involved occurrence of the syndrome than if they did not. As predicted, surprise events where the outcome was 'syndrome' produced more DLPFC activation than those where the outcome was 'no syndrome' — and these events were also more likely to produce learning (that is, to change the subjects' subsequent predictions).

This study provides further evidence that neural activity — across whole brain regions as well as in individual neurons — reflects the specific predictions that arise from formal learning theory. Further collaborations between behavioural theorists and neuroscientists might give us similar insight into the neural bases of other types of learning or behaviour.

Rachel Jones

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An embryonic chick wing, stained with an antibody to reveal the normal pattern of innervation. Courtesy of Jonathan Clarke and Paul Martin, University College London, UK.

VISUAL PROCESSING

A roving eye

As we view the world around us, our eyes frequently make ballistic movements from one point of gaze to another. These 'saccades', which can occur several times per second, are usually automatic and go unnoticed. This is somewhat surprising. After all, when the image of a fast-moving object sweeps across the static retina, we are normally aware of its motion. So why is it that we fail to detect the comparable motion of images as they sweep across the retina during saccades? This apparent paradox has previously been explained by the intrasaccadic suppression of visual sensitivity. But as García-Pérez and Peli report in the *Journal of Neuroscience*, it seems that we might have underestimated our capacity for visual perception during saccades.

Traditionally, intrasaccadic suppression has been studied by presenting a range of visual stimuli to subjects, and comparing their performance during saccades with that in fixation trials. But because the stimulus differs in these situations — the image falls onto a single retinal location in the latter case, but is spread across the retina in the former — this approach does not answer the question of whether lower sensitivity during saccades is actually the result of a deterioration in visual processing. García-Pérez and Peli adopted a different approach. They isolated intrasaccadic perception in human volunteers by presenting them with high-speed visual stimuli that are invisible under fixation (because fast temporal oscillations are filtered out by the mammalian visual system), but which can be detected by executing saccades. In this way, they removed the potential complications of pre- and postsaccadic perception of the visual stimulus.

Subjects viewed gratings (patterns made up of alternating bright and dark stripes) that differed in their spatial resolution (the number of repeats of the pattern per degree of the subject's visual angle) and in the speed at which they drifted. The fact that fast-drifting gratings can be seen during saccades shows that intrasaccadic suppression does not eliminate the perception of high-contrast stimuli. But how much are we able to perceive during saccades? As has been reported previously, García-Pérez and Peli found that intrasaccadic processing allows the conscious perception of motion. But interestingly, whereas motion perception during saccades has previously been ascribed to the magnocellular pathway, the authors found that it did not occur for stimuli that are optimal for processing by this system (those with low spatial and high temporal frequencies). They went on to show that a number of other complex visual tasks can be performed during saccades; for example, direction-of-motion discrimination, contrast discrimination and contrast matching. Moreover, they were able to show that, in theory at least, a filtering process of the type that accounts for the invisibility of fast-moving gratings under fixation might also operate during saccades.

The analysis presented by García-Pérez and Peli indicates that, rather than being degraded, visual processing during saccades shares many of the characteristics of processing under fixation. These findings argue against the idea of intrasaccadic suppression, so how is it that our view of the world remains stable as we execute saccades? The authors concur with others in suggesting that, under normal circumstances, the answer might lie in visual masking by pre- and postsaccadic perception.

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WEB SITE

Eli Peli's lab: http://www.eri.harvard.edu/faculty/peli/index.html