Linking perception to neural activation

The relevance of linking neural activity patterns to perceptual tasks — a core objective of cognitive neuroscience — is highlighted by a new study in the honeybee *Apis mellifera*. Reporting in *PloS Biology*, Guerrieri, Schubert and colleagues show that odours that are encoded as physiologically similar are also perceived to be similar by bees.

To determine the perceptual similarity of odours, Guerrieri *et al.* adopted the olfactory conditioning of the proboscis extension response, a classical conditioning paradigm in which an olfactory stimulus (the conditioned stimulus, or CS) is paired with a sucrose feed until extension of the proboscis is evoked by the CS alone. They used 16 odours that varied in two chemical features: functional group and carbon-chain length. Each bee was conditioned to one of the odours and tested

for generalization responses — in which different but similar stimuli are treated as equivalents — to four odours, one of which could be the trained odour.

The researchers found that all the odorants could be learned, and that generalization depended on functional group (for example, generalization was high from ketones to alcohols and aldehydes) and chain length (generalization was higher between long-chain than between short-chain odorants). They went on to build an olfactory perceptual space for the honeybee by principal components analysis (PCA), in which the relationships between odours were represented in a limited number of dimensions. The PCA showed a clear organization of odours depending on their chemical characteristics — functional group and chain length being ‘inner dimensions’ of the bees’

Yin and yang of acupuncture

Acupuncture, which is rooted in a 3,000 year-old Chinese tradition of yin and yang, is believed to cure diseases by re-establishing the ‘energy balance’ in organs when it goes awry. Although the practice of acupuncture is becoming increasingly mainstream in Western countries, whether acupuncture has a real therapeutic effect beyond placebo is the subject of heated debate. This debate is highlighted by two recent studies, although the answer remains elusive.

In a randomized controlled trial, Linde and colleagues tested the value of acupuncture for the treatment of migraines. They divided 302 patients with migraines into three groups. The first group received proper acupuncture treatment and the second a sham acupuncture treatment that did not follow the rules, whereas the third comprised an untreated control group. After 9–12 weeks, 15% of untreated patients reported a reduction of 50% or more in the number of days on which they had migraines.

In the acupuncture and sham groups, the percentage of patients who experienced a similar decrease was 51% and 53%, respectively. Therefore, acupuncture was no more effective than sham acupuncture in reducing migraines, although both interventions had some positive effects compared with no treatment.

In the second study, a team led by Lewith used position-emission tomography to investigate whether acupuncture has a specific demonstrable effect on the brain. The study group, which consisted of 14 patients with arthritis, was subjected, in random order, to three treatments. In one treatment, the patients were jabbed with blunt needles that did not penetrate the skin, having been told in advance that the procedure should not have any therapeutic value. In another treatment, they received sham acupuncture with placebo needles that retracted into their shafts like stage daggers, thereby tricking patients into believing that

they were being treated. The third treatment was genuine acupuncture. Interestingly, both sham and real acupuncture activated the dorsolateral prefrontal cortex, anterior cingulate cortex and midbrain — regions of the brain that are associated with belief and expectation. In addition, real acupuncture activated the insula, which is thought to be involved in pain modulation. The authors conclude that acupuncture has a real physiological effect that might underlie its ability to relieve pain.

The discrepancy between these studies highlights the importance of well-defined placebo controls in clinical trials. It will be interesting to determine whether acupuncture at unorthodox positions can also activate the insula, and whether different brain activities can be detected as a result of acupuncture using sham and real acupuncture needles at those positions.

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References and links

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FURTHER READING Colloca, L. & Benedetti, F. Placebos and painkillers: is mind as real as matter? *Nature Rev. Neurosci.* **6**, 545–552 (2005)