Retrieval Success and the Prefrontal Cortex
Evidence from fMRI

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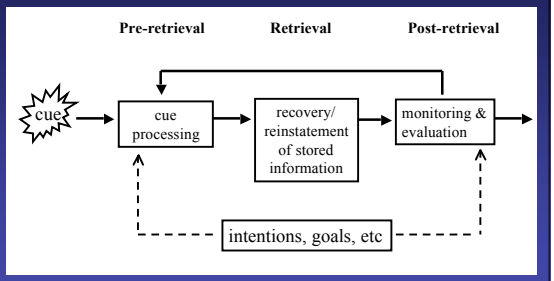
Learning and Memory

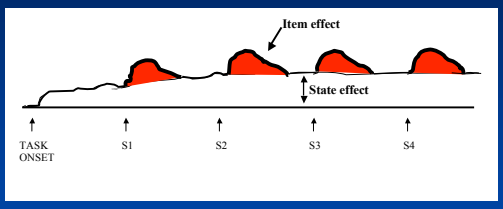
UC Irvine

Wellcome Trust
Medical Research
Council

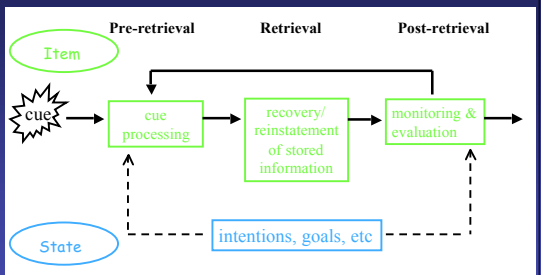
Episodic Retrieval



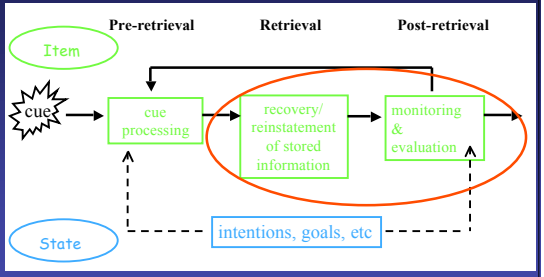
Item- & State-Related Effects



Episodic Retrieval



Episodic Retrieval



Prefrontal 'Old/New' Effects in Yes/No Recognition Memory identified by Event-Related fMRI
(as at 2001)

	L Anterior (BA 9/10)	L Dorsal (BA 9/46)	L Ventral (BA45/47)	R Anterior (BA 9/10)	R Dorsal (BA 9/46)	R Ventral (BA 45/47)
Konishi et al.	-31 +51 +8	-41 +13 +26	-45 +27 +16	+33 +51 +12		
Donaldson et al.	-40 +51 +6					
Saykin et al.					+54 +14 +32	
Henson et al. (b)	-12 +63 +18	-54 +24 +33	-48 +39 -12			
Henson et al. (a)	-21 +63 +21			+48 +48 -12		
Maratos et al.	-20 +60 +12		-52 +30 -10			+38 +34 -10
McDermott et al.	-37 +53 +10			+35 +51 +4	+45 +23 +30	
Cabeza et al.	-39 +49 +8				+38 +38 +6	

fMRI Study of Remember/Know

Study

Lexical decision judgment on a series of words and nonwords

Test

Old and New words: 'Remember'/'Know'/New judgment

Henson et al., J. Neurosci., 1999

fMRI Correlates of Remember/Know

Know & Remember > New

Know > Remember

Henson et al., J. Neurosci., 1999

'Retrieval Success' vs. Confidence

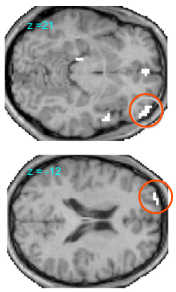
LOW>HIGH CONF
(regardless of old/new)

Henson et al., 2000

'Retrieval Success' vs. Confidence

LOW>HIGH CONF
(regardless of old/new)

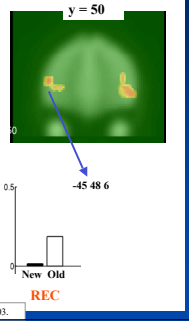
OLD>NEW
(regardless of confidence)



Henson et al., 2000

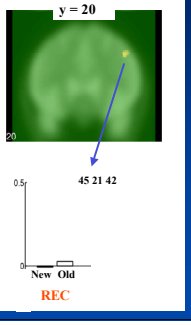
Recognition vs Source Memory

Main Effect Old>New



REC

Old/New x Task Interaction

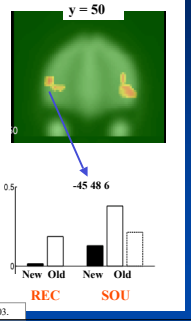


REC

Rugg et al., 2003.

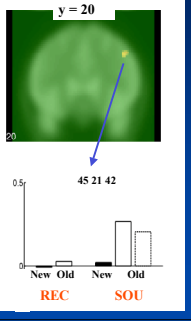
Recognition vs Source Memory

Main Effect Old>New



REC SOU

Old/New x Task Interaction



REC SOU

Rugg et al., 2003.

Prefrontal Cortex and Retrieval Success?

Anterior PFC

Sensitive to 'success' *per se* – representation and/or processing of retrieved information

(Right) Dorsolateral PFC

Sensitive to degree of post-retrieval monitoring required after a retrieval attempt prior to response selection

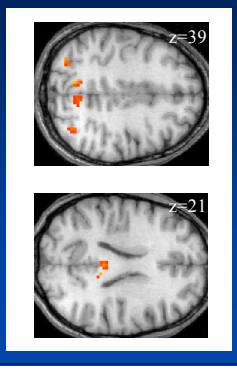
Other regions - ?

Probability Effects in Yes/No Recognition

Study	75 words	75 words	75words
Test	**25old:75new (Low)**	**50old:50new (Equal)**	**75old:25new (High)**

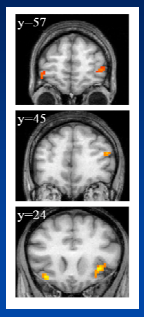
Herron et al., in press

Probability Effects in Yes/No Recognition
Main Effect of Old/New



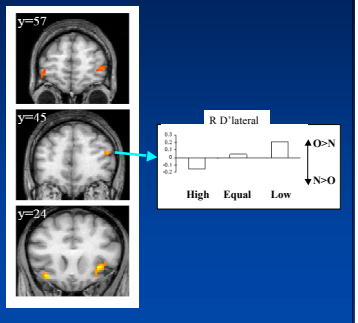
Herron et al., in press

Probability Effects in Yes/No Recognition
Probability x Old/New Interaction



Herron et al., in press

Probability Effects in Yes/No Recognition
Probability x Old/New Interaction



Herron et al., in press

Probability Effects in Yes/No Recognition
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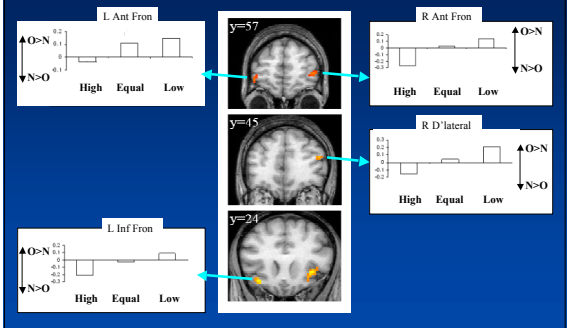

Herron et al., in press

Probability Effects in Yes/No Recognition
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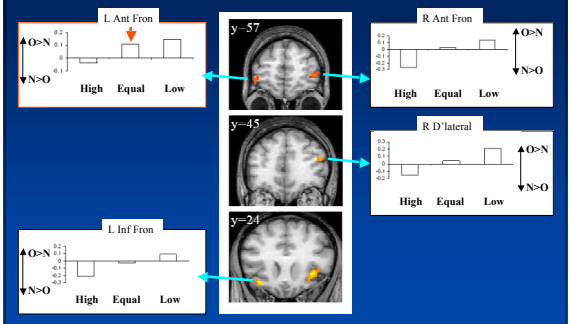

Herron et al., in press

Probability Effects in Yes/No Recognition
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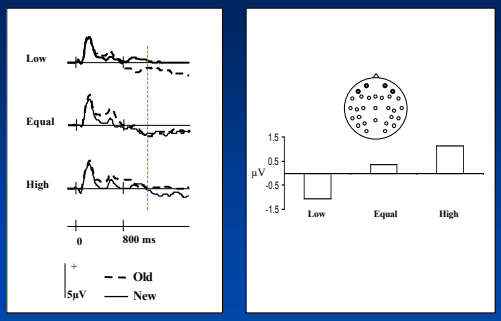


Herron et al., in press

Conclusions

- Multiple prefrontal regions sensitive to 'retrieval success' (old vs new)
- They don't all do the same thing (e.g. dorsolateral vs. anterior)
- None of them appear to be involved directly in the representation or processing of retrieved information *per se* (at least during recognition)
- Seem to support processes contingent upon the outcome of a retrieval attempt. e.g. adjustment/maintenance of response criteria, retrieval strategy, or signalling the salience of the test item (c.f. oddball tasks)

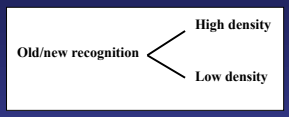
Acknowledgements

Rik Henson - Institute of Cognitive Neuroscience and Institute of Neurology, UCL

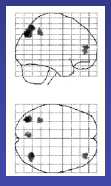
Jane Herron - Department of Psychology, University of Cardiff

William Robb - Institute of Cognitive Neuroscience, UCL

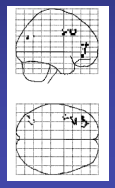
'Retrieval Success' Effects in Blocked Designs



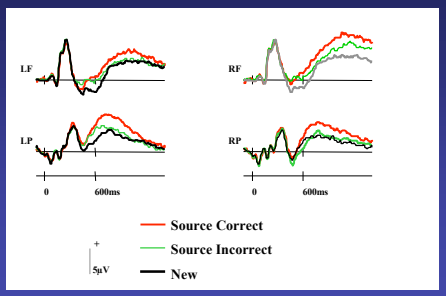
Rugg et al., 1998



Le Page et al., 2000



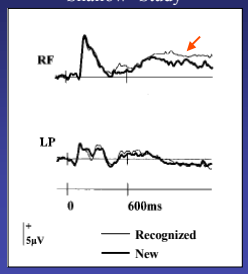
Electrophysiological Correlates of Successful Source Memory

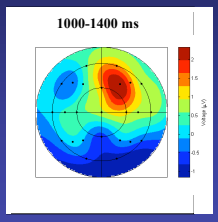


Wilding and Rugg, Brain, 1996

Right frontal ERP Effect Without Recollection

'Shallow' Study

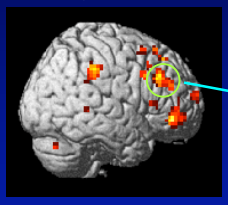


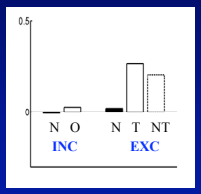


Rugg et al, J.Cog Neurosci, 2000

fMRI Correlates of Recognition Exclusion

Target > New

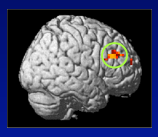




Rugg et al., Neuropsychologia, 2003.

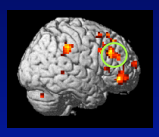
Neural Correlates of Postretrieval Monitoring

Yes/No Recognition



Is there a memory signal?

Source

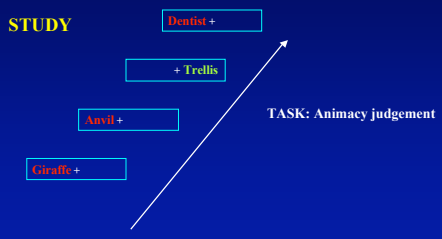


What's the origin of the memory signal?

Prefrontal Cortex and Memory Retrieval

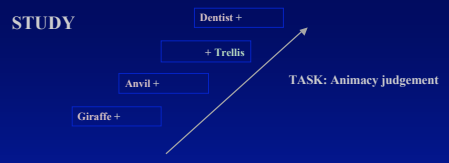
- **Is the Prefrontal Cortex necessary for retrieval?**
- **Functional Dissociation – do different regions of the PFC support different components of retrieval processing?**
- **Functional Characterization – what are these components?**
- **Are any of these components unique to memory retrieval, or are they better conceived in terms of the recruitment of more general 'frontal' processes?**

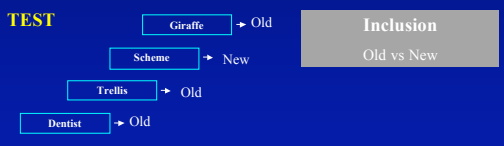
Source vs Recognition Memory



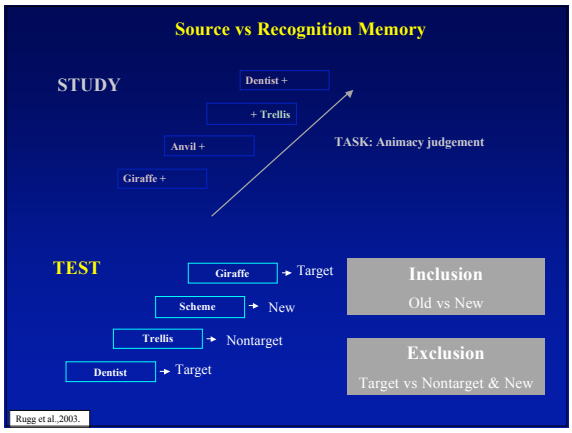
Rugg et al., 2003.

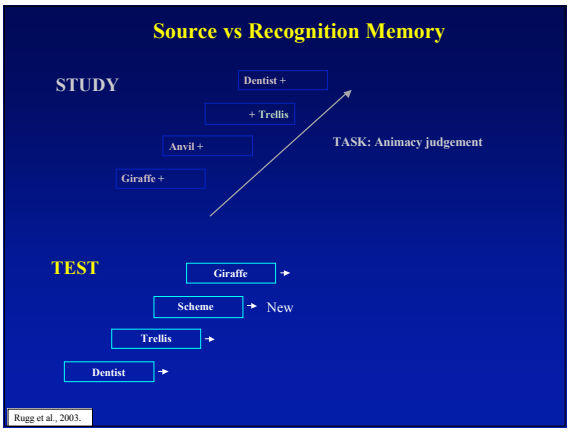
Source vs Recognition Memory





Rugg et al., 2003.


Source vs Recognition Memory
STUDY
Dentist +
+ Trellis
Anvil +
Giraffe +
TASK: Animacy judgement
TEST
Giraffe
Target
Scheme
New
Trellis
Nontarget
Dentist
Target
Inclusion
Old vs New
Exclusion
Target vs Nontarget & New
Rugg et al.,2003.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Rugg et al., 2003.