Overview of the function of sleep

Sleep is a complex physiological process that occurs in some extent in all animals, indicating its physiological importance. Sleep plays an important and intrinsic role in many behavioral and physiological functions. However, although sleep is important and is critical and exists within every living things life, it still remains unknown what the function and purpose of sleep is, and whether it serves a single role in our lives or if it has multiple. Nonetheless, it is quite evident that sleep is essential for many vital functions included development, cognition, performance, and survival. I propose that although sleep may have many functions, its most significant and compelling function seems to be involved with the idea of maintaining a homeostatic state. Sleep's purpose in short, is to repair and maintain the bodies' state of well-being through a variety of factors, to aid and promote the survival of species.

Sleep has been characterized in many species ranging from very anatomically and physiologically complex to much simpler creatures. Such species range from humans and birds to even worms. The classic definition of sleep that we have is generally based upon physiological and observable characteristics seen within mammals. Such mammalian characteristics include reduced movement of the body and electrical activity, reduced or no responsiveness to external stimuli, reduced breathing rates, and shut eyes. In non-mammalian creatures however, partly due to the lack of technology and information to study such, wakefulness and sleep is often measured by simpler parameters such as by rest and relaxation. Overall, our definition of sleep relies heavily on metabolism and activity in relation to the electrical signals of our brains obtained via electroencephalogram, or EEG. The states

of sleep are typically determined in animals by muscle activity levels in both the EMG, or electromyogram, and EEG recordings. Our states of sleep are usually more discernable than in lower animals, including more specific characteristics of electroencephalogram architecture. For instance, human sleep is classified within 3 defined sub states of NREM, or non-rapid eye sleep, including N1, N2 and N3 sleep. These NREM states are associated with slower EEG waves and an increasing depth of sleep; in addition to REM, or rapid eye movement. Sleep within us cycles between the stages of NREM sleep and REM sleep for approximately an hour and a half (90 min) and about 4 or 5 times during the night. Typically, human sleep is light in the beginning and continues to deepen as you progress through the stages, making you less and less unconscious and unreactive to external factors as you approach REM sleep.

It’s evident and clear to say that sleep is important. We can all agree so from the fact that, when deprived and in need of sleep, we are strongly motivated to engage it. There is also more compelling evidence from animal sleep studies, which indicate that an animal deprived of sleep will eventually perish. In particular, it appears that stage 4 and REM sleep are especially important stages. There is strong evidence that support the debate that rapid eye movement is a particularly important stage of sleep. Evidence shows that when an individual is deprived of sleep, a phenomenon called REM rebound often occurs. This can be explained as that although a sleeper may not recuperate all the lost sleep they have, he or she will often make up the REM. In REM rebound the amount of time in REM sleep will increase to compensate for the loss of REM lost from the nights of insomnia or inability

to sleep. Another 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, thus depriving them of it. Those subjects deprived of REM were found to perform less efficiently and more poorly on cognitive tasks when compared to the control group. Additionally, more evidence pointing to REMs importance is research that indicated that during intense periods of mental activity, the amount of REM sleep occurring during sleep increases.

There are many possible theories of why we sleep. The evolutionary or adaptive theory, suggests that the inactivity when we sleep is an adaptation serving as a survival function by keeping animals out of harms at times when they are particularly vulnerable. This theory proposes the idea that if animals remained quiet and still during these periods of vulnerability, they had/have an advantage over other animals who remain active. These animals, inactive and resting, weren't hunted nor killed during sleep. Through natural selection, this behavioral strategy supposedly evolved to what we now recognize as sleep. Another theory which seems to be related to the prior is the theory that we sleep for the purpose of energy conservation. Its grounded on the idea that one of natural selections strongest factors is the competition for and efficient use of energy resources. This theory of energy conservation suggests that the principle function of sleep is the reduction of one's energy demand and expenditure throughout the day and night, especially during times when it's least efficient to search for food or other resources. It has been shown through research that energy metabolism is greatly reduced during sleep in humans and even more significantly in other

species. For instance, caloric demand, as well as body temperature, decreases during sleep, compared to when one is awake. This provides evidence that supports the theorem that one of the primary functions of sleep is to help organisms, such as ourselves, to conserve their energy resources. Lastly another theory and the one which seems the most compelling is the theory that the function of sleep is for restoration and maintaining a homeopathic state. This theory is based on the long-held belief that sleep in some way serves to restore what the body has lost while awake. Sleep provides the body the opportunity to rejuvenate and repair itself. The evidence is strong as that much human and animal research is done in relation to this theory. The most striking evidence being that observed in animal studies, in that animals that were deprived almost entirely of sleep succumbed to a wide variety of complications and issues that arose as a result of such a lack of sleep. These animals lost all immune function and died in just a matter of weeks. This is supported further by the findings that many restorative functions in the body like tissue repair, growth hormone secretion, muscle growth, and protein synthesis occur mostly, or in some cases only, during sleep.

Some might argue that the restoration theory of sleep might be inferior to other theories and that restoration isn’t the primary function of sleep. Evidence shows that NREM sleep is important for the restoration of many physiological functions, whereas in REM, such restoration doesn’t occur nearly as much. This makes a valid point, in that REM sleep is a very significant and important factor in our sleep cycle, so far as to even help define our ideas about what is sleep, so why is that such a level of

restoration doesn’t continue into REM sleep? REM wouldn’t occur if it wasn’t essential and important to our well-being, but we know that physiological restoration doesn’t occur during that stage, allowing possible critics to comment that restoration must not be the function of sleep because it doesn’t occur continuously and throughout the night, which would ideally make the most sense and be most beneficial, knowing what occurs within and to our bodies each and every day and how important the process is for maintaining good health and well-being for survival. Others might argue in favor of other theories such as the energy conservation or adaptivity theory because they too seem to be logical and possible functions of sleep. Both theories are strong because they are grounded on the principle of natural selection and years of evolution. If sleep didn’t serve a role as protection from predators and didn’t conserve energy in order to survive, many organisms would be vulnerable to predators and many smaller, prey species that we see today would most likely cease to exist. That being the case, it’s evident that sleep does indeed play a crucial role for the survival of many creatures because it protects them and helps them avoid being injured and predation. There is indeed strong evidence that there might be an ecological relevance to sleep.

In contrast however, this theorem has its faults. Several things make the energy conservation and ecological theories insufficient to explain sleep functions. These theories base sleep in regards too similar to hibernation, in that it is done selectively for energy savings. However, against expectation, it has been shown that animals coming out of torpor experience a sleep rebound, suggesting some type deprivation of sleep. In addition, whereas

NREM sleep might be associated with decreased energy expenditure, REM sleep is often most associated with increased oxygen consumption of the whole body. Overall, considering that its plausible that energy savings are involved in the selection of sleep at earlier in the evolution process or in specific species such those with high energy demands, it is somewhat not likely to be of primary importance in explaining its maintenance in all species. Whereas in the theory that the function of sleep is restorative, a massive strength lies in that it is applicable to all organisms, in that all organisms are cellular carbon-based life, where cellular restoration is vital and necessary for the continuity and development of life on this planet.

It goes without saying that sleep is as essential to life as food and water, yet it is not completely clear as to what its function is and why such a process continues to be a requirement for survival that has maintained throughout evolution. There are many possible reasons and theories as to why, but it goes without saying that the function of sleep includes recovery, recuperation, and maintenance of cells and vital system functions on a degree of levels. Nevertheless, as advancements in technology and research continue to arise rapidly, our understanding and knowledge of the functions of sleep will further expand, hopefully in the near future.

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