

Functions of Sleep

by Richard H. Hall, 1998

Necessity

It goes without saying that sleep is important. We all know this from the fact that, when deprived of sleep, we are strongly motivated to do it. There is also more powerful evidence that sleep is important from animal studies, which indicate that an animal deprived of sleep will eventually die. In addition, a human disease called **fatal-familial insomnia**, as the name implies, causes an inability to sleep in humans and is, eventually fatal.

In particular, it appears that REM and stage 4 sleep are especially important stages. There are at least three lines of evidence that support the contention that REM is a particularly important stage of sleep. First, when one is deprived of sleep, a phenomenon called **REM rebound** often occurs. This refers to the fact that, while the sleeper may not make up all the sleep that was lost, she or he will often make up the REM. The percentage of REM sleep will increase to compensate for the loss of REM. A second piece of evidence that supports the importance of REM comes from **REM deprivation** studies. In REM deprivation experiments, subjects are awoken once they show physiological signs of REM, and then compared with other subjects awoken during other stages of sleep. Those deprived of REM are found to perform more poorly on cognitive tasks. A third piece of evidence that points to the importance of REM is research that indicates that during intense periods of mental activity the percentage of REM sleep increases, for example for students during finals week.

"Brain vs. Body"

(note: When I use the term "body" in this section, I mean the body, besides the brain, despite the fact that the brain is, of course, a part of the body. As we will learn this distinction is important when considering the function of sleep.)

Despite the fact that researchers know that sleep is an important necessity, the reason that this is true is not so clear. For example, although death can result from sleep deprivation as described above, the actual physiological mechanism is largely unknown.

It would seem logical to most of us that sleep would play a role in rest and restoration of our body. However, the evidence from sleep deprivation studies with humans doesn't support this logical assumption. For example, it does not appear, surprisingly, that a lack of sleep significantly interferes with one's ability to exercise. Further, the typical physiological correlates of the "stress response" do not occur when a human is deprived of sleep.

On the other hand, evidence is beginning to accumulate that indicates that the function of sleep is not to restore the "body", but rather to rest and restore the "brain". First, this is supported by behavioral evidence from sleep deprivation studies. While subjects may be

able to exercise effectively, and while they may not exhibit a stress response, their cognitive function is impaired. In addition (as most of us know from experience) their mood becomes more negative. With respect to the physical brain itself, cerebral blood flow studies indicate that blood flow to the brain decreases dramatically during delta sleep. Moreover, the areas that are most active during waking are those to which the flow is decreased the most. This suggests that those areas of the brain may in effect be "resting" during sleep (Figure 1 is a summary of the mind vs. body need for sleep.)

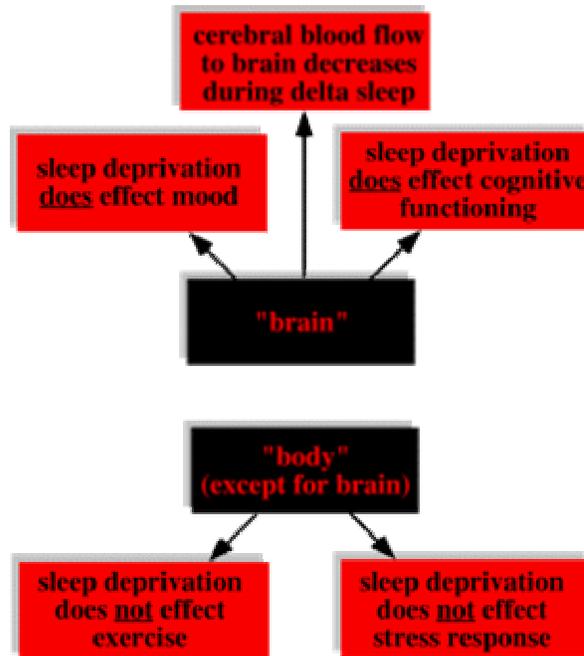


Figure 1. "Brain" vs. "Body" in Need for Sleep