an interesting story. Do mutant flies simply need less sleep, or do they sleep more efficiently? Are the effects central or peripheral? It will also be important to determine whether the results are relevant to mammalian sleep regulation. Cirelli *et al.* suggest that this might be the case, on the basis of evidence that potassium channels are involved in mammalian sleep rhythms. In addition, some tantalizing hints come from a rare autoimmune disorder, Morvan's syndrome, in which sleeplessness might be associated with autoantibodies against voltage-dependent potassium channels.

There is one crucial caveat for anyone who reads this paper with hopes of a drug that could lead to a reduced need for sleep: compared with controls, the mutant flies had reduced lifespans.

John Spiro, Senior Editor, Nature

References and links

ORIGINAL RESEARCH PAPER Cirelli, C. *et al.* Reduced sleep in *Drosophila Shaker* mutants. *Nature* **434**, 1087–1092 (2005)

FURTHER READING Pace-Schott, E. F. & Hobson, J. A. The neurobiology of sleep: genetics, cellular physiology and subcortical networks. *Nature Rev. Neurosci.* **3**, 591–605 (2002)

VISUAL PROCESSING

Seeing all the angles

Two recent papers extend our understanding of the potential of functional imaging by showing that functional MRI (fMRI) images of activity in the earliest stages of visual cortex can be used to identify what a person is looking at.

Kamitani and Tong used fMRI to scan people's brains while they were looking at stimuli that consisted of lines in one of eight possible orientations. In monkeys, neurons in the primary visual cortex are arranged in 'orientation columns' that respond most strongly to a particular line orientation. However, these columns are too small to image reliably using fMRI. So, rather than trying to view the activity in individual orientation columns in the human visual cortex, the authors investigated whether each 'voxel' — the smallest subdivision of the image in an fMRI scan — showed orientation-dependent changes in activity, and whether these could be used to predict the orientation of the stimulus being viewed by a participant during a scan.

By applying linear pattern analysis techniques, the authors found that they could use fMRI scans to identify which of the eight orientations was being viewed. They then went on to investigate whether this ability to identify a person's 'brain state' could be extended to determine their mental state — a kind of 'mind-reading'. Participants viewed a pattern that consisted of two overlapping orientation stimuli, and had to pay attention to one orientation while ignoring the other. fMRI scans of the early visual cortical areas V1 and V2 taken during these trials could be used to predict which orientation a participant was concentrating on, showing that the information in the fMRI scans relates not only to the objective nature of the visual stimulus, but also to the subjective experience of the person who is being scanned.

Haynes and Rees also showed that fMRI scans could be used to predict which orientation a person was viewing. They took this further by investigating the effects of 'invisible' stimuli — images that are 'masked' by other stimuli so that the participant is not aware of seeing them. Such stimuli can cause 'interference' effects in psychophysical studies, showing that they are influencing visual processing in some way. Haynes and Rees found that their fMRI scans of cortical area V1 could be used to predict the orientation of such a masked stimulus, even though the subject didn't consciously see it.

As well as showing the ability of fMRI scans to extract information about visual processing in the early visual cortex, these two studies provide insights into the importance of V1 and V2 for conscious visual perception. On the one hand, activity in V1 and V2 reflects the subjective experience of a person who is paying attention to one of two simultaneously presented stimuli; whereas on the other hand, masked stimuli produce activity changes in V1 that are clearly not sufficient to allow perception of the stimulus. Further studies of this type should advance our understanding of how activity in the brain relates to conscious experience.

Rachel Jones

References and links

ORIGINAL RESEARCH PAPER Kamitani, Y. & Tong, F. Decoding the visual and subjective contents of the human brain. *Nature Neurosci.* **8**, 679–685 (2005) | Haynes, J.-D. & Rees, G. Predicting the orientation of invisible stimuli from activity in human primary visual cortex. *Nature Neurosci.* **8**, 686–691 (2005)

FURTHER READING Tong, F. Primary visual cortex and visual awareness. *Nature Rev. Neurosci.* **4**, 219–229 (2003)