

Tales of the unexpected: how the brain detects novelty

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When you sit down to watch a DVD of your favourite film, the chances are that you are able to predict the exact sequence of events that is about to unfold. Without our memories we would not only be unable to remember our past but perhaps more importantly predict the future. Scientists believe they may have identified how the brain allows us to anticipate future events and detect when things do not turn out as expected.

Dr Dharshan Kumaran and Dr Eleanor Maguire at the Wellcome Trust Centre for Neuroimaging at University College London have shown that the hippocampus, the area of the brain believed to play a crucial role in learning and memory, makes predictions of what will happen next by automatically recalling an entire sequence of events in response to a single cue. The research is published today in the journal *Public Library of Science Biology*.

Using an fMRI scanner, which uses changes in blood flow within the brain to provide measurements of brain activity, Dr Kumaran and Dr Maguire were able to show how the brain reacts to unexpected changes in a sequence of images. A subject is shown a series of four images which are then repeated in a different order. By changing the order of only the final two images, the researchers found that the hippocampus appeared to be predicting which image would come next and reacting when an unexpected image appeared.

"These experiments indicate that the hippocampus acts as a sort of

comparison device, matching up past and present experience” says Dr Kumaran. "It does not appear to be reacting to novelty as such, but rather to discrepancies between what it expects to see and what it actually sees."

The results imply that when the hippocampus is prompted by a cue, it recalls a sequence of associated memories, a process that may explain how seeing a particular person's face or listening to a piece of music can trigger the recollection of an entire past experience. Furthermore, the hippocampus would appear to perform a critical comparison between our past and present experiences alerting us to unexpected occurrences in our environment, such as changed layout.

"Patients with damaged hippocampi, such as those with Alzheimer's Disease, often have trouble remembering sequences of events or finding their way around" explains Dr Kumaran. "This would seem to be because the damaged hippocampus is unable to rapidly bind together the many different components of our experiences into a coherent whole."

Citation: "An Unexpected Sequence of Events: Mismatch Detection in the Human Hippocampus" by Kumaran D., Maquire E.; Public Library of Science Biology - 28 November 2006

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