SLEEP

Sweet dreams for sleepy flies

In a new study of the relationships among experience, sleep and plasticity in the fruit fly *Drosophila*, Ganguly-Fitzgerald *et al.* describe how increased social experience early in life causes flies to sleep more during the day. Intriguingly, this effect seems to be mediated by genes and signalling pathways that are involved in long-term memory.

Both flies and humans need to sleep to survive. Although the importance of sleep is clear, its function is less so. There is increasing evidence that sleep is important for the consolidation of memories, and the authors of this study have used *Drosophila* to investigate how sleep, experience and plasticity might be linked at a molecular level.

First, Ganguly-Fitzgerald *et al.* exposed flies to either a socially enriched environment (a group of other flies) or an impoverished environment (single housing) immediately after they emerged from their pupal cases. Flies that had been housed with other flies subsequently slept for significantly longer during the day than did their isolated counterparts — and the amount of sleep was proportional to the number of other flies in their group. This difference did not arise from differences in activity levels or mating experience, and was not affected by mutations in the genes that control circadian rhythms. Furthermore, the effect of early social experience was overridden by adult experience of sleep-need, suggesting that plasticity in sleep-need persisted throughout adulthood. In adult flies, daytime sleep-need was determined by the most recent social experience — if previously isolated flies were exposed to social enrichment, they began to sleep for longer, and vice versa.

To identify the cues that induced the alteration in sleep-need, the authors tested flies with mutations that affected their visual, auditory or olfactory systems. Both vision and smell were needed for social experience to increase daytime sleep, although hearing was not. Socially enriched flies had around three times as much dopamine in their brains as did isolated flies, and disruption of endogenous dopamine levels by a mutation in the catabolic enzyme arylalkylamine *N*-acetyltransferase interfered with the effect of social experience on sleep in adult flies.

Further studies of mutant flies revealed that cyclic AMP signalling, which is important for short-term memory, was involved in the ability of social experience to regulate sleep-need. In addition, a subset of genes that are required for long-term memory (~40% of those tested) were also required for this type of behavioural plasticity.

Finally, the authors showed that male flies trained on a courtship conditioning task, which leads to the formation of long-term memories, also subsequently needed more daytime sleep. Together, these results shed new light on the connections between sleep, experience and neural plasticity, and establish a paradigm that will facilitate future gene discovery. Further work will no doubt build on these findings in both flies and vertebrates.

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Ganguly-Fitzgerald, I. *et al.* Waking experience affects sleep need in *Drosophila*. *Science* **313**, 1775–1781 (2006)