COGNITIVE NEUROSCIENCE

Colourful language

Synaesthesia — a phenomenon that occurs when one sense is stimulated by another — has intrigued scientists for more than a century. Recently, imaging techniques have advanced studies of this condition, allowing scientists to finally show that synaesthesia is the result of cross-activation between different brain areas — possibly caused by a failure in spine pruning — and that it can aid perception. Reporting in *Neuron*, Boynton, Ramachandran and co-workers provide further support for the cross-activation theory, and show a link between two particular brain areas in one type of synaesthesia.

The authors studied a relatively common form of synaesthesia — grapheme–colour synaesthesia — in which individuals see colours when viewing particular letters and numbers. They first used number and letter patterns to show that synaesthetes really do see colours when viewing certain graphemes, and that this helps them to identify shapes within the patterns more easily than control subjects. However, the use of synaesthetic colours was found to be less effective than real colours in discriminating such shapes.

Boynton *et al*. then went on to use a combination of behavioural and imaging techniques to investigate the idea that grapheme–colour synaesthesia might be caused by cross-activation between areas of the fusiform gyrus that are involved in grapheme processing and areas that are involved in colour processing. During a grapheme-viewing task, functional MRI scans showed activation of grapheme areas in all participants. In grapheme–colour synaesthetes the colour-selective area V4 was also activated, whereas for control subjects significantly less activation was seen in this region. The lack of variation seen in the grapheme areas of synaesthetes and control subjects indicates that the observed differences between the two groups were not related to the attentional states of the participants.

Boynton and colleagues also present evidence that synaesthetes and control subjects showed no differences in their brain activation in response to colours, which indicates that synaesthesia does not arise from any serious differences in brain anatomy or function.

Importantly, although the authors propose that the strength of the synaesthetic colours experienced depends on the degree of activation of area V4, they do not believe that this entirely accounts for these differences. Synaesthetes, they suggest, might be a highly heterogeneous group, so it would be a mistake to simply pool data from a group of synaesthetes and compare them with data from non-synaesthetes. Further research with many more subjects will be required to establish whether this is the case.

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References and links

ORIGINAL RESEARCH PAPER Hubbard, E. M., Cyrus Arman, A., Ramachandran, V. S. & Boynton, G. M. Individual differences among grapheme–color synesthetes: brain–behavior correlations. *Neuron* **45**, 975–985 (2005)

FURTHER READING Rich, A. N. & Mattingley, J. B. Anomalous perception in synaesthesia: a cognitive neuroscience perspective. *Nature Rev. Neurosci.* **3**, 43–52 (2002)