FEDERATION OF EUROPEAN NEUROSCIENCE SOCIETIES
10th FENS Forum of Neuroscience
2-6 July 2016 – Copenhagen, Denmark
http://forum2016.fens.org/

PRESS RELEASE

EMBARGOED UNTIL SUNDAY 3 JULY 2016 17.15 CEST / 16.15 BST

VISUAL PART OF BRAIN IMPORTANT FOR WORKING MEMORY

Working memory is the process by which our brains actively store and process information over brief time periods, before integrating into long-term memory. The brain's prefrontal cortex (PFC) is known to play a major role. But how is working memory information actively maintained in the brain? New research by **Dr Kartik Sreenivasan** and colleagues at the University of California, Berkeley indicates that other brain regions involved in sensation and perception, especially the visual cortex, are also important as working memory takes place.

Speaking today (3 July) at the FENS Forum of Neuroscience, Dr Sreenivasan described existing models on how working memory is implemented in the brain, and how current research is rethinking the role of the PFC.

Examining how the brain processes and stores short-term memory in a robust way, Dr Sreenivasan and colleagues conducted human studies. "We asked 'what role does the visual cortex play in helping us remember something?'" The research questioned several aspects of the standard PFC model: that all working memory information is stored in the PFC; that the PFC stays active during entire time one is remembering something; that the active parts of PFC are doing the storing action; that information gets stored in static form; and that PFC areas that represent information continue to do so the entire time one remembers something.

In this study, 49 human participants (20 women, 29 men aged 18-32 years) performed an extended standard working memory task. After seeing two faces and two scenes, they were instructed to remember or ignore various combinations, over delayed time periods. Using fMRI, Dr Sreenivasan's team measured data on the subjects' brain activity at the interval where images were not on screen but were being remembered. Looking at the visual cortex and PFC separately, the team created an algorithm from brain activity measurements. "We wanted to know if we could predict the category of the item they were actually remembering," he explained. They found that certain representations for visual feature and object information are, in fact, maintained in the visual cortex.

The researchers were successful in using this algorithm with the visual cortex data, gaining access to visual quality of info - even when subjects remembered items visually similar to each other, and the algorithm became more 'confused'. "With visually similar items, the algorithm had a harder time telling them apart. It's what you'd expect, if that's where the brain is actually remembering information," Dr Sreenivasan explained. But when they fed the algorithm data from the PFC, the readings became less clear.

These results suggest that the visual cortex stores information about visual and object information, including the shape, colour, orientation, of object; or the visual, more concrete (as opposed to abstract) aspects of different objects.

Dr Sreenivasan's team found that even if they took data from less-active parts of the visual cortex during memory retention period, they were still able to use the algorithm to predict information from these less-active areas, suggesting that information remains in that area.

"This means one doesn't need to have a persistently active area in order to process working memory," he said.

The research also indicates that information storage changes over time. "Remembering a face, for example, might not be stable. Patterns of brain activity may be constantly changing over time. But yet they lead to information which is stable. So activity patterns in the brain are not static, but dynamic."

Dr Sreenivasan believes these findings deepen understanding of how the brain forms and implements goals, and offer alternatives to existing theories. "It's clear that the PFC's role in working memory is complex, multi-faceted, and context-dependent," he said. "Our research pushes this conversation into a space where researchers from a variety of disciplines can weigh in, convene, and discuss together."

Dr Sreenivasan and colleagues are utilising these visual cortex findings to rethink, question, and query the role of PFC. Working memory is a core feature of cognition and a critical element of complex functions, including abstract reasoning; and disruptions to it are hallmarks of disorders such as schizophrenia, and aging, he explained. "So it is important to understand a bit more about what the PFC and other brain areas are doing."

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Abstract Reference: Contrasting roles of visual and prefrontal cortices in visual working memory
Symposia S11

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NOTES TO EDITORS

The 10th FENS Forum of Neuroscience, the largest basic neuroscience meeting in Europe, organised by FENS and hosted by the Danish Society for Neuroscience will attract an estimated 6000 international delegates. FENS mission is to advance research and education in neuroscience within and outside Europe, to facilitate interaction and coordination between its members. FENS represents 43 national and single discipline neuroscience societies with about 24,000 member scientists from 33 European countries. http://www.fens.org/

Further Reading
Revisiting the role of persistent neural activity during working memory. Sreenivasan K, Curtis C, D'Esposito M. *Trends in Cognitive Sciences* 2014 Volume 18 , Issue 2 , 82 - 89.