Journal Club

Seeing patterns in human visual cortex

Cells in the visual system look out on the world through the relatively small windows of their receptive fields. This creates a perceptual dilemma known as the 'aperture problem', in which the locally ambiguous views of individual cells must be resolved into higher-order percepts that are consistent with the whole. When cells in V1 see a moving plaid (grid), for example, they respond to the direction and orientation of the component lines. They are referred to as 'component-motion' cells. Cells higher up in the visual hierarchy must integrate this component information and respond to the direction of movement of the pattern. Such 'pattern-motion' cells (as they are called) are found in visual area MT of macaque monkeys. Using fMRI, Huk and Heeger have been able to infer the existence of subpopulations of these pattern-motion cells in area MT+ of humans [1].

Two sets of plaids were composed from a common set of moving grid patches. One set was constructed so that the pattern-motion of the plaids was in a single direction. Cells sensitive to pattern-motion should adapt to this unidirectional set.

'This work provides the first evidence for the component-motion/pattern-motion dichotomy in the human visual system...'

The other set was constructed so that the pattern-motion varied between plaids. Pattern-motion cells should not adapt to this multidirectional set. Component-motion cells should not adapt to either set because the directions of the component grids were equally varied in both. Differences in the activity of cortical areas, due to adaptation of subpopulations of pattern-motion cells, allowed Huk and Heeger to use fMRI to determine the relative proportions of each cell type in the visual areas. Area MT+ (suspected to be the human homologue of macaque area MT) showed the greatest difference in activity between sets, indicating a relatively high proportion of pattern-motion cells, while area V1 was found to be predominantly populated by component-motion cells.

This work provides the first evidence for the component-motion/pattern-motion dichotomy in the human visual system and confirms suggestions that human area MT+ is the homologue of macaque area MT. It also introduces a powerful paradigm for using fMRI to infer the existence of different subpopulations of cells in cortical areas of humans.

1 Huk, A.C. and Heeger, D.J. (2002) Pattern-motion responses in human visual cortex. *Nat. Neurosci.* 5, 72–75

James Ingram
j.ingram@ion.ucl.ac.uk

Left hemisphere discourse?

Language processing is known to take place predominantly in the left hemisphere. Research in the past few decades though, has shown that the right hemisphere is also substantially involved in language processing. How the linguistic pie is divided over the two sides of the brain is still unclear, however. Is the left hemisphere involved in syntactic processing, and the right hemisphere more involved in integrating ideas across sentences?

'These results suggest that the left, but not the right, hemisphere is involved in constructing a propositional representation of a text.'

In a recent paper, Long and Baynes contribute to this research by looking at how each hemisphere deals with two particular aspects of text processing [1]. The first aspect concerns the propositional structure. For instance, the sentence '*the guest ate garlic in his dinner, so the waiter brought a mint*' can be said to consist of two propositions (guest-eat-garlic; waiter-bring-mint) connected by the '*so*' relation. The second aspect concerns what the sentence is about (the 'topic'); for instance, the topic of the sentence above might be 'bad breath'. Long and Baynes had volunteers study a number of two-sentence stories. Next, the participants were presented with a list of words and asked to indicate for each word whether it had occurred in the stories. Words could be presented in the left visual field (connecting to the right hemisphere), or the right visual field (left hemisphere). Words that followed another word from the same proposition (e.g. 'guest' – *garlic*) elicited faster and more accurate responses than words following a word from a different proposition ('waiter' – *garlic*) but only when these words were presented to the left hemisphere. This suggests that only the left hemisphere is sensitive to the propositional structure of the text. Similar use of propositional structure was found in patients with a severed corpus callosum when the words were presented to them centrally, and they responded with their right hand (thus presumably drawing on information in the left hemisphere). No difference between the left and the right hemisphere was found in any of the subjects when test words concerned the topic of the passages, or meaning of ambiguous words used in the stories.

These results suggest that the left, but not the right, hemisphere is involved in constructing and accessing a propositional representation of a text. In addition, these results challenge the assumption that only the right hemisphere is specialized for discourse-level processing (including the representation of the topic of a passage). Although much more research is needed to isolate the processes involved in representing the propositional structure and topic, this line of research should lead to a better understanding of the various levels of language processing.

1 Long, D.L. and Baynes, K. (2002) Discourse representation in the two cerebral hemispheres. *J. Cogn. Neurosci.* 14, 228–242

Edith Kaan
kaan@duke.edu

