NEURAL CODING

Selective for direction

Does stimulus perception depend on large populations of neurons, or on the activity of single neurons? Neither, according to a new study — in some situations, perceptual decisions are based on population activity in the most useful subset of neurons.

The middle temporal (MT) area of the primate brain is important for the perception of moving visual stimuli, and contains many neurons that respond to objects that move in a preferred direction. When monkeys are asked to discriminate between two widely separated directions of motion, it is thought that information from many MT neurons is pooled. However, it now seems that finer discriminations rely on more selective information pooling.

Purushothaman and Bradley trained monkeys to compare the directions of motion of two moving stimuli. The differences in direction were small — less than 3° — and the authors recorded the activity of neurons in area MT while the monkeys did the task. They then analysed the responses of the neurons to the different stimulus directions, and compared the neuronal activity with the psychophysical performance of the monkeys.

The 'choice probablility' of a neuron is a measure of how well its firing rate correlates with perception — for example, if a neuron usually shows higher activity when the monkey perceives the second stimulus as moving anticlockwise relative to the first, regardless of the actual direction of motion, it has a high choice probability and is likely to be involved in perception. In this study, neurons whose preferred directions of motion were about 70° away from that of the reference stimulus showed the highest choice probabilities. As MT neurons are broadly tuned, the tuning curves of these neurons are probably steepest around the directions of the test stimuli, which would allow them to show large differences in activity for relatively small changes in direction.

Do monkeys selectively use information from these neurons to make perceptual decisions, or do they pool neuronal activity indiscriminately? On the fine discrimination task used in this study, indiscriminate pooling of neuronal activity was much less accurate than the monkeys' performance, indicating that some other strategy is used. When the authors analysed the covariance of neuronal activity and perceptual performance, they found that perceptual decisions correlated more closely with the activity of 'high-precision' MT neurons than with the activity of low-precision neurons. According to the authors, to achieve the observed performance levels, the monkeys must use selective pooling of activity from those neurons whose responses are most informative for the task.

In an accompanying News and Views article, Naler and DeAngelis discuss the implication that areas such as MT can use different coding strategies for different tasks, such as broad versus fine discrimination. As they conclude, studies that use multielectrode arrays to record simultaneously from many neurons will provide greater insight into population coding.

Rachel Jones

References and links

ORIGINAL RESEARCH PAPER Purushothaman, G. & Bradley, D. C. Neural population code for fine perceptual decisions in area MT. *Nature Neurosci.* **8**, 99–106 (2005)

FURTHER READING Nadler, J. W. & DeAngelis, G. C. Precision pooling predicts primate perceptual performance. *Nature Neurosci.* **8**, 12–13 (2005)

IN BRIEF

ADDICTION

Insulin signaling in the nervous system regulates ethanol intoxication in *Drosophila melanogaster*.

Corl, A. B. *et al. Nature Neurosci.* **8**, 18–19 (2005)

The fruitfly is a popular model for studying the effects of alcohol intoxication, because many of the molecular mechanisms that underlie ethanol-induced behaviour are conserved between flies and vertebrates. In this report, Corl *et al.* uncover a role for insulin signalling in the response to ethanol intake in *Drosophila melanogaster*. They show that flies become more sensitive to ethanol intoxication if the function of insulin-producing cells is impaired or if the insulin-receptor signalling pathway is disrupted.

GENE EXPRESSION

Mouse brain organization revealed through direct genome-scale TF expression analysis.

Gray, P. A. *et al. Science* **306**, 2255–2257 (2004)

Transcription factors have important roles in many aspects of brain development, and Gray *et al.* used *in situ* hybridization to map the expression of more than 1,000 transcription factor-encoding genes in the developing mouse brain. Their screen identified an array of new markers for various brain regions and cell types, and the data are being compiled into a searchable atlas of transcription factor expression during brain development.

SYNAPTIC PLASTICITY

Dendritic spine heterogeneity determines afferent-specific Hebbian plasticity in the amygdala.

Humeau, Y. *et al. Neuron* **45**, 119–131 (2005)

In laminar brain structures, dendritic arbors tend to be compartmentalized, so that afferents from different sources are spatially segregated within the arbor. However, Humeau *et al.* show that in the lateral nucleus of the amygdala (LA), which is not overtly laminar, cortical and thalamic afferents intermingle on the same dendritic branch. Moreover, spines that are postsynaptic to these two types of afferent have distinct morphological and molecular characteristics. These findings imply that synaptic plasticity in LA neurons is controlled locally on a spine-by-spine basis.

NEURAL INDUCTION

Neural induction in *Xenopus* requires early FGF signaling in addition to BMP inhibition.

Delaune, E. *et al. Development* **132**, 299–310 (2005)

Classical experiments using explants of embryonic *Xenopus* ectoderm led to the hypothesis that neural induction depends on the inhibition of bone morphogenetic protein (BMP) signalling. Recently, this model was challenged by findings in avian embryos, which indicated a crucial role for fibroblast growth factor (FGF) signalling. To try to reconcile this discrepancy, Delaune *et al.* studied neural induction in whole frog embryos, and they provide evidence that induction of the nervous system requires FGF signalling at the pre-gastrula stage, as well as BMP inhibition.