Feature ambiguity influences performance on concurrent discriminations in patients with extensive damage to the medial temporal lobe

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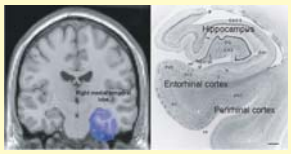
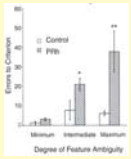
Introduction

The prevailing view of memory[1] holds that the regions in the medial temporal lobe (MTL) compose a unitary system dedicated to declarative memory.



Studies in monkeys, however, suggest that the hippocampus and perirhinal cortex may play different roles in spatial and visual recognition memory, respectively[2-3].

Furthermore, the perirhinal cortex may actually subserve higher-order visuoperceptual processes.



Bussey et al.[4] found that monkeys with perirhinal lesions were impaired in concurrent discriminations with high, but not low, levels of feature overlap, suggesting that discrimination of perceptually similar objects may be dependent on perirhinal cortex.

Neuropsychological studies[5-7], however, have found evidence of a solely mnemonic role for perirhinal cortex in man.

These studies may have failed to observe perceptual deficits in patients with perirhinal cortex damage due to the use of stimuli that did not possess sufficient feature ambiguity.

Aims

Do different structures within the MTL (i.e., hippocampus and perirhinal cortex) have disccociable functions?

Is performance on visual discriminations in humans with perirhinal damage modulated by the degree of feature ambiguity between stimuli[4]?

Is the perirhinal cortex important for representing only 'novel' stimuli, or does it also play a role in representing already 'familiar' items?

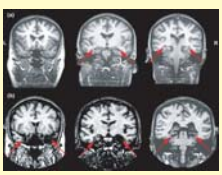
Subjects

1) **HC group: 4** amnesic patients with predominant damage to the hippocampus bilaterally (mean 45.8yrs).

2) **MTL group:** 3 amnesic patients with larger MTL lesions, including perirhinal cortex (mean 67.0yrs).

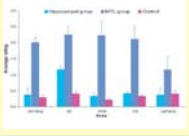
3) **Young controls:** 9 healthy control subjects age matched to HC group (mean 49.5 yrs).

4) **Elderly controls:** 9 healthy control subjects age matched to MTL group (mean 65.3 yrs).



(a) Hippocampal group patient

(b) MTL+ group patient



Tasks

Subjects learned to discriminate between pairs of objects possessing varying levels of feature ambiguity[4]. In each pair, only one object was rewarded (shown here on the left). In the following schematic, features are represented by letters and ambiguous features are highlighted in red.

Minimum Ambiguity		Intermediate Ambiguity		Maximum Ambiguity	
+	-	+	-	+	-
AB	EF	AB	AF	AB	AD
AB	EF	AB	CE	AB	CB
CD	GH	CD	AF	CD	AD
CD	GH	CD	CE	CD	CB

No features are ambiguous (i.e., each feature was either consistently rewarded or nonrewarded), allowing the discrimination to be solved on the basis of a single feature.

One feature in each object (i.e., A and C) is ambiguous. The remaining features are unambiguous.

All features are ambiguous (i.e., each feature was rewarded when part of one object, but not when part of another). The solution requires binding the features together.

Barcodes: Low familiarity

Minimum Ambiguity
AB+, CD+, EF-, GH-

Intermediate Ambiguity
AB+, CD+, AF-, CE-

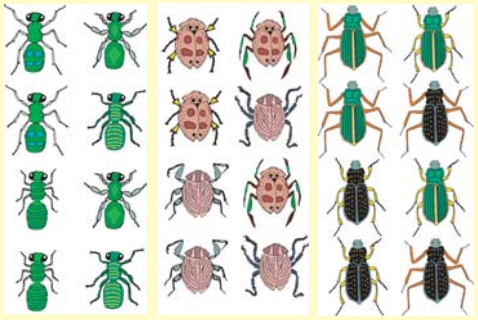
Maximum Ambiguity
AB+, CD+, AD-, CB-

Bugs: Moderate familiarity

Minimum Ambiguity
AB+, CD+, EF-, GH-

Intermediate Ambiguity
AB+, CD+, AF-, CE-

Maximum Ambiguity
AB+, CD+, AD-, CB-



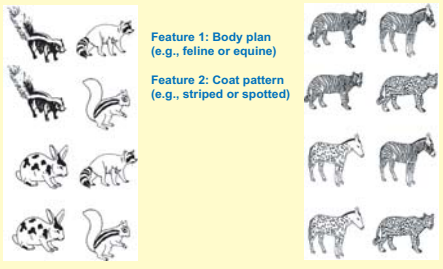
Animals: High familiarity

Minimum Ambiguity
AB+, CD+, EF-, GH-

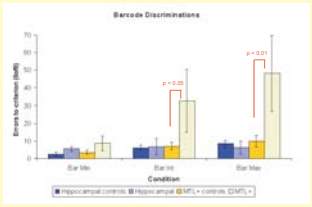
Feature 1: Body plan (e.g., feline or equine)

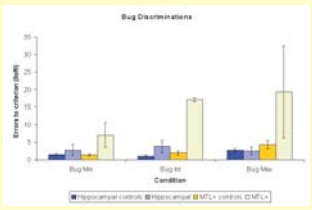
Feature 2: Coat pattern (e.g., striped or spotted)

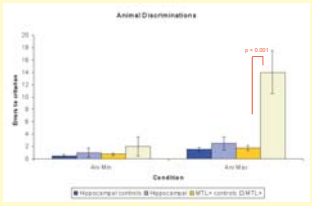
Maximum Ambiguity
AB+, CD+, AD-, CB-



Results







Patients with selective bilateral hippocampal lesions were unimpaired on all conditions of this task.

Patients with lesions to MTL including perirhinal cortex exhibited a selective effect of feature ambiguity, showing good performance for discriminations which could be solved on the basis of a single feature, but impaired performance on discriminations with ambiguous features.

Conclusions

Lesions to the MTL, including perirhinal cortex, produced an impairment in the discrimination of novel and familiar objects with a high degree of feature ambiguity (similar to Bussey et al.[4]).

The intact performance of the MTL patients on discriminations that could be solved on the basis of a single visual feature (i.e., the minimum feature ambiguity condition), suggests that damage to more caudal temporal regions is unlikely to underlie this impairment.

The normal performance of patients with hippocampal lesions confirms dissociation of function within MTL structures and provides evidence against a unitary declarative memory system in the MTL.

In conclusion, our findings suggest that the human perirhinal cortex, like its non-human primate counterpart, may have a role in both mnemonic and perceptual processes.

Acknowledgements

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References

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