by Jerome M. Siegel (opponent of the role of sleep in learning)

- The REM sleep memory consolidation hypothesis by Jerome M. Siegel (opponent of the role of sleep in learning)
- Sleep Disorders at About.com
- Sleepnet.com
- Sleep Medicine links
- How much do animals sleep?

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