The Effects of Sleep Deprivation

Sleep can be observed in mammals, birds and reptiles. This had led many researchers to ask themselves what its function is. One way of finding out what sleep is for is to deprive humans and other animals of sleep and see what the effects are.

Animal Studies

Animals that are deprived of sleep for long enough eventually die. This appears to indicate that sleep is necessary for normal biological functioning.

Rechtschaffen & Bergman (1995)
Aim: to show the effects of sleep deprivation in animals.
Sample: rats.
Design: laboratory observation, longitudinal.
Method: rats were completely deprived of sleep for a period of four weeks. During this time, observations were made of appetite, body weight, metabolic activity and brain activity.
Result: the rats started to eat more, but at the same time to lose weight. Body temperature rose and metabolic rate increased. After 2 weeks, weight loss was very marked, despite increased food intake, and body temperature had become unstable. At this point, the thyroid gland failed and metabolic rate dropped. Within three weeks, the rats were showing signs of immune failure and most had died after four weeks of continuous sleep deprivation.
Conclusion: sleep appears to be necessary for the maintenance of life. Without it, the body has to work harder than usual just to keep going – this was shown by the way metabolic rate and food intake increased in the rats. Sleep may have a role to play in immune functioning, as it was immune failure that led indirectly to the death of most of the rats.

There are some problems with the results of studies like this:

- Rats and humans are biologically rather different, so what is true of rats may not be true of humans. In other words, it may not be possible to generalise across species in this way.
- The results of this study may be due to stress, not sleep deprivation. The procedures used to keep the rats awake may have been highly stressful, and it could have been this that led to their eventual death.

Studies Using Humans

Studies of humans have produced different results to animal studies. In general, there has been no evidence that sleep deprivation in humans leads to problems in metabolism, appetite, body temperature or immune functioning, even after 200 hours of sleep deprivation.

Webb & Bonnet (1979a)
Aim: to show the effects of sleep deprivation in humans.
Sample: two adult males.
Design: exploratory study.
Method: the pps were restricted to two hours sleep on one night. Measures were taken of physiological and psychological functioning and the pps sleep was monitored the following night.
Result: The pps reported no ill effects the following day. The following night, they fell asleep more quickly than usual and slept for slightly longer than usual.
Conclusion: short term sleep deprivation has no obvious effects in humans, but there is a tendency to catch up on lost sleep.

Webb & Bonnet (1979b)
Aim: to show the effects of longer-term sleep deprivation in humans.
Sample: student volunteers.
Design: longitudinal.
Method: Over a period of two months, pps were allowed shorter and shorter sleeping times, reducing from 8 hours at the beginning of the study to 4 hours by the end. Measures of physiological and psychological functioning were taken.
Results: There were no ill effects for the pps.
Conclusion: long term sleep deprivation has no ill effect on humans.

These studies show that sleep deprivation in humans does not produce the same dramatic effects as in rats. However, two points should be made:

- In the first study, there was only a very short period of sleep deprivation. Longer term sleep deprivation may have produced more of an effect.
- In the second study, (1) the amount of sleep was gradually reduced, so that pps had time to adjust; and (2) pps were still getting 4 hours of sleep in every 24.

So these studies don't tell us about the effects of total and abrupt sleep deprivation over longer periods of time. Studies that have looked at total sleep deprivation suggest that it has some unpleasant effects including:

- Increased sleepiness, and generally decreased arousal.

- Problems doing cognitively demanding tasks, such as mental arithmetic.
- Increased irritability.
- Perceptual disturbances (but not hallucinations).

However, it must be stressed that these effects are rather slight and there is no evidence for a major decline in either health or psychological functioning, even following long periods of sleep deprivation. Nonetheless, there are still problems with the studies that have been done on humans. These include:

- The pps in such studies are volunteers. Therefore, the effects of sleep deprivation may be far less stressful than for non-volunteers. As an example, of this, sleep deprivation of prisoners has been used in many countries as a form of torture.
- For ethical reasons, extreme periods of sleep deprivation have not been studied. It may therefore be the case that sleep deprivation is ultimately fatal in humans, but the periods involved are far longer than those we have been able to study.

Selective Deprivation of REM Sleep

Because there are different types of sleep, some researchers have looked at whether deprivation of different stages of sleep has a particular effect. Most researchers have concentrated on REM sleep deprivation.

Jouvet (1967)
Aim: to investigate the effects of REM deprivation in animals.
Sample: a domestic cat.
Design: longitudinal observation in laboratory.
Method: the cat was placed on a small island surrounded by cold water. When the cat went into REM sleep its skeletal muscles relaxed, leading it to fall into the water, waking it up. The effects of this on the cat's physiological and behavioural functioning was observed over a period of 70 days.
Result: The longer the cat was deprived of REM sleep, the more attempts it made to enter REM. The cat became progressively more disturbed and eventually died.
Conclusion: REM is necessary for adequate brain functioning.

Once again, the problems with this study is that it was done on a non-human and the technique used was very stressful, so nit is difficult to tell whether the cat died from REM deprivation or from the effects of being cold and wet for over two months.

Dement (1960)
Aim: to investigate the effects of REM deprivation in humans.
Sample: student volunteers.
Design: experimental, longitudinal.
Method: pps spent their nights in a sleep laboratory, hooked up to an EEG. The experimental group were woken up every time the EEG showed they were entering REM sleep. The control group were woken the same number of times, but only in NREM sleep.
Result: as the experimental group was deprived of REM for longer, they made more attempts to enter REM sleep. When they were eventually allowed to sleep uninterrupted, they increased the amount of time spent in REM over the next 5 days, until they had recovered what they had lost (REM rebound).
Conclusion: REM sleep is in some way necessary for proper brain functioning, as the body tries to get it when deprived of it and makes up for lost REM by getting more of it following a period of REM deprivation.

Dement (1960) also found that the pps became irritable, suspicious and paranoid, which might be due to interrupted brain functioning. However, **Dement (1965)** repeated the above study and did not find any such effects. He concluded that the psychological symptoms found in the original study were the result of demands characteristics, as he had warned the pps in advance that he expected them to have psychiatric problems.

Not all people who are deprived of REM sleep show any problems at all. **Pinel (1993)** uses the example of depressed patients taking tricyclic antidepressants. These drugs effectively suppress REM sleep entirely, so people taking them may get no REM at all for months at a time. However, they don't seem to show any ill effects as a result. However:

- The brain functioning of depressed patients may be different in a number of ways from that of clinically normal people, so it may be unwise to generalise.
- The drugs may have some action that compensates for the effects of REM deprivation on the brain and behaviour.

Conclusions

The results from studies of sleep deprivation are inconsistent. Sleep appears to be necessary – we all try to get it and don't feel right if we don't – but on the other hand, sleep deprivation does not seem to have a dramatic impact on functioning in humans. Similarly, REM deprivation does not seem to have a marked effect on how well people function but at the same time, humans and other animals try to compensate for loss of REM, which appears to suggest it is important. It remains possible that the timescales involved for the effects of sleep deprivation in humans to become obvious are greater than ethical strictures allow us to investigate.