The Vision Centre

ARC Centre of Excellence in Vision Science

MEDIA RELEASE

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‘MIND READING’ HELPS REVEAL HOW VISION WORKS

In a vital advance for understanding how vision works, an international team of researchers has used a remarkable technique known as ‘mind reading’ to show how the human brain combines perceptions of colour and motion.

The achievement, by a team led by Dr Colin Clifford of The Vision Centre, challenges the prevailing scientific view that the brain processes colour and movement in separate ‘modules’ – and then combines them in a third, superior location.

“In fact we have demonstrated that the parts of the brain which recognise colour also to some degree recognise motion, while those that recognise motion also to some extent recognise colour,” Dr Clifford explains.

The ability to rapidly detect and interpret colour and movement is regarded as being among the essential keys to the evolutionary success of primates, including humans.

The research by Kiley Seymour and Colin Clifford of Sydney University and Andreas Bartels and Nikos Logothetis of Max Planck Institute for Biological Cybernetics appears in the latest issue of Current Biology, in an article entitled "The coding of colour, motion and their conjunction in human visual cortex".

The team used functional magnetic resonance imaging (fMRI) to identify which parts of the brain became active when their subjects looked at red or green, or motion to the right or left. This method is popularly referred to as ‘mind reading’ as it enables the team to tell which colour or movement direction the subject is actually looking at – by observing data from their brain.

The team’s research was aimed at solving a major challenge in understanding how the brain functions, the so-called “binding problem”.

“All the information received from the eyes is channelled through the primary visual cortex, and from there – it has long been thought – colour is processed by one part of the brain and motion by another, and then the two recombined or bound together in a third as-yet unknown location.

“However our research indicates quite strongly this isn’t the case, but that colour and motion are both processed, to some degree, in the same parts of the brain,” says Dr Clifford.

“This challenges the accepted view that the visual part of the brain is essentially modular in the way it functions, with different tasks being carried out in different locations. We feel the process is much more integrated than this.”

The researchers exposed their subjects to a series of green dots rotating left and red dots rotating right, and vice versa, and studied the responses of their brains using fMRI. It soon became clear colour and motion were being combined very early in the brain’s visual system.

“This makes sense to us, because if all the colour you see and all the motion you see were processed in different parts of the brain and them re-bound together to create our very rapid and unified view of the world, you’d probably need an extra brain to handle all the processing involved,” says Dr Clifford. “Our results support the idea that binding is a much more homogenous process that starts very early on, and is maybe based on some sort of feedback loop.”

Dr Clifford adds that while the ‘mind reading’ technique has so far only been used by the team to tell if subjects are looking at either green or red, in further research at The Vision Centre they plan to explore if the technique can be used across the full colour spectrum and so ‘read’ what colour a person is looking at.

It will also be used to explore synaesthesia – the rare condition in which people strongly associate a colour with a particular number.

Down the track, it is hoped, research such as this will help medical science to restore brain function in cases where there has been traumatic injury to a vital centre. “We need to understand how the normally-functioning brain works before we can treat deficits or damage to an injured brain,” Dr Clifford explains.

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