Shapes, lines and movements are in the eye of the beholder

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More information is processed in the eye itself than previously thought.

New thinking about how we perceive shapes, lines and movement suggests this information is first deciphered in the retina of the eye, rather than within the brain's visual cortex as previously thought.

Learning more about the circuitry of the sensory systems is essential to making medical advancements in the treatment of conditions such as dyslexia and schizophrenia or even to develop the next generation bionic eyes.

A new paper in *Trends in Neurosciences*, authored by University of Melbourne neuroscientist Professor Trichur Vidyasagar and Professor Ulf Eysel from Ruhr-University-Bochum in Germany suggests we process orientation and movement of objects in the same way we process their colours.

The vast majority of information about the world around us is processed in the visual cortex of the brain, but it has long been known that colour is a different case.

Colour perception is initially processed in the eye itself by three types of receptors within the cone cells of the retina that are sensitive to blue, green and red.

Information sent from the cone cells is measured by the brain's primary visual cortex as a ratio of the activity of the three cone types. Every perceived colour has thus, a unique 'ratio'.

"Our sensory world of colour is first painted by only three primary pigments rather than drawn with hundreds of different coloured pencils, which is a very efficient way of processing" Prof Vidyasagar explains.

"But we have found that the way colour is processed may not be unique to colour perception, but may also apply to perception of most sensory stimuli.

"When we observe that the orientation of a line or an edge is vertical, horizontal or oblique, or that one object is larger or darker than another,

or how fast an object is moving, our nervous system uses the same simplifying and combining principles as it does when perceiving colours.

"The mechanisms for registering, for example, a line's orientation, are already in the retina in a coarse form. And just like colour, the visual cortex is only required to sharpen these signals."

The new theory is at odds with the dominant school of thought that sensitivity to lines and edges is first developed only in the brain's cortex.

More information: "Origins of feature selectivities and maps in the mammalian primary visual cortex." DOI: dx.doi.org/10.1016/j.tins.2015.06.003

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