## Discuss two theories relating to the function of sleep

Although much is known about *how* we sleep, there is less understanding about *why* we sleep. There are two main theories; namely the restoration theory proposed by Oswald (1966) and the evolutionary theory (ET) of sleep. The restoration theory suggests that sleep is essential to restore any physiological processes that are degraded through use during the day. Sleep helps to restore the homeostatic balance of the body. Oswald (1980) stated that REM sleep was necessary for brain repair through the stimulation of protein synthesis and NREM sleep restores bodily processes which have deteriorated during the day. Many restorative processes such as digestion, removal of waste products and protein synthesis do appear to occur during sleep. The restoration theory suggests different functions for the stages of sleep. For example, patients who survive drug overdoses and withdrawal, and other brain 'insults' (such as intensive electroconvulsive therapy), experience increases in REM sleep. These increases are consistent with the estimated time for the half-life of proteins in the brain, that is, in a six-week period, about half the brain's total protein is replaced and this is the approximate length of the increased REM period.

Evolutionary theory (ET) less readily explains the need for these different stages of sleep. Like restoration theory, the ET suggests that sleep serves some restorative function as a method for animals to conserve energy. In this way, sleep is similar to hibernation. However, the ET goes further by stating that sleep also helps to protect us at night when we might be vulnerable to predators. Sleep is thus an evolutionarily stable strategy which increases individual, and in turn species, survival. The ET predicts that animal species should vary in their sleep needs depending on how much time they need to search for food each day and how safe they are from predators when they sleep.

The restoration theory of sleep seems to make more cognitive sense than the ET since we all have the experience of feeling tired prior to sleep and refreshed on awakening. With regard to the ET of sleep, it doesn't seem to make sense that as complicated a process as sleep has evolved to ensure safety from predators. Merely remaining still would surely serve the same purpose.

Sleep deprivation studies have been cited as evidence of the restoration theory. Animal studies have shown that sleep, particularly REM sleep, is essential for proper functioning. Human studies have also demonstrated that cognitive deficits can occur as a result of total sleep deprivation and the phenomenon of REM rebound, whereby sleep-deprived participants experience more REM sleep on subsequent nights, supports restoration theory. However, such participants don't make up all the hours that they have lost, suggesting that sleep may not be entirely a process for restoration and repair. Similarly, there are case studies of people who manage to lead perfectly 'normal' lives with very short periods of sleep each night (1–2 hours). Such studies suggest that sleep may serve some other purpose or indeed may be an 'evolutionary hangover'.

The restoration theory can explain why babies have a far higher proportion of REM sleep. During their first year, babies sleep for about 18 hours per day. It's suggested that they need this to help with their synaptic growth. The ET, on the other hand, explains the same evidence as a period that allows parents' time to recover and conserve the energy they have expended through looking after their infants.

Findings from animal research are relevant to both theories. The restoration theory would predict that animals that expend a lot of energy during the day should sleep for longer periods. This does not appear to be the case. For example, giant sloths appear to exercise little during the day and yet sleep for about 20 hours per day. Such evidence is

also not readily explained by the ET. According to the ET's predation argument, animals which are likely to be preyed upon should sleep more than predators since sleep serves to hide them from predators. The ET accounts for this with the suggestion that metabolic differences affect sleep levels. Many prey species such as herbivores have to graze for long periods in order to gain sufficient nutrients and therefore have less time to sleep. Another aspect of the ET is the claim that the size of an animal is related to total sleep time. Animals with high metabolic rates (e.g. squirrels) expend a lot of energy and thus need more time for sleep. Larger animals with slower metabolic rates therefore sleep less. The second strand of this argument shares some similarities with the restoration theory. Indeed, Horne (1988) proposed that energy conservation is a major function of sleep in smaller mammals such as rodents. The animal evidence appears to more readily support the ET.

Horne (1988) later produced a weaker version of the 'evolutionary theory'. He distinguished between 'core' sleep, which he believed was essential for restoration processes, and 'optional' sleep, whose main purpose was energy conservation. This proposal is also supported by the REM rebound phenomenon and the fact that not all the hours lost due to sleep deprivation are regained, suggesting that the later rebound has no physiological function.

Empson (1993) concludes the debate as to the purpose of sleep by stating that: 'sleep appears to be ubiquitous and necessary… it is difficult to believe that it does not have an important function and the restorative theories provide a coherent account of what this might be'.