

## Understanding Sleep Debt

Reduced amounts of sleep over several consecutive days have a cumulative effect – a phenomenon known as “Sleep Debt.” As sleep researchers like to say, it is rather like your bank balance; it is easier to make withdrawals than deposits in your sleep bank. However like all appealing metaphors, one can take the analogy too far. We have seen respected sleep experts testify that humans accumulate sleep debt in a manner that demands that every hour of debt be repaid at some point in time with an extra hour of sleep. This makes appealing but dangerously erroneous testimony.

It is generally agreed upon that each individual has a daily sleep requirement. This is the amount of sleep that a given person needs to function through the day at what is colloquially referred to as “100%.” Sleeping for any amount shy of the sleep need will result in some form of fatigue, varying from very minor fatigue to severe fatigue depending on the extent of the sleep deprivation and other factors. Sleep need can vary significantly from person to person but most people need somewhere between 7 and 8 hours per day. If a person’s sleep on a given day is short of his or her sleep need, the amount by which it is short is commonly referred to as a sleep debt. So if a fully rested person’s sleep need is 8 hours, and that person only sleeps 6 hours, the sleep debt would be 2 hours.

Some sleep researchers advocate the strict banking system—that for every hour of sleep we shortchange ourselves we must make it up by sleeping an extra hour. This argument is largely based on studies that rely upon a measurement known as the Psychomotor Vigilance Test, or PVT. The PVT is a very monotonous 10-minute test that repeatedly measures reaction times to a sustained attention task. The PVT is trumpeted for being immune to biases caused by aptitude or a learning curve that can affect the results of other types of performance testing. While this is a great attribute for a research instrument, this mere fact should suggest caution. You have to ask yourself what real world task that a potentially fatigued operator might perform – driving a truck, flying a plane – is uninfluenced by aptitude or experience?

While it is true that very small changes in sleepiness can be detected by such tests, when you look at the data more carefully the relationship is not so straightforward. What really matters is the relationship between sleepiness level and actual risk of having an accident or making an error. That relationship turns out to be very non-linear because people compensate for most minor to moderate levels of fatigue impairment.

Furthermore, the one-for-one sleep debt repayment argument also fails to recognize research evidence that shows a sleep deprived person sleeps more deeply during recovery sleep, and hence sleep debt can be paid back more quickly than at a one-to-one pace. Numerous studies indicate that most sleep deprived individuals can recover from sleep debt after two

consecutive nights of high-quality sleep that extend beyond the ordinary sleep need. Even a nap can reverse a considerable amount sleep debt.

We are frequently involved in cases where opposing experts have tracked a worker's schedule back over a period of a month or more, and calculated an enormous sleep debt based on the worker's assumed sleep need and consistent failure to meet that need. In these instances, it is necessary to refute these claims by explaining the plethora of evidence countering that stance and speaking to the experiences of the jurors, who have themselves experienced periods of sleep deprivation and will likely find it hard to believe in the theory that every hour lost must be strictly repaid to the sleep bank.