The hippocampus is necessary for binding object identity to location in visual working memory.

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12th International Conference On Cognitive Neuroscience, Brisbane Australia
Visual working memory is often used for localizing objects.

Landing positions of large single orientation movements, requires memory (out of the visual field >90°)

Remembering what was where

Sample array: 1 or 3 fractals

Delay: 1 or 4 seconds

Touch the object that appeared in sample array

Identification performance

Drag the object to its remembered location

Localization performance

Voltage Gated Potassium Channel Antibody encephalitis

• 7 patients.


• Antibodies target LGI1 protein which is expressed very restrictively in the hippocampus.

• Post mortem study revealed neural loss exclusively in the hippocampus and amygdala.

• Abnormal signal restricted to the MTL.

Pertzov et al. Medial temporal lobe damage impairs binding in visual short-term memory. BRAIN, 2013

Are locations “lost” from memory?

Leading to random localizations?
Patients’ impairment is associated with swap errors.
• When forgotten, items are lost in their entirety?
• The links that bound objects to their locations could be forgotten in spite of intact memory of item identity and position.
• Medial temporal lobes (MTL) involved in long term memory but not in working memory?
• MTL is involved in binding isolated properties also across brief retention intervals. But not ID or position alone.
• Challenging the ‘multi-store hypothesis’.
Recent failures of clinical trials imply that we must treat Alzheimer's Disease (AD) prior to its mild to moderate stages.

– Requires early detection of the disease.

The MTL is compromised in AD – years before onset of behavioral symptoms.

Standard tests of episodic memory are crude and uncontrolled. Maybe use binding in memory?

How can we test patients BEFORE they are diagnosed with AD
Familial Alzheimer's Disease (FAD)

- Autosomal Dominance disease
- Mutation Carriers have 100% chances of developing FAD at the parents age.
- Invaluable for studying presypotomatic stages.
- 12 asymptomatic mutation carriers with no deficits on standard neuropsychological tasks
- 62 healthy controls
- “double blind” design.

In Autosomal Dominance the chance of receiving and expressing a particular gene is 50% regardless of the sex of parent or child.
Asymptomatic carriers vs. controls

Identification

Localisation performance

Proportion correct

Distance (in deg)

Percent of items %

1 item

3 items

1 item

3 items

3 items location nearest

Swaps

or
Correlation with hippocampal volume

Swap errors

All mutation carriers

R = -0.76
P = 0.02

Percent of items

Centred hippocampal volume

Automatic segmentation of Hippocampal volume
Items and their locations are represented independently in visual working memory.

Binding in visual working memory related to hippocampal integrity.

Binding errors in WM may provide a means for early detection in Alzheimer’s disease.
Thanks to:

Masud Husain
Cognitive Neurology Research Group
Cognitive Neuropsychology Centre
University of Oxford

MTL patients:
Chris Butler
Tom Miller
Department of Clinical Neurology
University of Oxford

Alzheimer patients:
Yuying Liang
Sebastian Crutch
Dementia Research Centre
University College London
Back-up slides
Controls

Mutation carriers

Hippocampal volume

percent of swaps

localization error

MCa
MCs

Hippocampal volume
Symptomatic carriers vs. controls

Identification

Localisation performance

or
Contribution of swap errors to localization?
Swap across time

![Graph showing percent of objects versus delay with two lines: one for Patients and one for Controls. The Patients line shows a decrease over delay, while the Controls line shows an increase.]