Introduction to Neuropsychology

Introduction

Lecture Series:

1. *(a)* Introduction; *(b)* Memory
2. Visual Perception
3. Motor Behaviour
4. Emotion
5. Executive Function

Introduction

...lectures

6. Language
7. Lateralisation
8. Current Issues/Debates
9. Revision/Discussion
10. Exam

Introduction

Presentations (30%)

- 15min presentation (groups [3]) on a particular area of neuropsychology (e.g. memory)

a) An understanding of the behavioural deficits that result from the circumscribed brain damage
b) An appreciation for the inferences that can be drawn from the presented case(s)
c) An awareness of the advantages and limitations of the “lesion” approach in advancing our understanding of brain-behaviour relationships, within the context of the presented case(s).

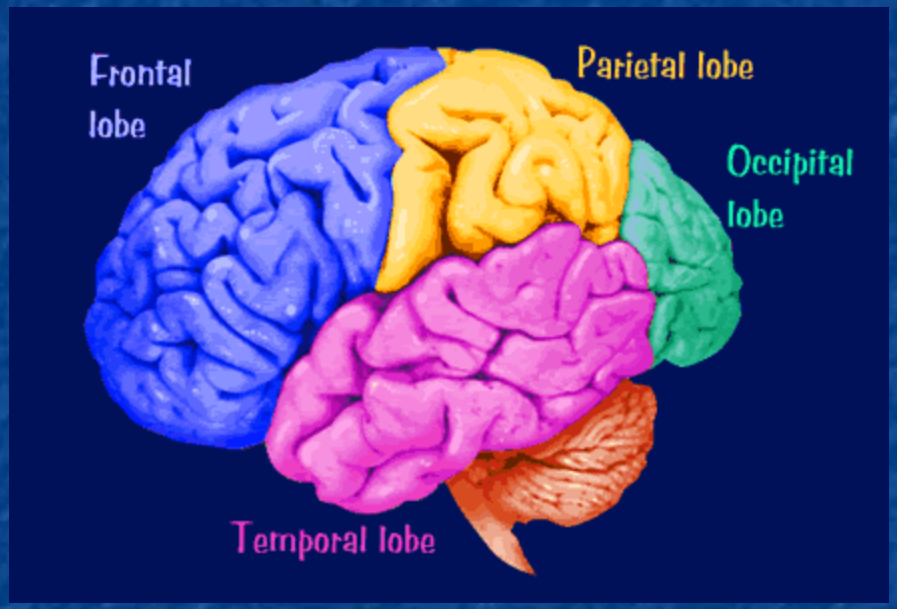
Introduction

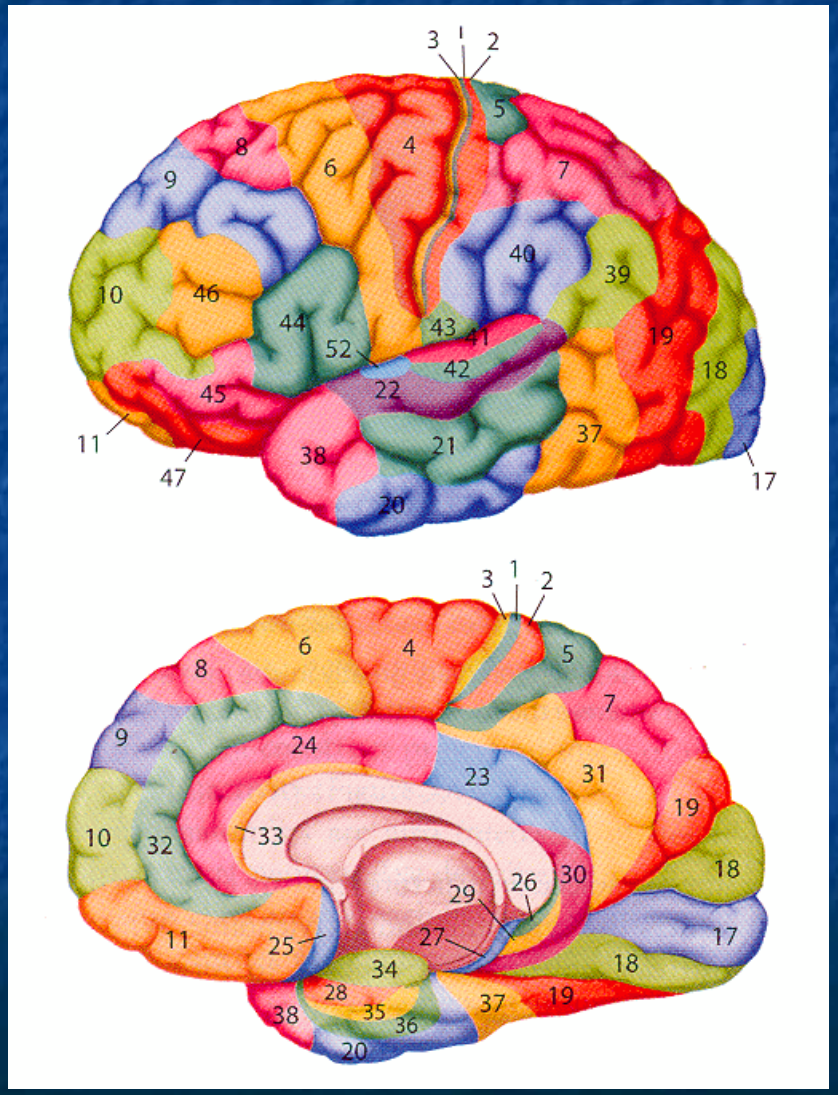
Exam (70%)

- 1hr written exam answering 2 questions (related to areas covered in the lectures)

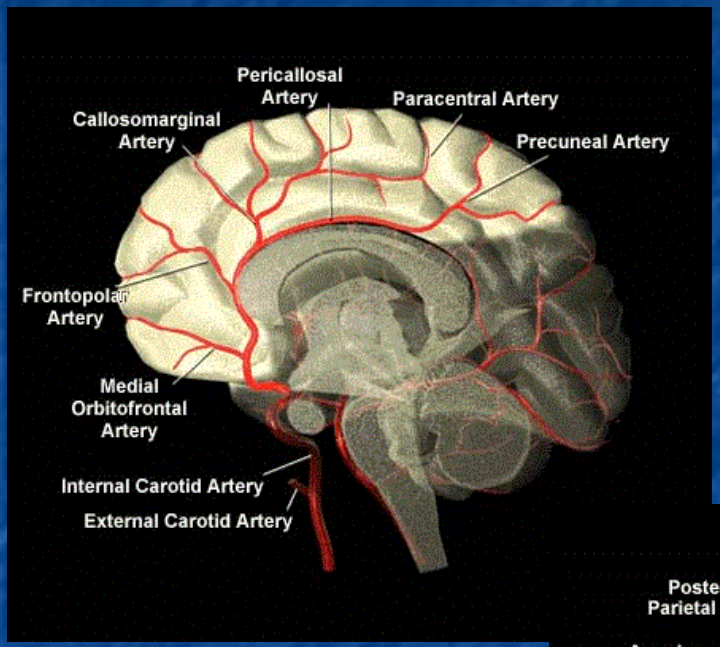
a) An understanding of the behavioural deficits that result from the circumscribed brain damage
b) An appreciation for the inferences that can be drawn from the presented case(s)
c) An awareness of the advantages and limitations of the “lesion” approach in advancing our understanding of brain-behaviour relationships, within the context of the presented case(s).

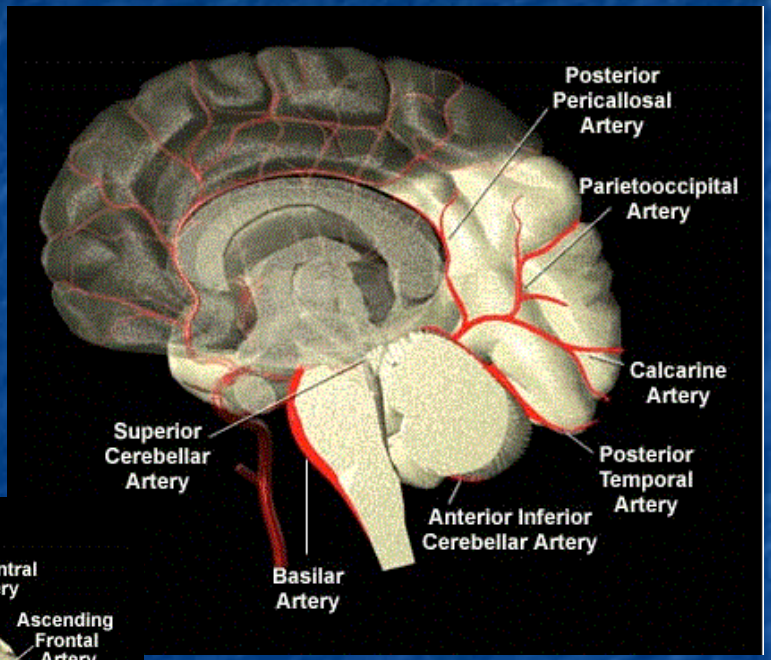
Basic Anatomy

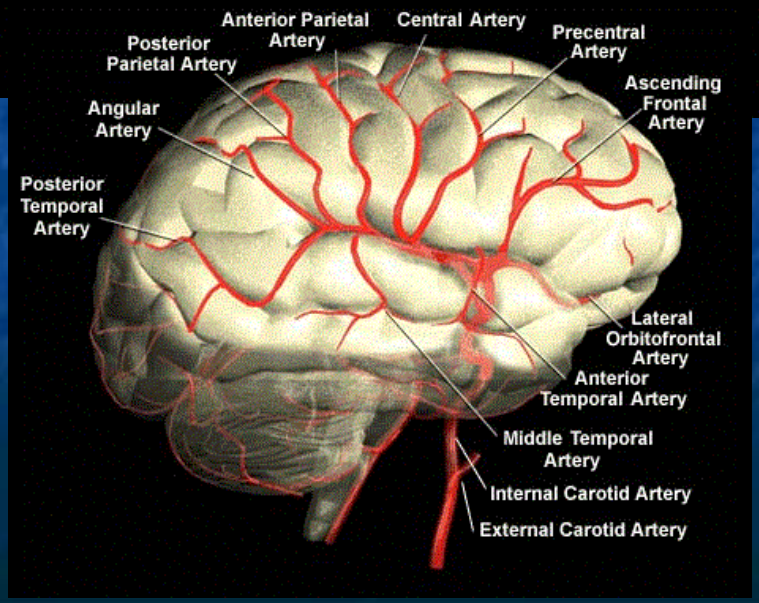




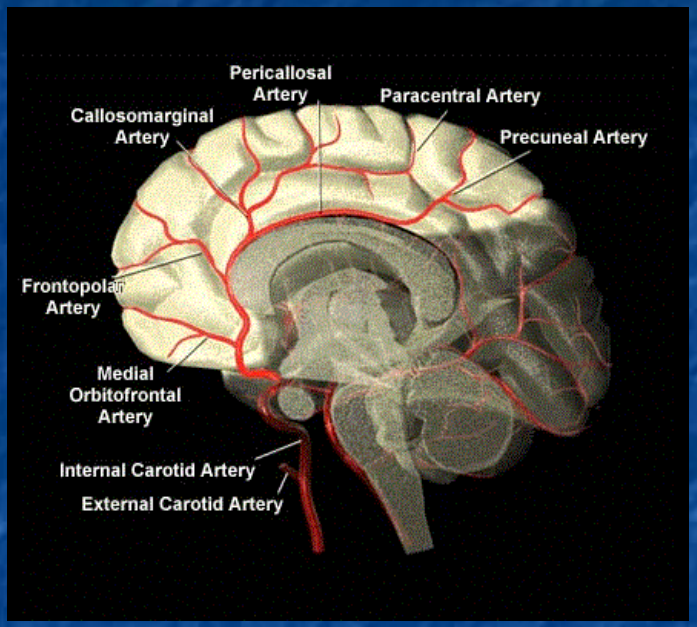
Basic Anatomy







Basic Anatomy



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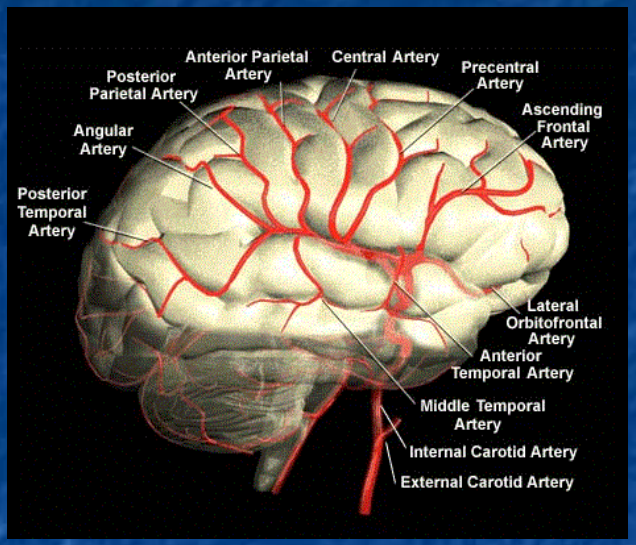
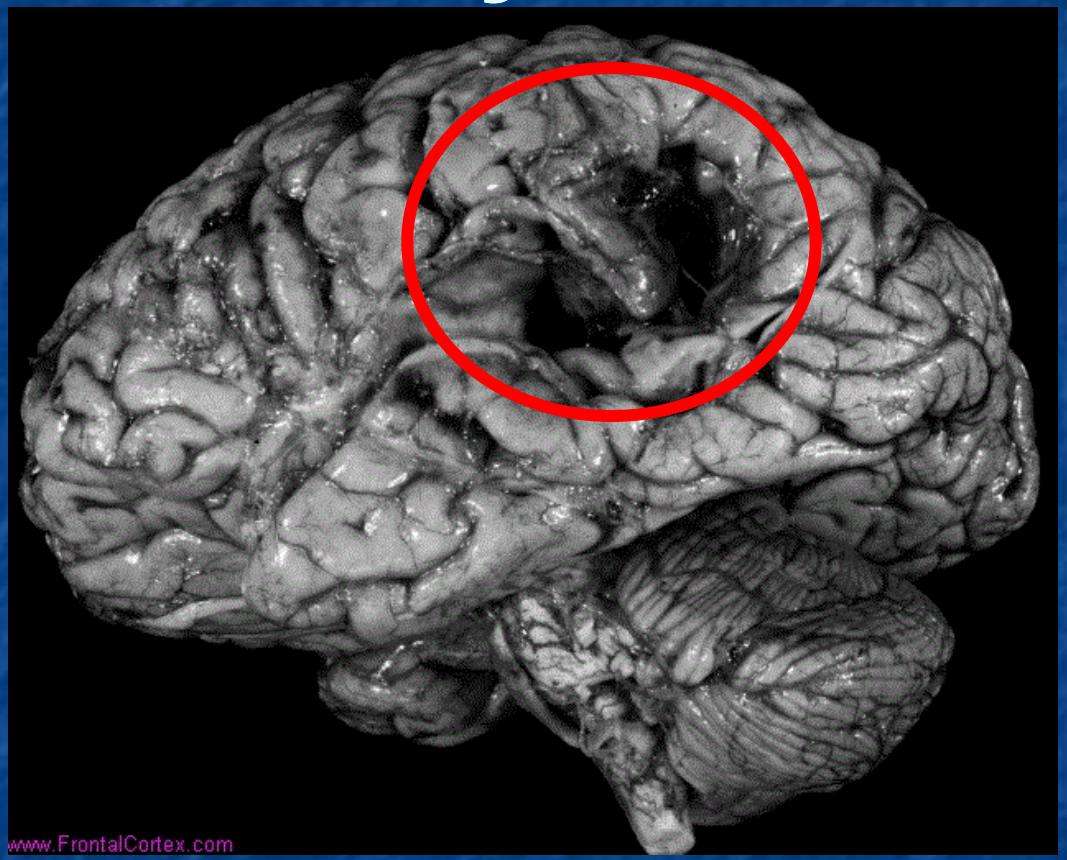
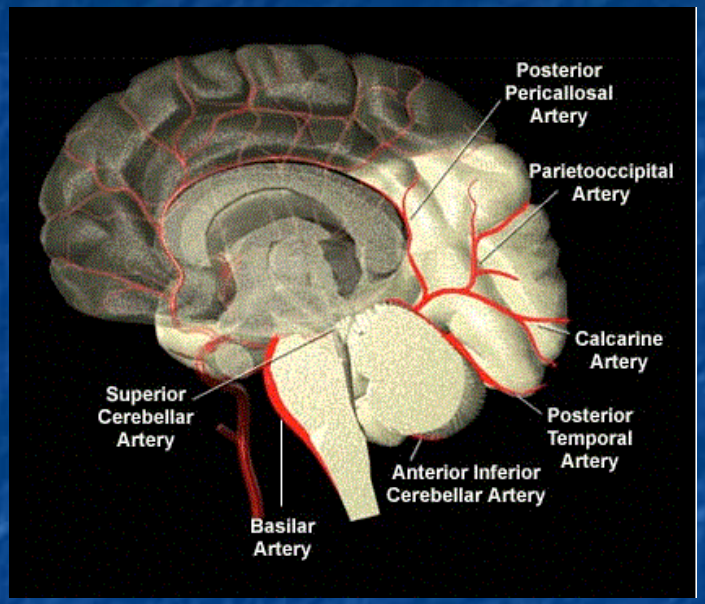
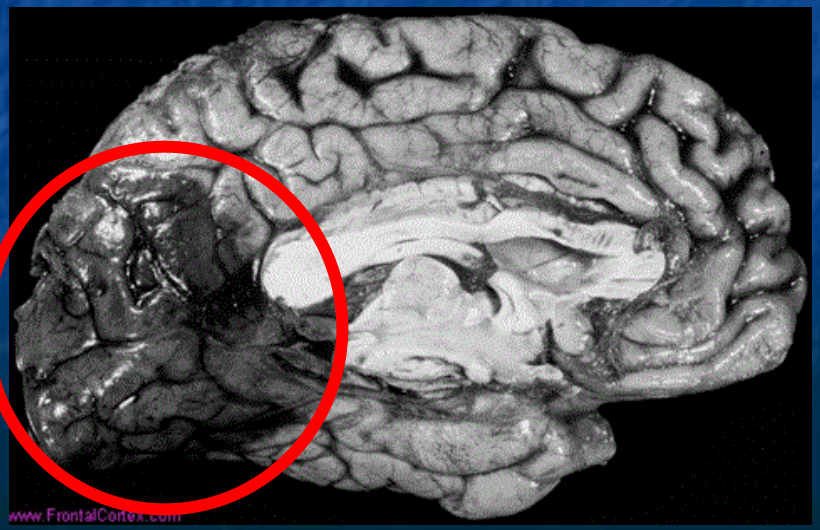




Basic Anatomy



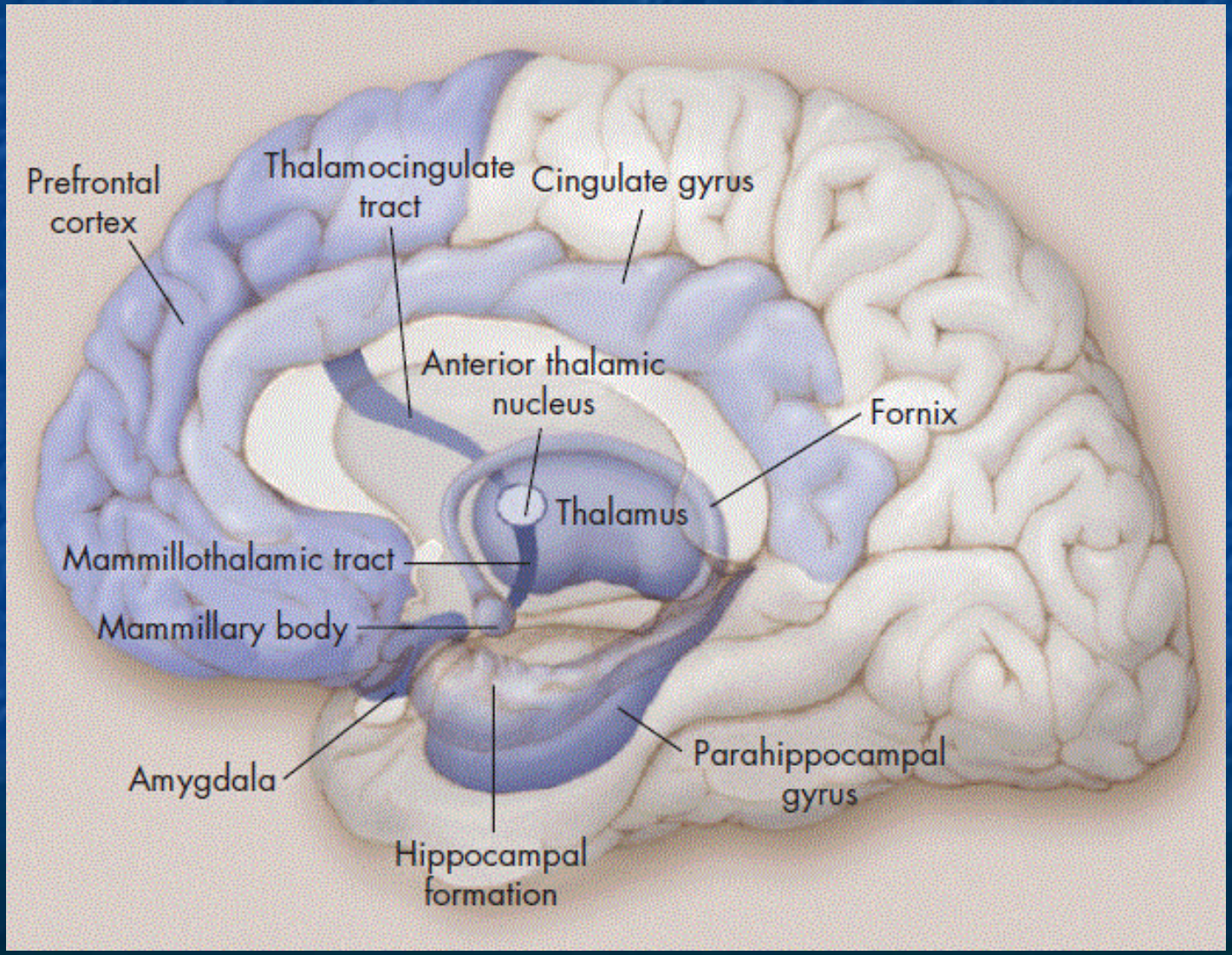


Memory

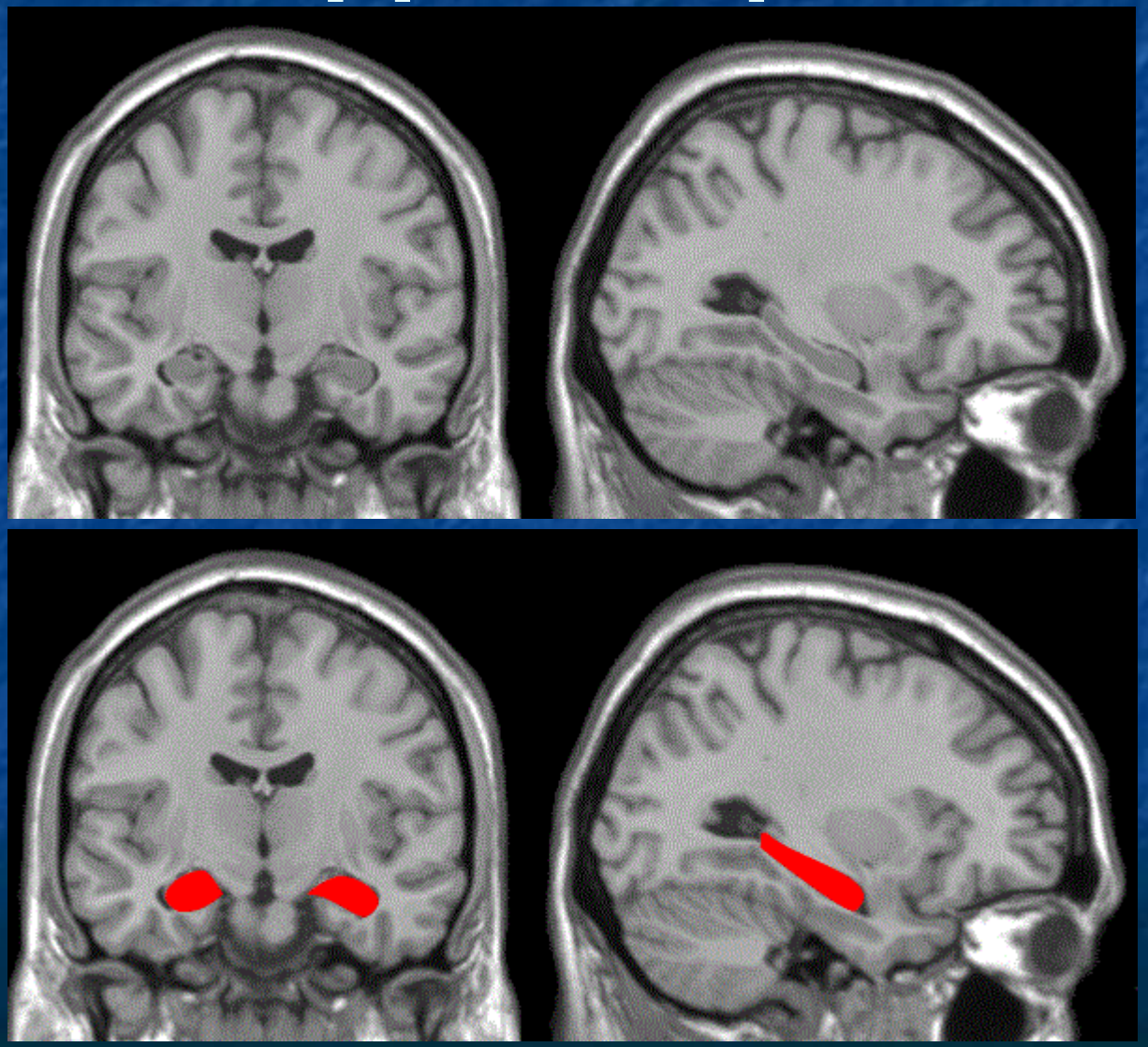
Patient H.M.

(The Hippocampus)

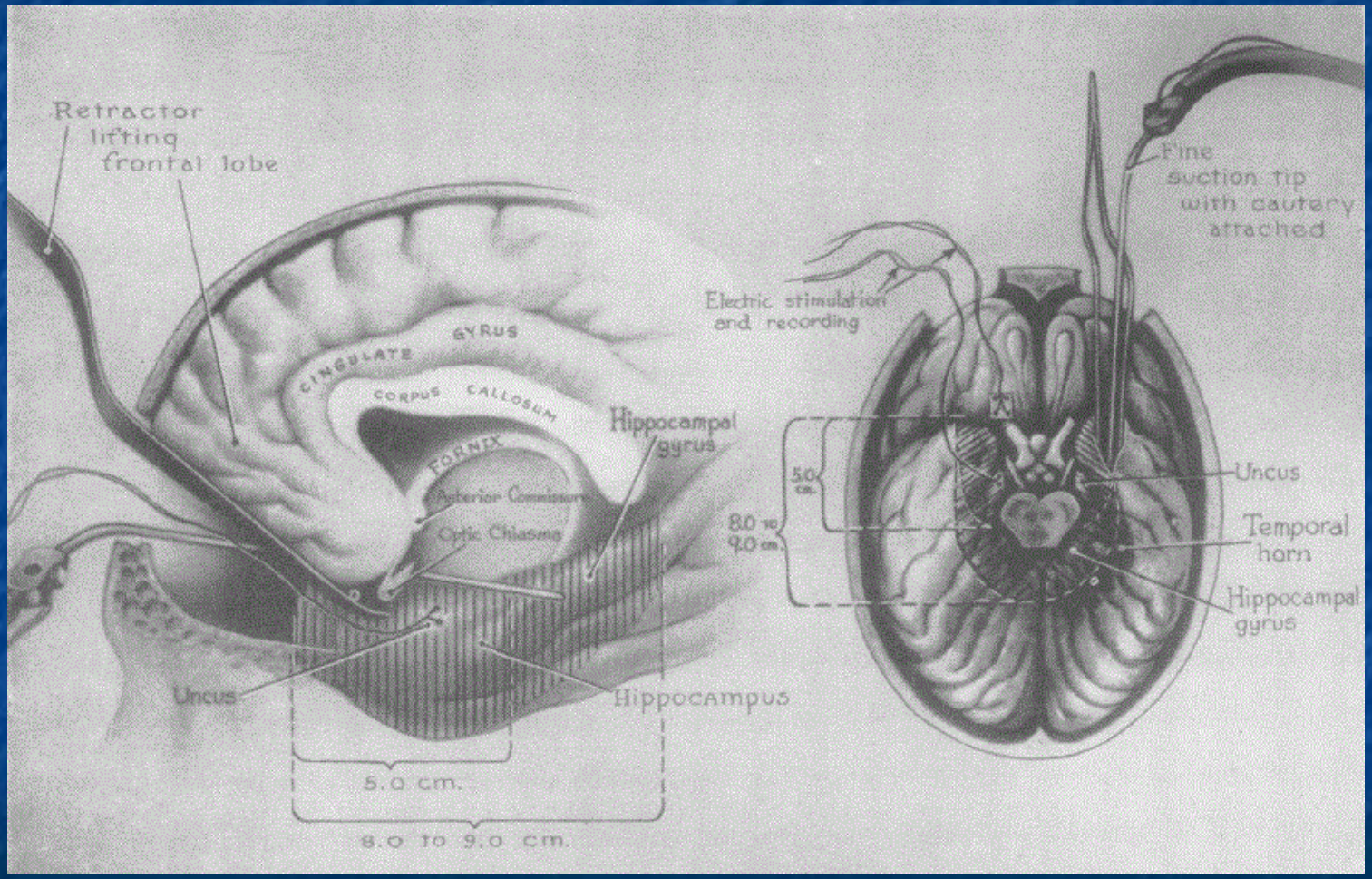
Hippocampus



Hippocampus

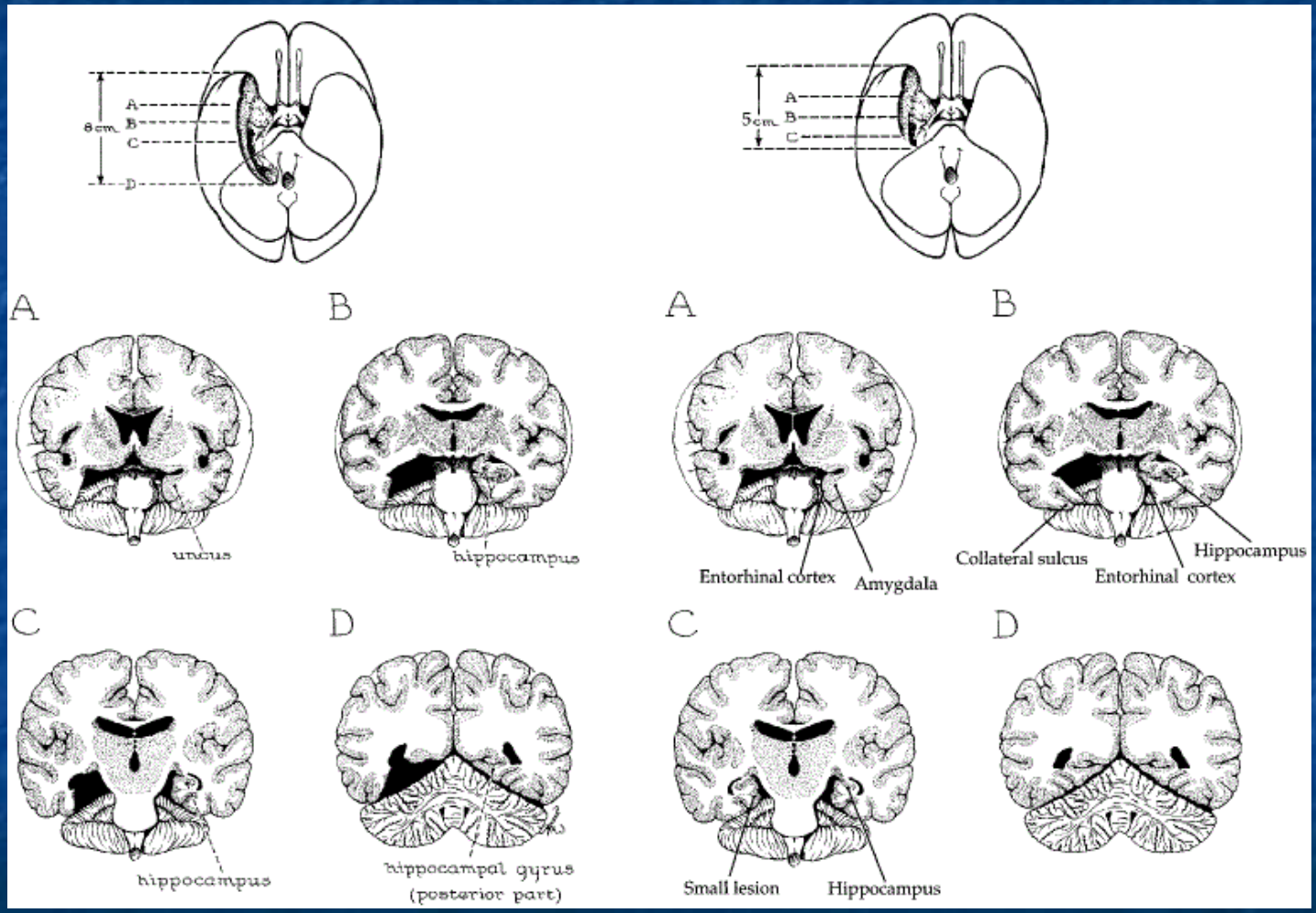


Patient H.M.



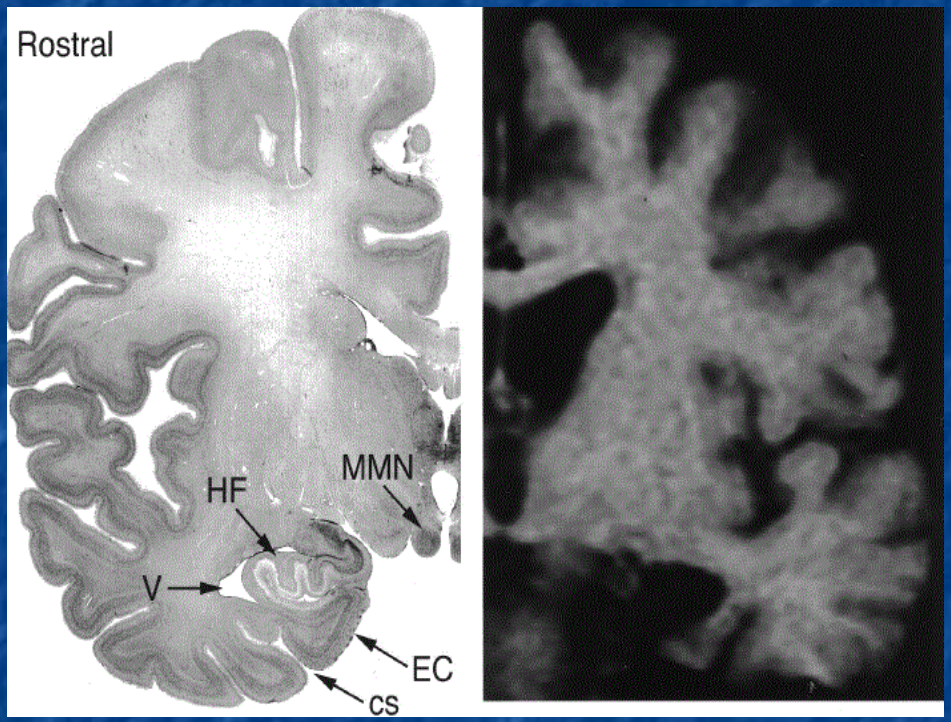
(Scoville & Milner, 1957)

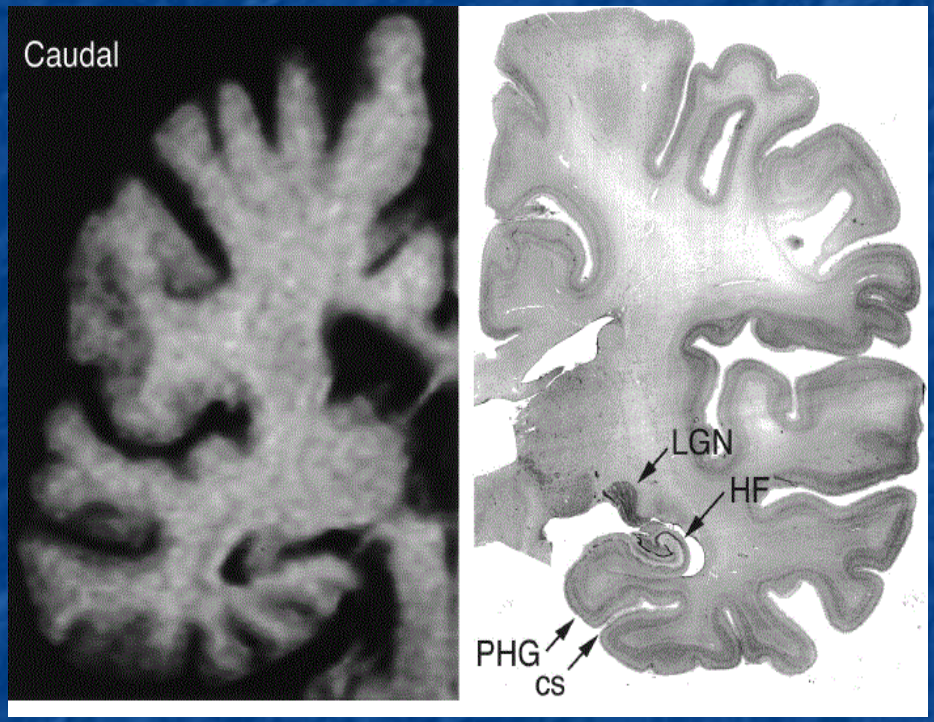
Patient H.M.



(Scoville & Milner, 1957) (Corkin et al., 1997)

Patient H.M.





(Corkin et al., 1997)

Patient H.M.

- Bilateral medial temporal-lobe excisions *(5cm posterior)* in 1953 (27yrs old)
- At 19 months

x *Retrograde amnesia* (3yrs)
x *Anterograde amnesia*
  x Age*, date, address*
  x Verbal stimuli
  x Non-verbal stimuli

✓ IQ = 104-112
✓ Good vocabulary/articulation
✓ Visual perception
✓ Abstract thinking*
✓ Reasoning ability
✓ No change in personality
✓ Normal *digit span*

(Scoville & Milner, 1957; Milner, Corkin & Teuber, 1968)

Patient H.M.
IQ vs. Memory

Table 1. The Amnesic Patient H.M.: Wechsler Intelligence-Scale and Memory-Scale Results (1953–1983)

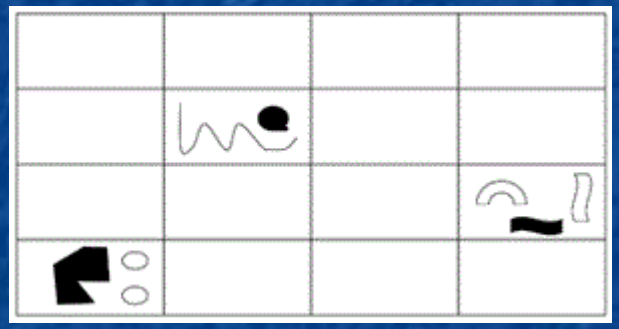
Date	Age	Test	Verbal IQ	Performance IQ	Full Scale IQ	Memory Quotient	Delayed Recall	
							Verbal (Deficit ≤ 11)	Nonverbal (Deficit ≤ 7)
Preop								
1953	27	W-B I	101	106	104	*	*	*
Postop								
1955	29	W-B I	107	114	112	67	*	*
1962	36	W-B II	109	125	118	64	1	0
1977	51	W-B I	107	126	118	74	5	0
1978	52	W-B II	91	104	98	63	1	0
1980	54	W-B II	97	108	104	64	1	0
1983	57	W-B II	97	115	108	64	0	0

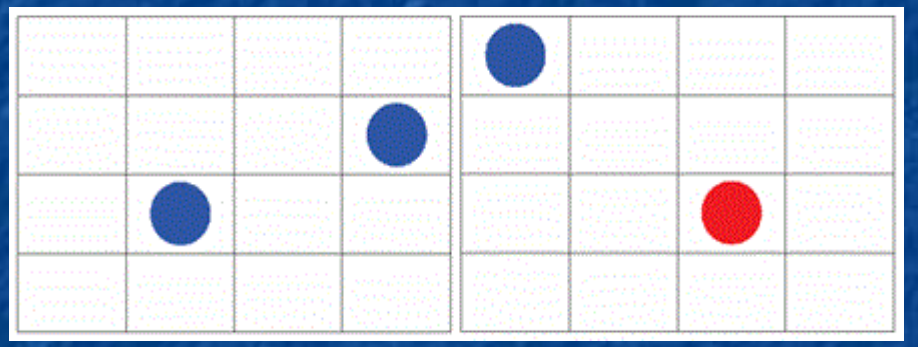
*Not assessed

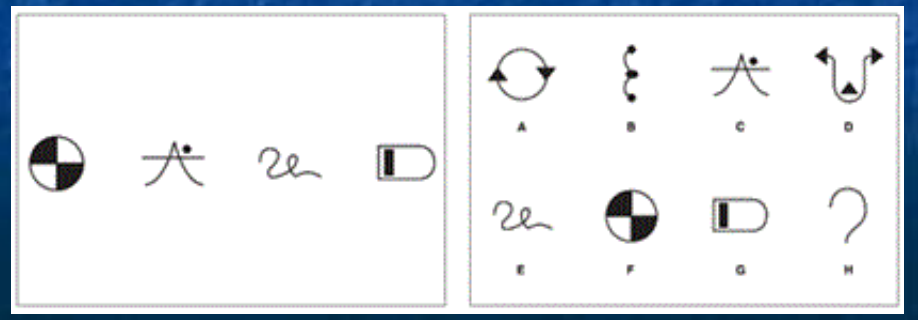
(Corkin, 1984)

Wechsler Memory Scale (WMS-IV)

WMS-IV SUBTESTS
Logical Memory I
Logical Memory II
Verbal Paired Associates I
Verbal Paired Associates II
Designs I
Designs II
Visual Reproduction I
Visual Reproduction II
Spatial Addition
Symbol Span







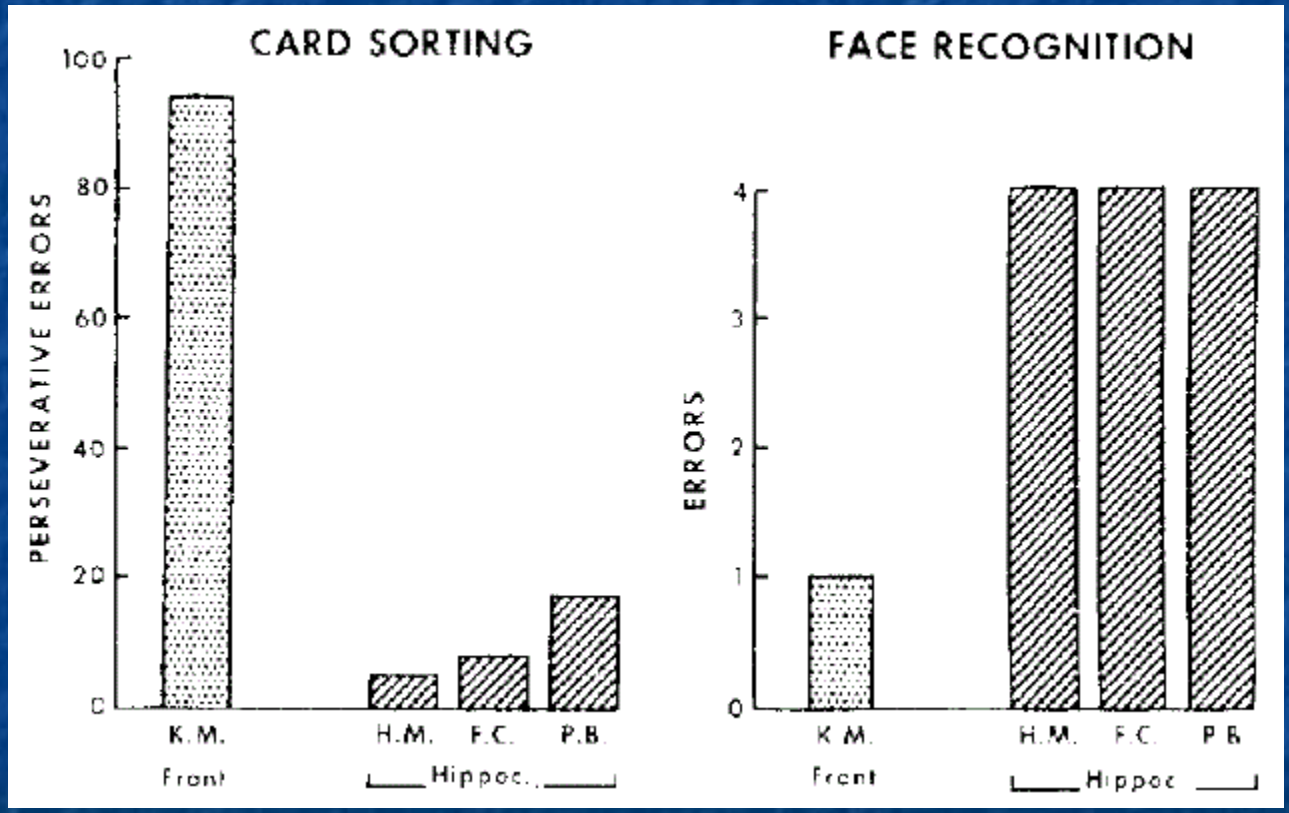
Patient H.M.
Perception

Table 1. Performance of H.M. on Mooney's face-perception test, as compared with that of 8 normal control subjects matched for age and sex (Maximum score: 44)

Subjects	Age (yr)		No. correct responses		Total time	
H.M.	40		40		6′40″	
	Mean	Range	Mean	Range	Mean	Range
Normal control	41.4	39–45	36.2	33–39	9′53″	8′10″–12′40″

(Milner, Corkin & Teuber, 1968)

Patient H.M.
Executive function



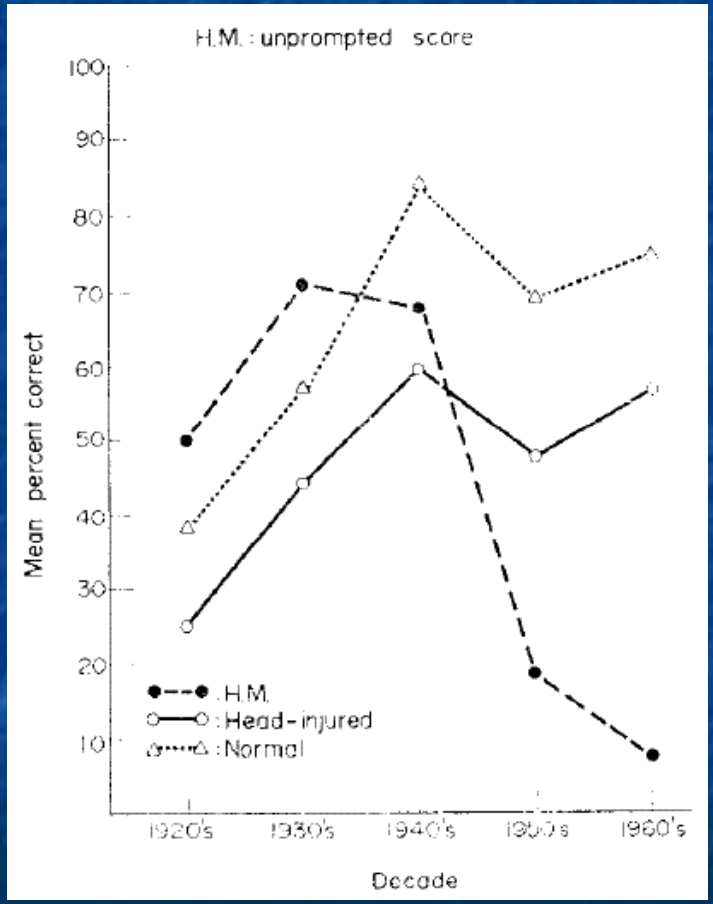
(Milner, Corkin & Teuber, 1968)

Patient H.M.
Short-term Memory (STM)

Exp. 1 (Single digits)		Exp. 2 (Digit triples)			
		L5		L7	
k	P(yes)	k	P(yes)	k	P(yes)
*	0.14	*	0.04	*	0.12
1	0.91	1	0.44	1	0.29
2	0.87	2	0.63	2	0.21
3	0.85	3	0.84	3	0.31
4	0.85	4	0.88	4	0.50
5	0.92	5	1.00	5	0.64
6	0.94			6	0.83
7	1.00			7	1.00
8	1.00				
*2+5	0.09				
2+5	1.00				

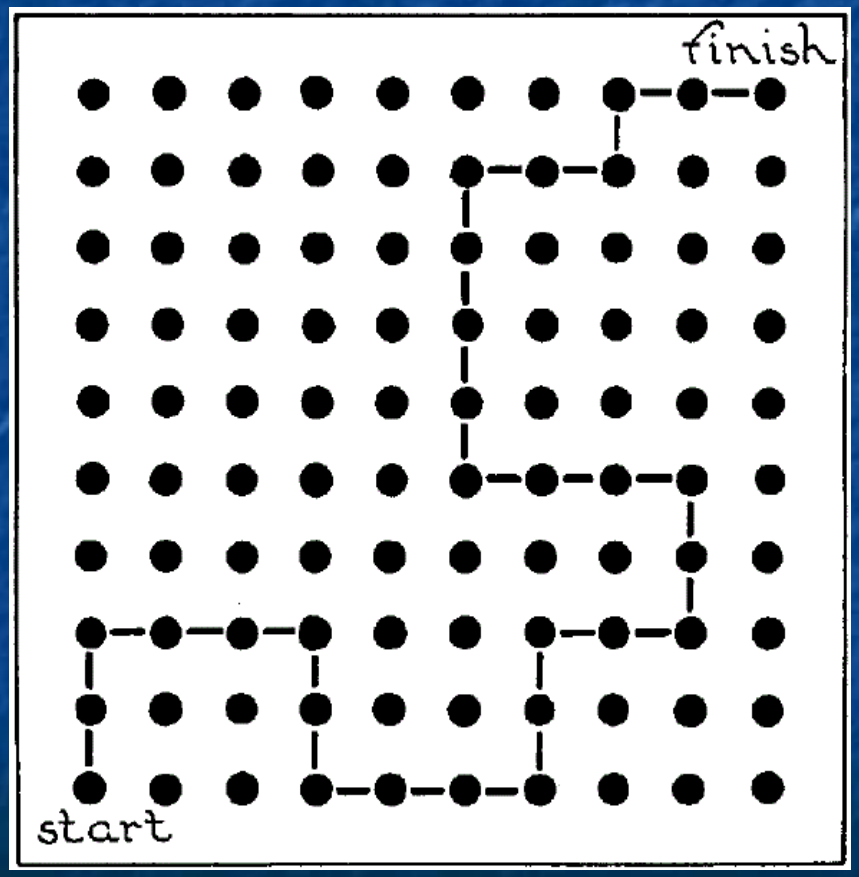
(Wickelgren, 1968)

Patient H.M.
Long-term Memory (LTM)



(Marlsen-Wilson & Teuber, 1975)

Patient H.M.
Non-verbal LTM



(Milner, 1965)

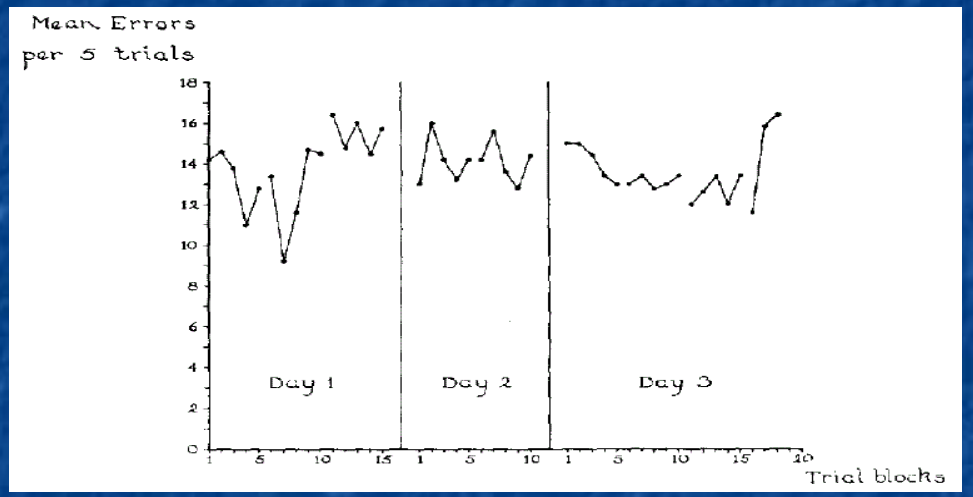


Table 5. Maze-learning scores for 5 subjects with bilateral lesions

Group	No. of cases	Trials	Errors
Bilateral frontal	2		
Case K. M.		73	381
Case A. N.		18	91
Bilateral hippocampal	3		
Case H. M.		215+	2,877+
Case F. C.		183	828
Case P. B.		102	377

Patient K.F.

Double Dissociation (STM)

TABLE I.—REPETITION OF NUMBERS, LETTERS AND WORD STRINGS OF INCREASING LENGTH

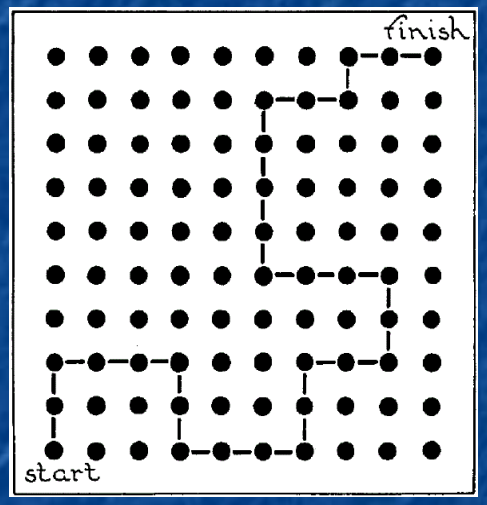
	String length	*1 Item*	*2 Items*	*3 Items*	*4 Items*
Numbers	No. of items correct	20/20	28/40	37/60	37/80
	No. of strings correct	20	12	6	1
Letters	No. of items correct	19/20	21/40	26/60	22/80
	No. of strings correct	19	7	2	0
Words	No. of items correct	20/20	29/40	32/60	33/80
	No. of strings correct	20	13	4	1

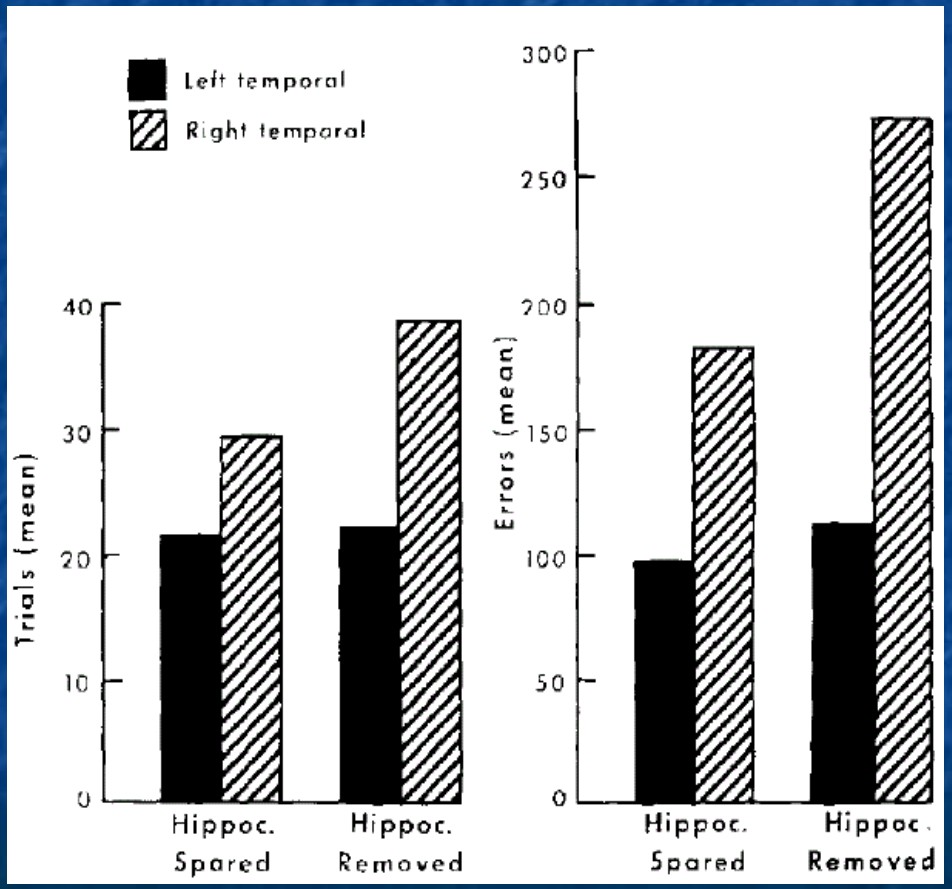
TABLE IX.—LEARNING OF INCOMPLETE WORDS AND PICTURES

		Patient		*Control group*	
		Test	*Retest*	*Test*	*Retest*
Gollin pictures	Initial score	14	10	19	10
	Trials	2	1	3	1
Incomplete words	Initial score	23	11	20	11
	Trials	4	2	3	2

(Shallice & Warrington, 1969)

Hippocampus: Lateralisation

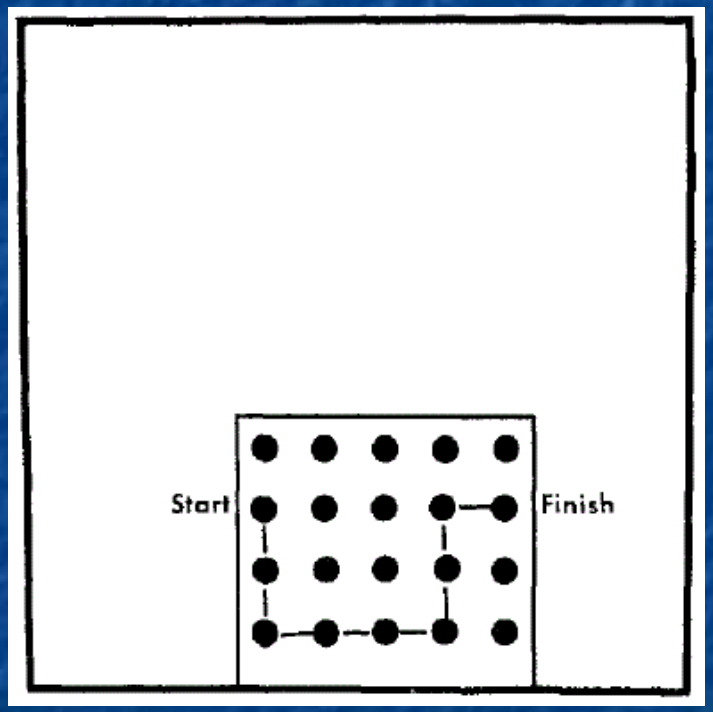


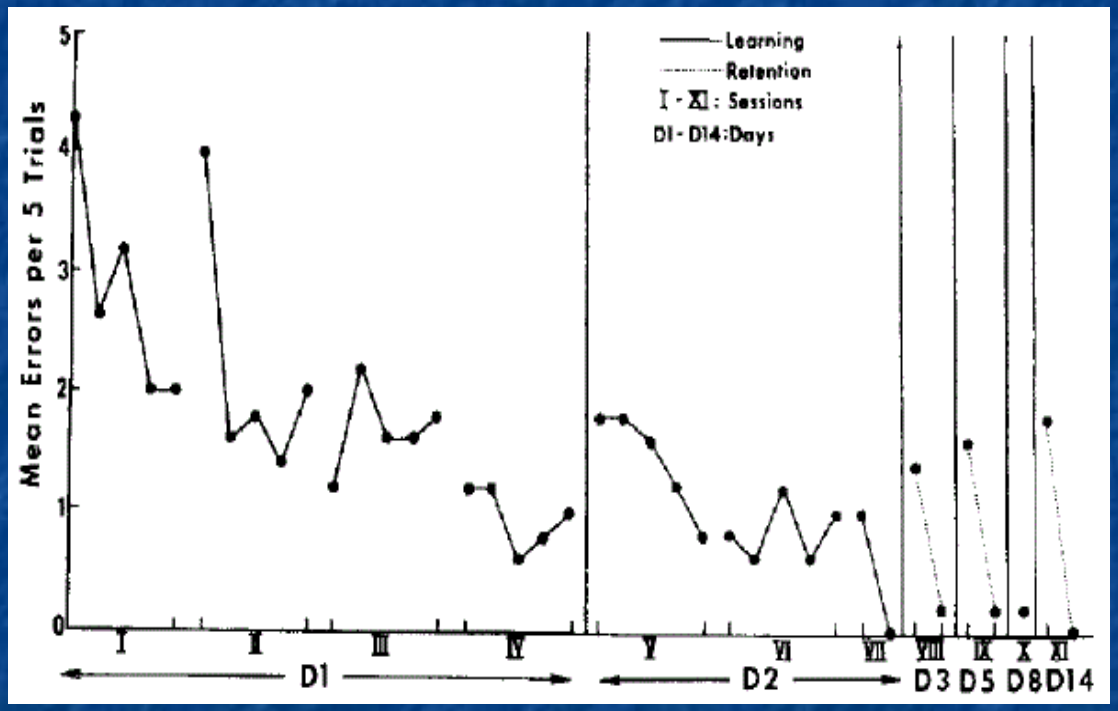


(Milner, 1965)

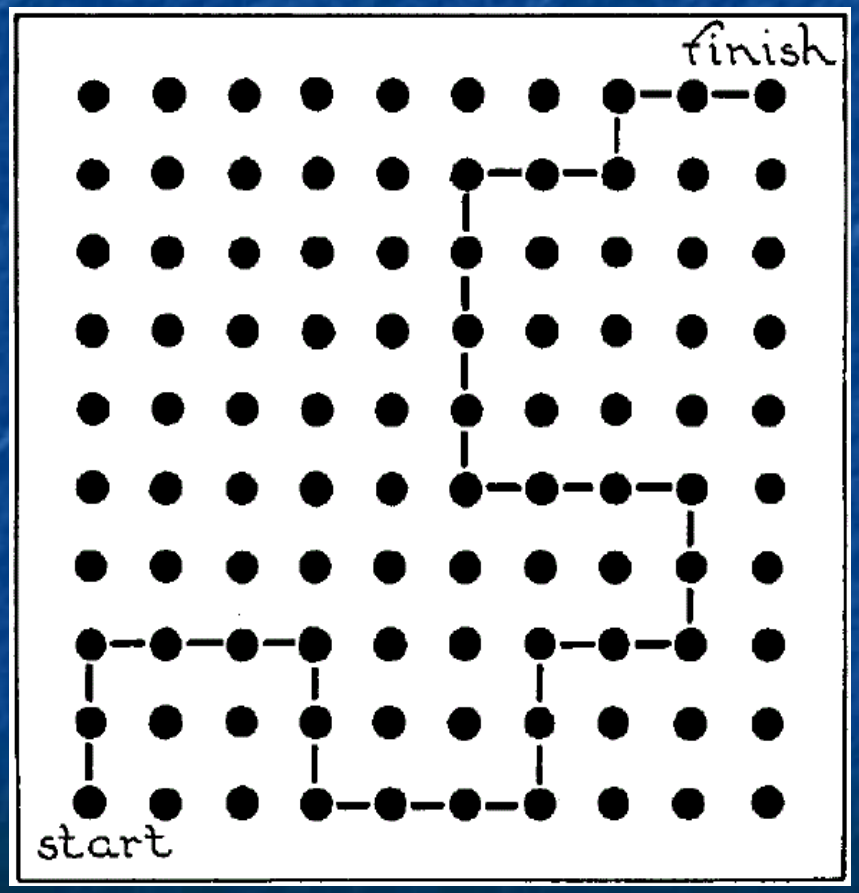
Patient H.M.

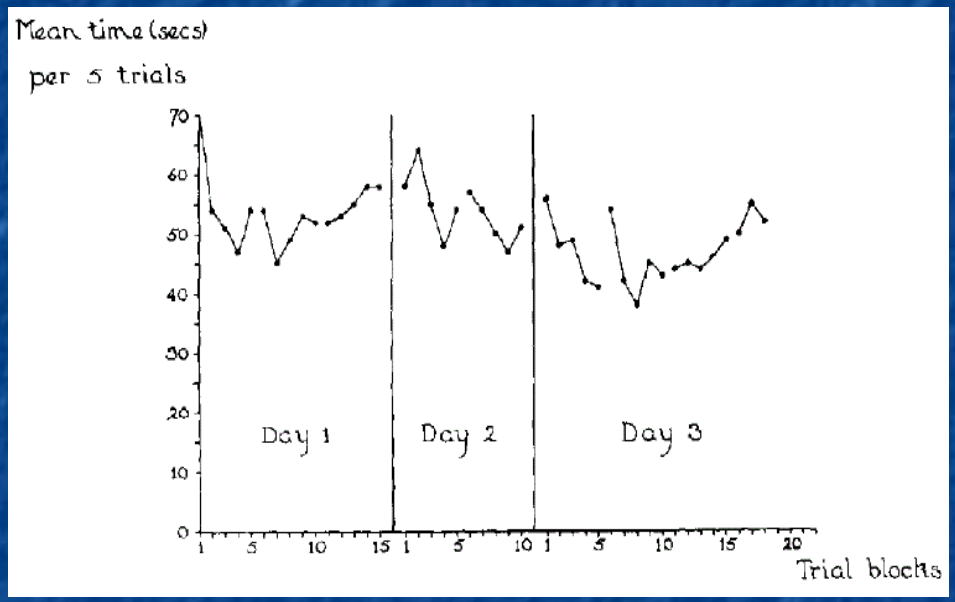
Non-verbal LTM





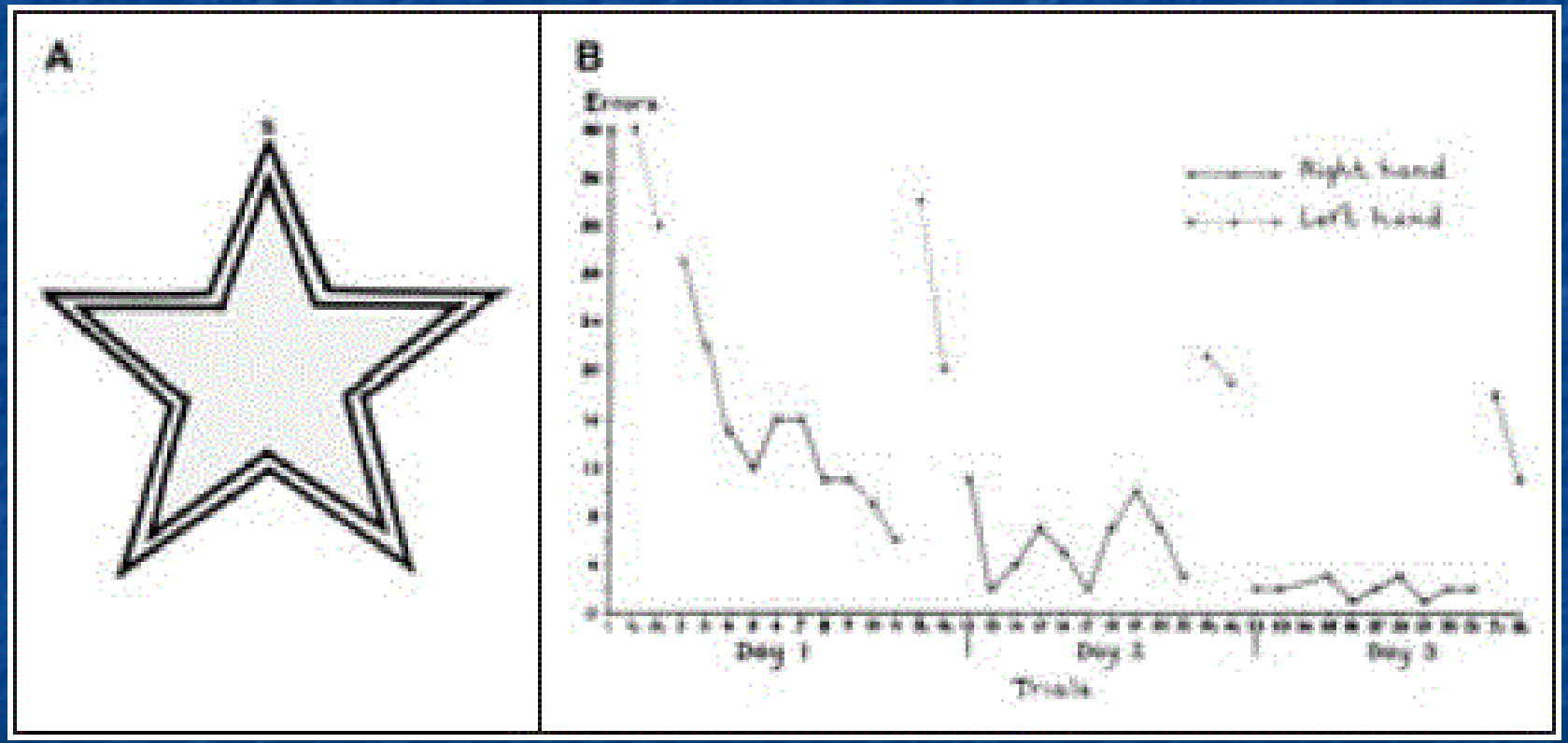
Patient H.M.





(Milner, 1965)

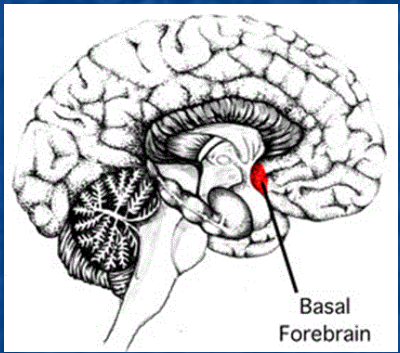
Patient H.M.
Procedural LTM

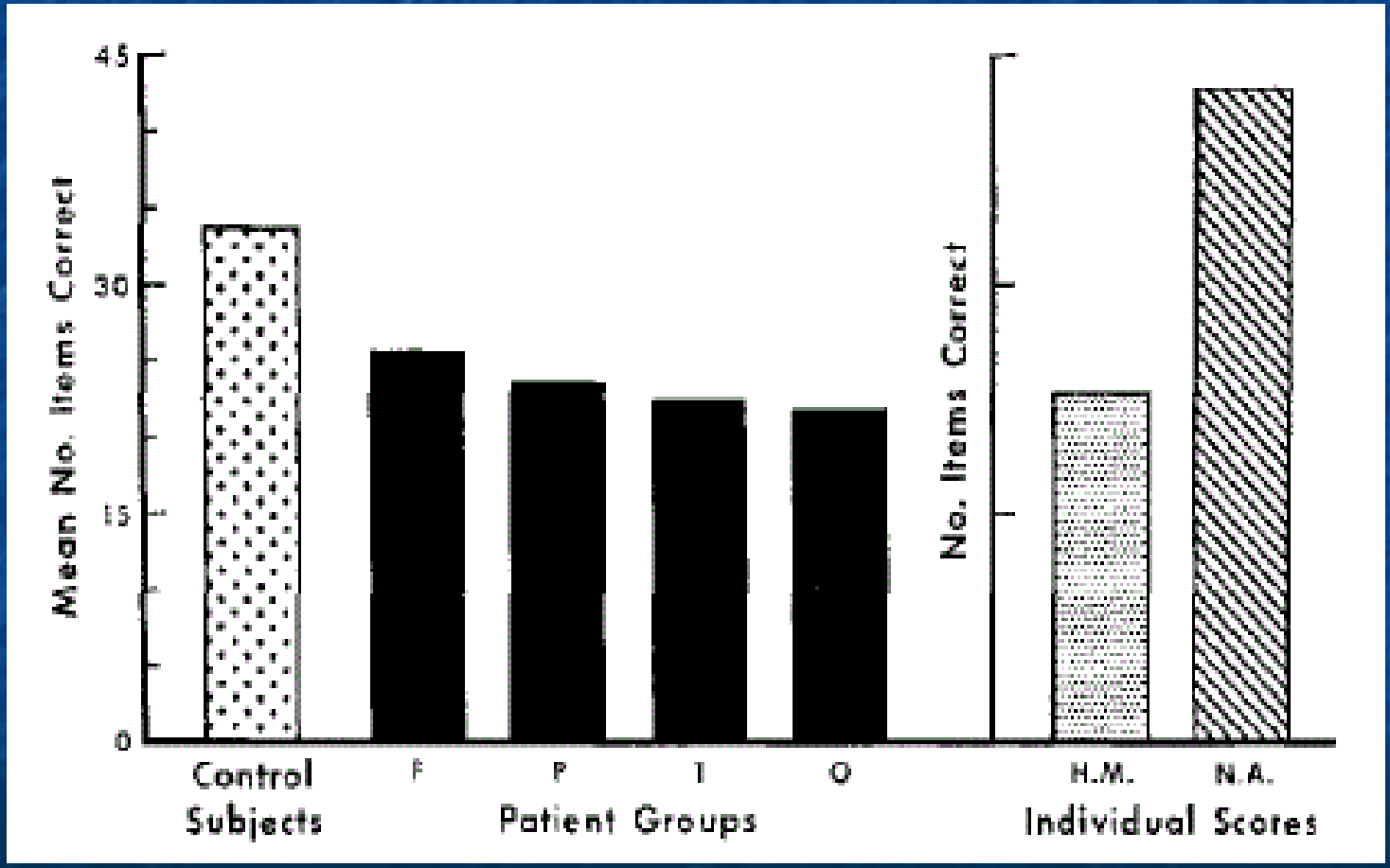


(Milner, 1962; [Corkin, 1968])

Patient N.A.

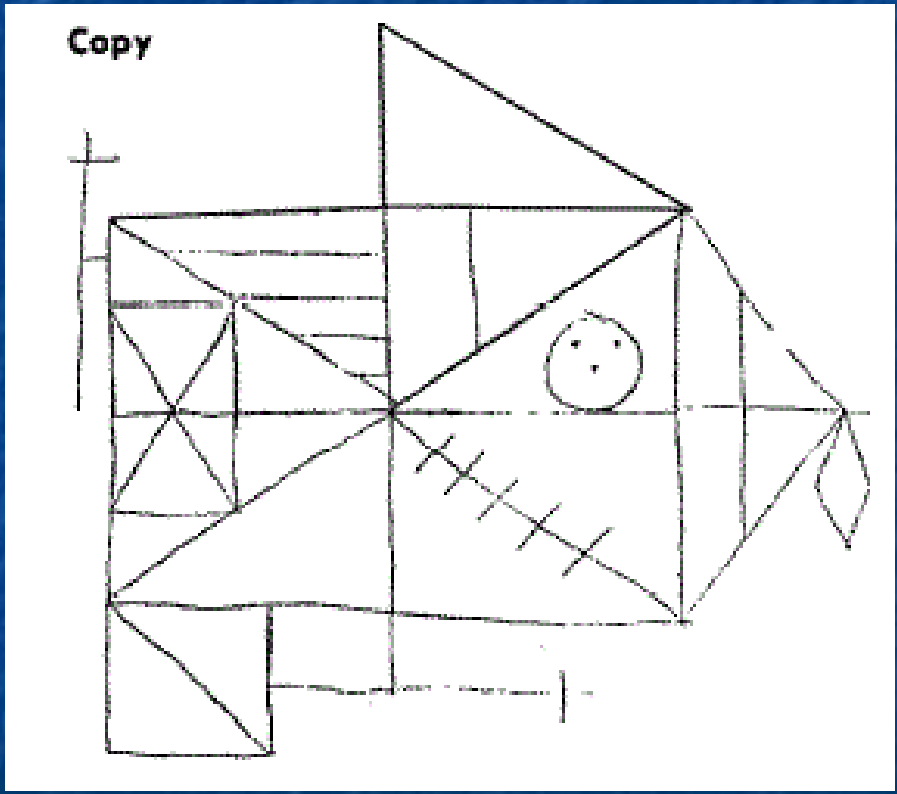
Perception

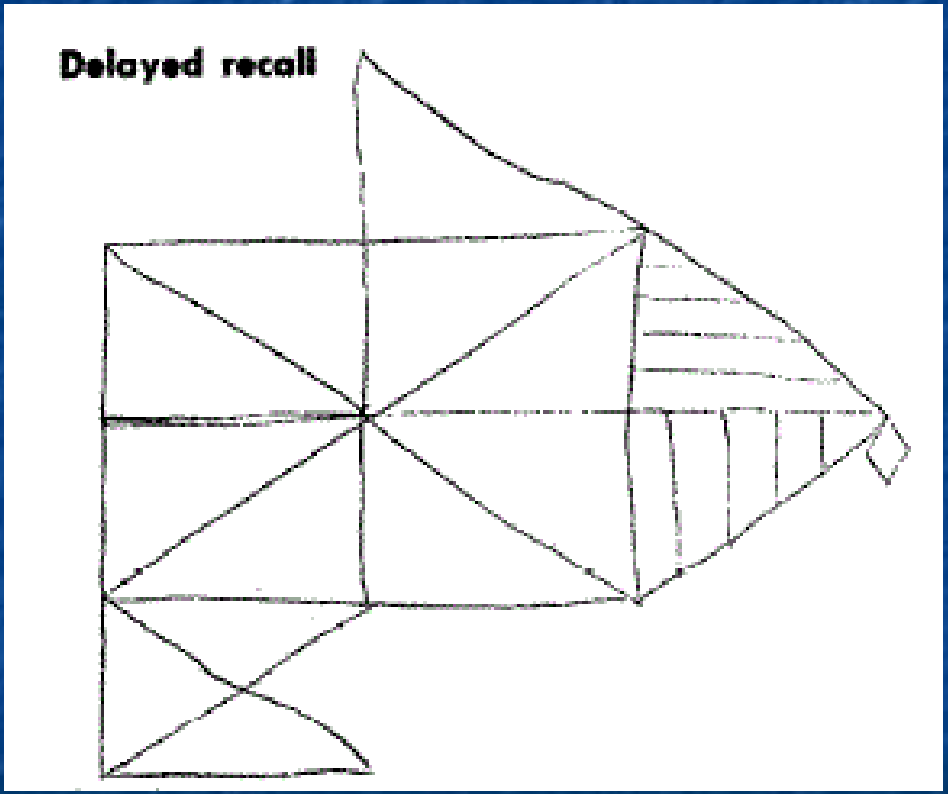




(Tueber, Milner & Vaughan, 1968)

Patient N.A.
Non-verbal LTM





(Tueber, Milner & Vaughan, 1968)

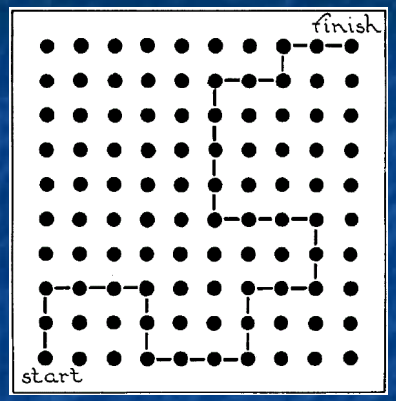
Patient N.A.
Non-verbal LTM

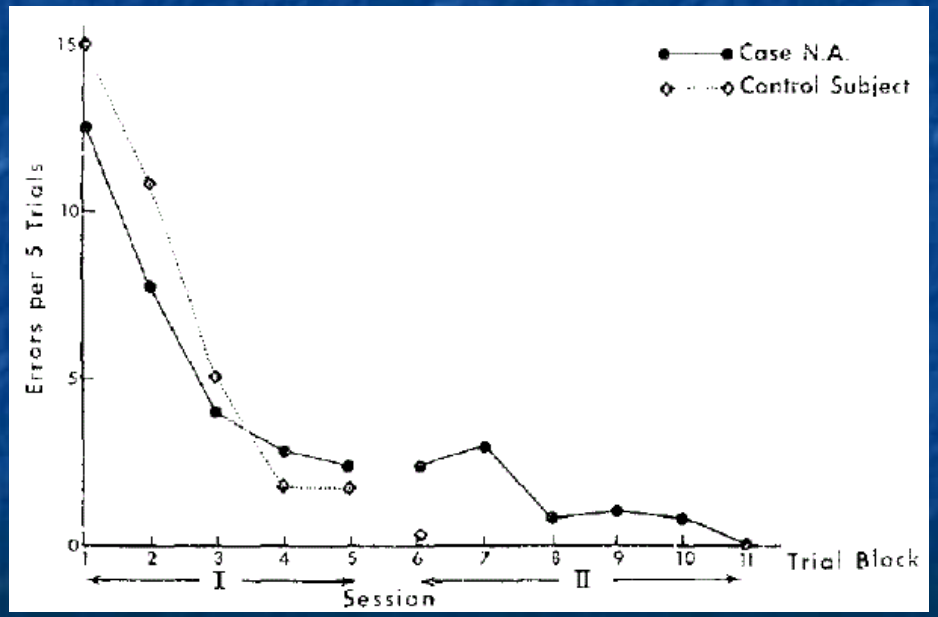
	Copy		Delayed reproduction		Loss (%)	
N.A.	32		17		47	
	Mean	Range	Mean	Range	Mean	Range
Left temporal (N=19)	33.1	30–35	21.2	14.5–28.0	36	20–54
Right temporal (N=26)	30.0	22–34	14.2	6.0–24.5	53	24–80

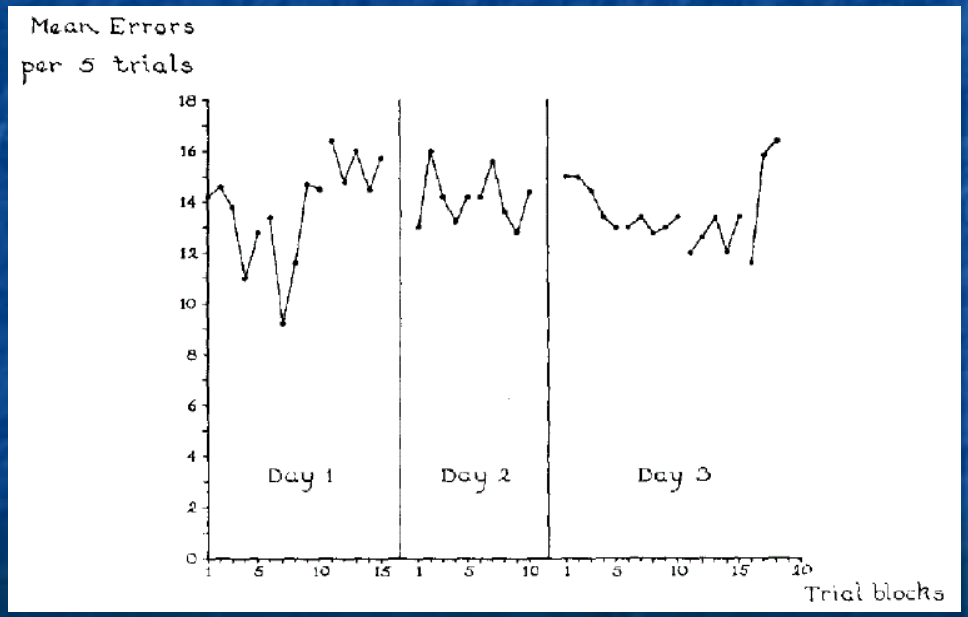
(Tueber, Milner & Vaughan, 1968)

Patient N.A.

Non-verbal LTM

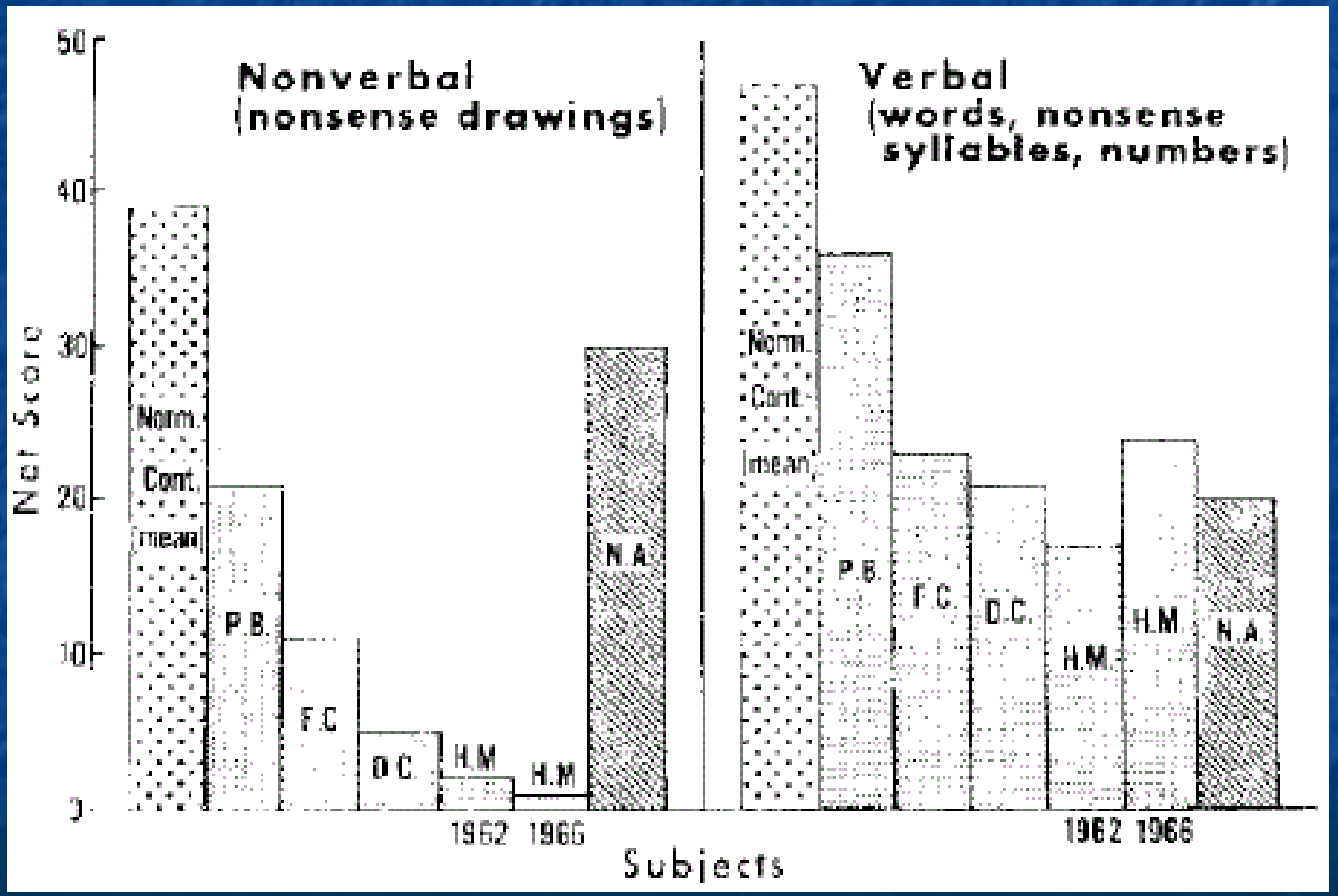






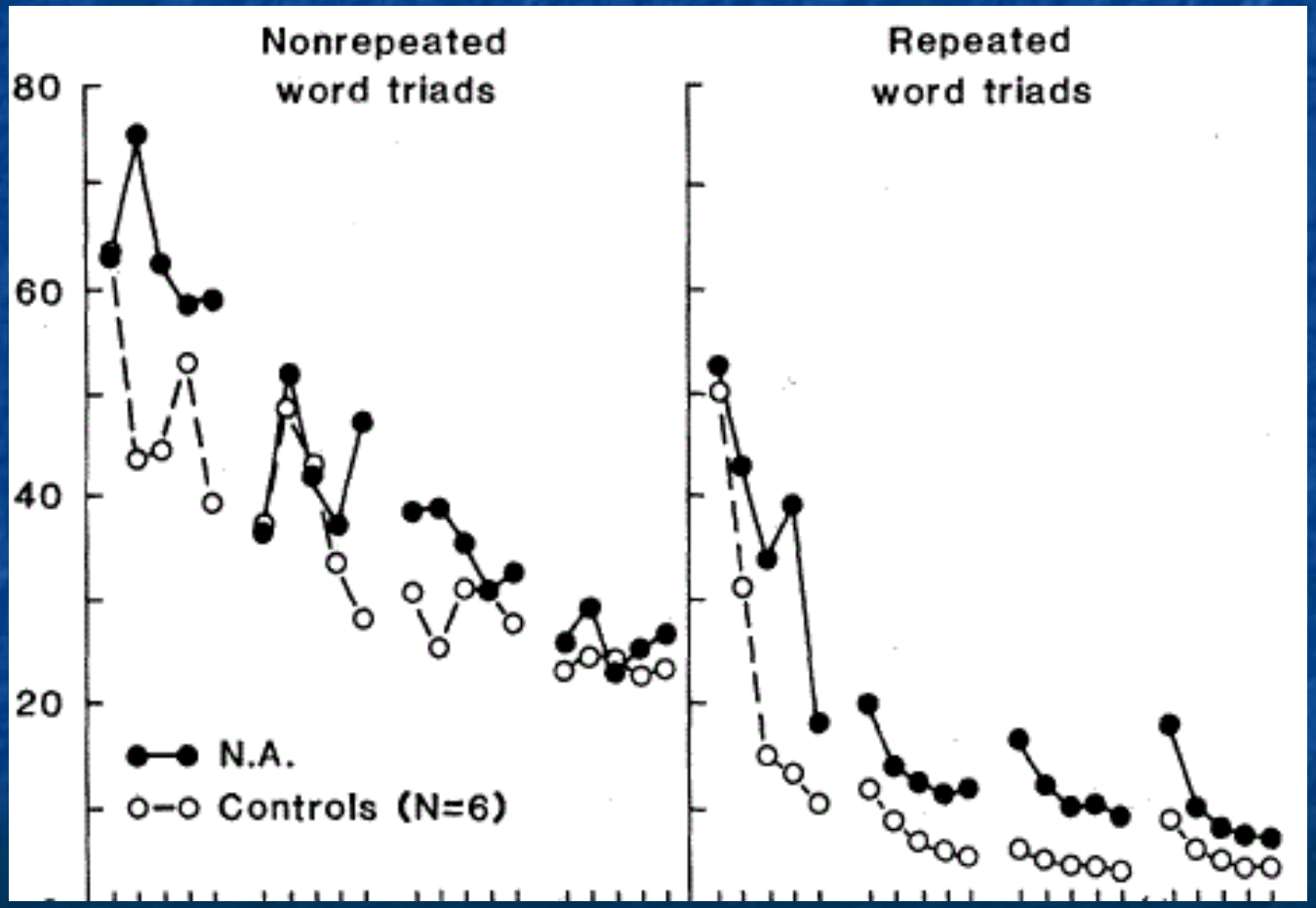
(Tueber, Milner & Vaughan, 1968)

Patient N.A.
Verbal LTM



(Tueber, Milner & Vaughan, 1968)

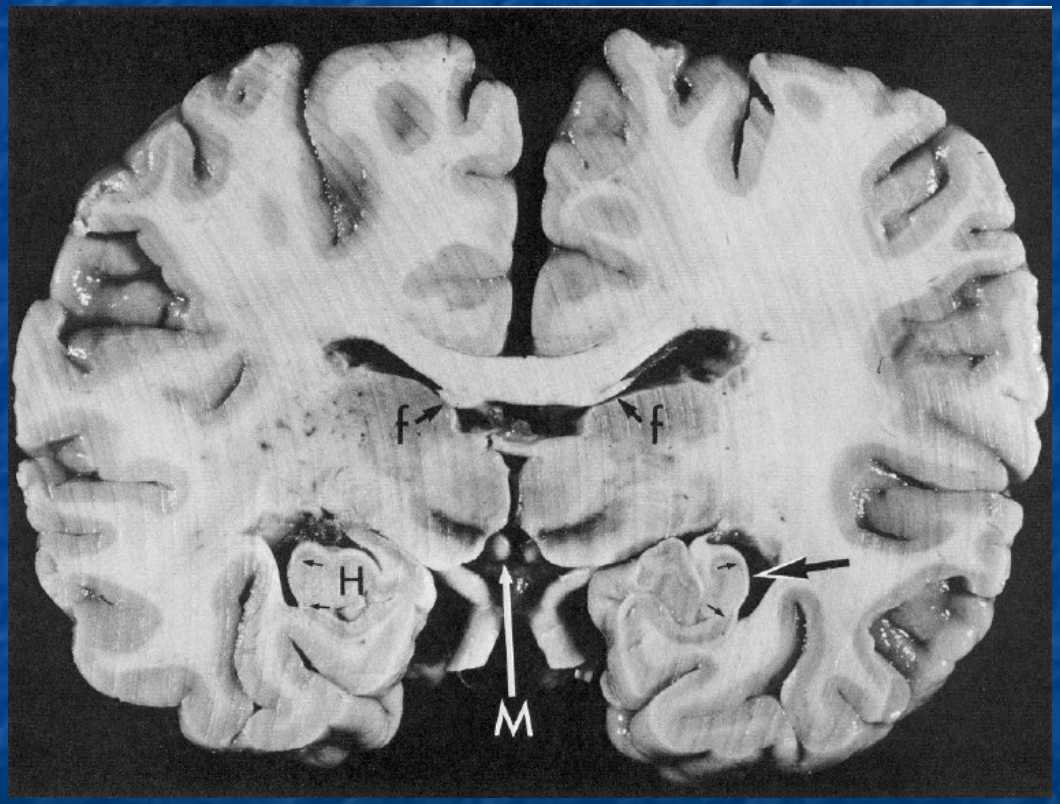
Patient N.A.
Procedural LTM



(Cohen & Squire, 1980)

Patient R.B.

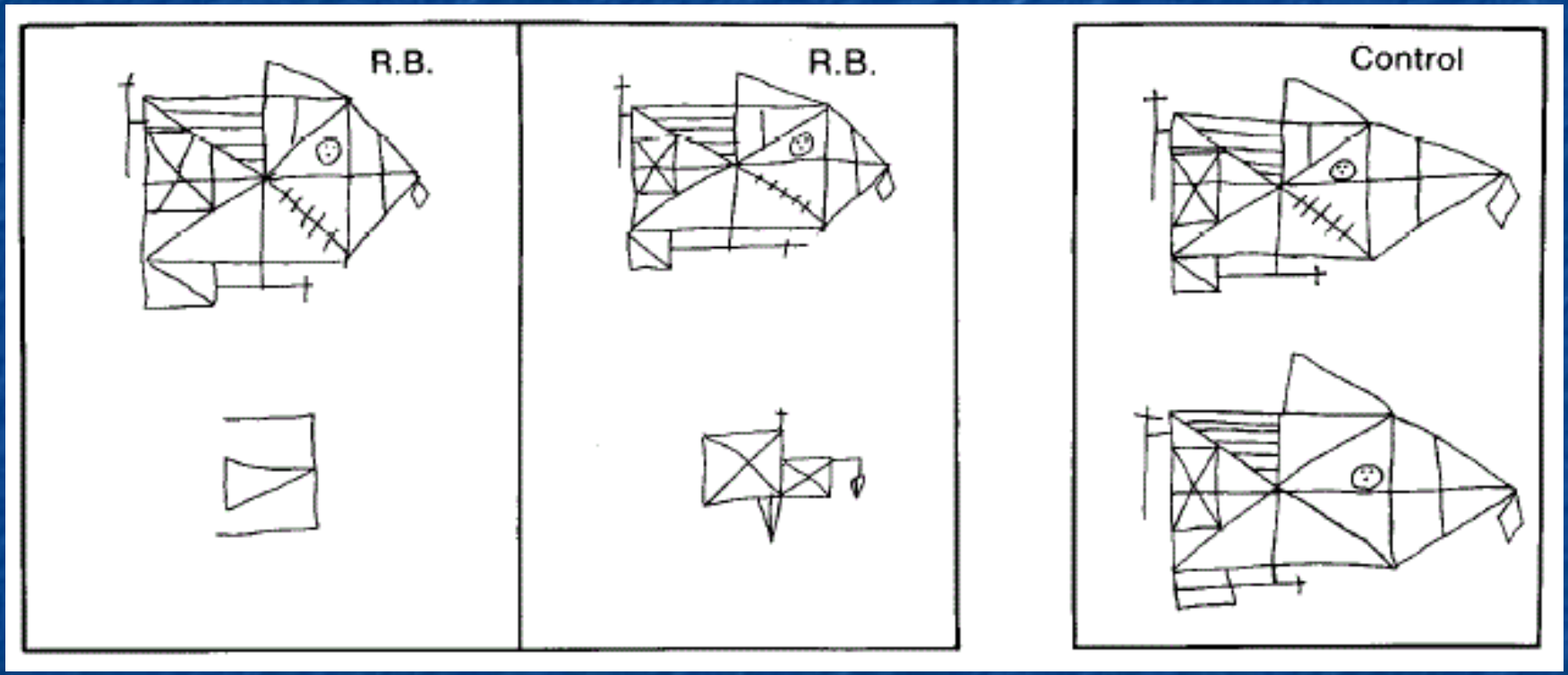
Hippocampus: CA1



(Zola-Morgan, Squire & Amaral, 1980)

Patient R.B.

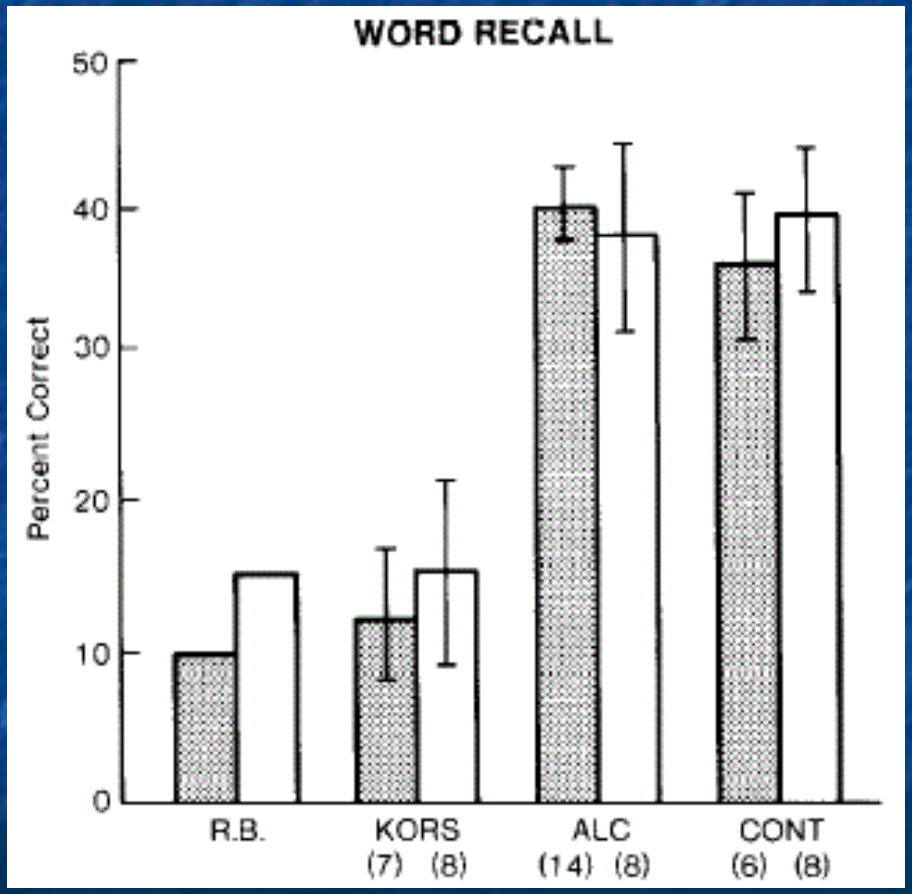
Hippocampus: CA1



(Zola-Morgan, Squire & Amaral, 1980)

Patient R.B.

Hippocampus: CA1



(Zola-Morgan, Squire & Amaral, 1980)

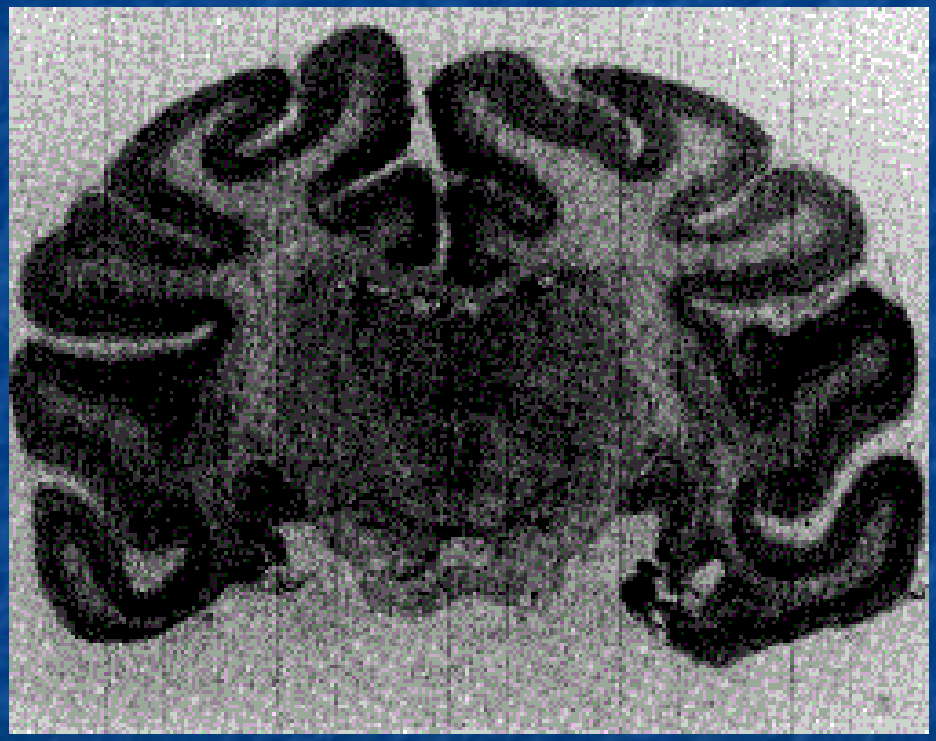
Animal Models
Neuroanatomy

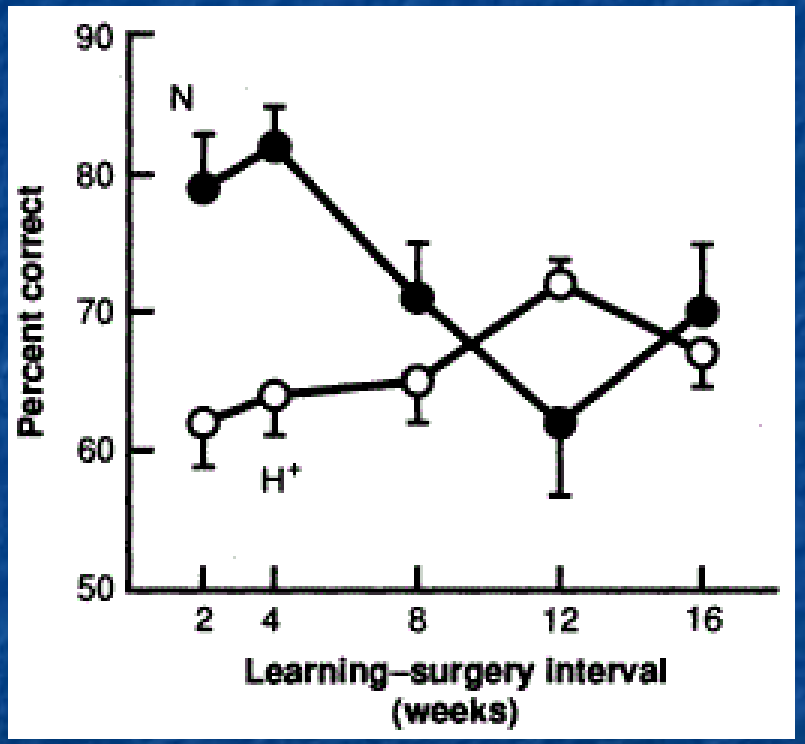
Table 1 Effects of removal of amygdala and hippocampus on memory

Groups		Preoperative Trials	Preoperative Errors	Postoperative Trials	Postoperative Errors	Delays (%correct) 30 s	Delays (%correct) 60 s	Delays (%correct) 120 s	Objects (% correct) 3	Objects (% correct) 5	Objects (% correct) 10
Normal control	1	100	26	0	0	97	98	96	96	93	91
	2	80	28	0	0	99	100	98	97	97	94
	3	40	19	0	0	98	99	98	97	96	92
Amygdalectomy	1	120	42	80	32	95	95	95	91	92	82
	2	100	27	340	85	91	89	92	88	87	77
	3	80	30	0	0	91	95	94	96	95	87
Hippocampectomy	1	60	17	80	22	98	93	94	95	92	84
	2	100	26	120	32	85	89	83	89	85	71
	3	120	31	20	4	98	99	95	95	92	88
Amygdalectomy + hippocampectomy	1	210	49	760	179	79	65	65	62	64	59
	2	100	26	1,500	429*	64	59	63	60	55	61
	3	80	22	700	203	61	47	52	53	58	44
Group means											
Normal control		73	24	0	0	98	99	98	97	96	92
Amygdalectomy		100	33	140	39	94	93	94	92	91	82
Hippocampectomy		93	25	73	19	94	94	91	93	90	81
Amygdalectomy + hippocampectomy		130	32	987	270	68	57	60	58	59	55

(Mishkin, 1978)

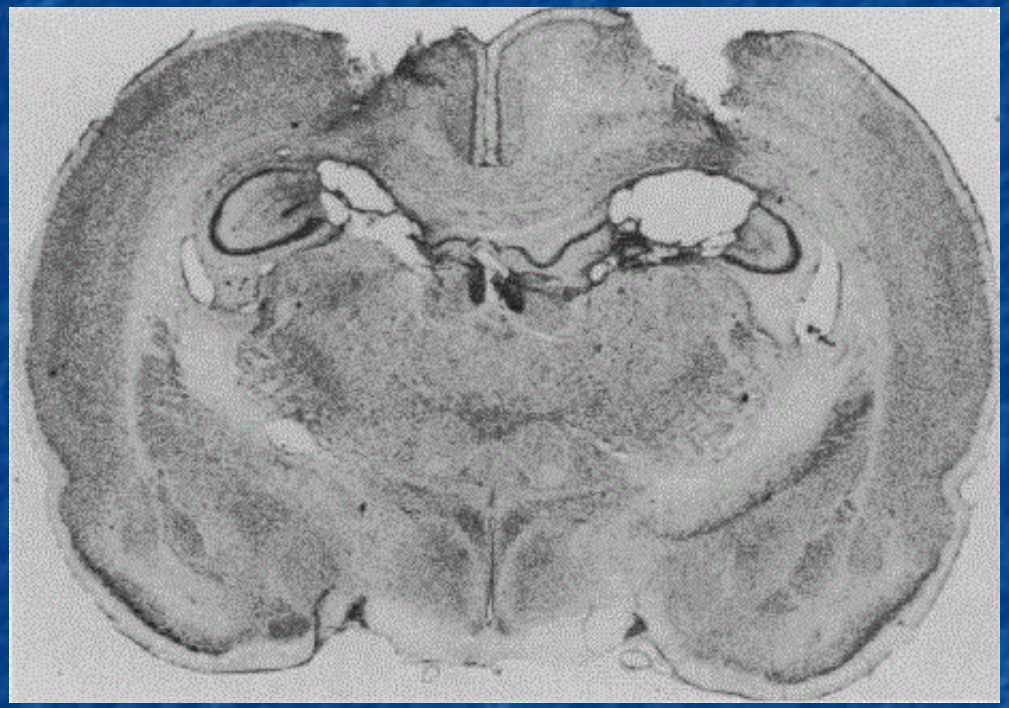
Animal Models
Consolidation

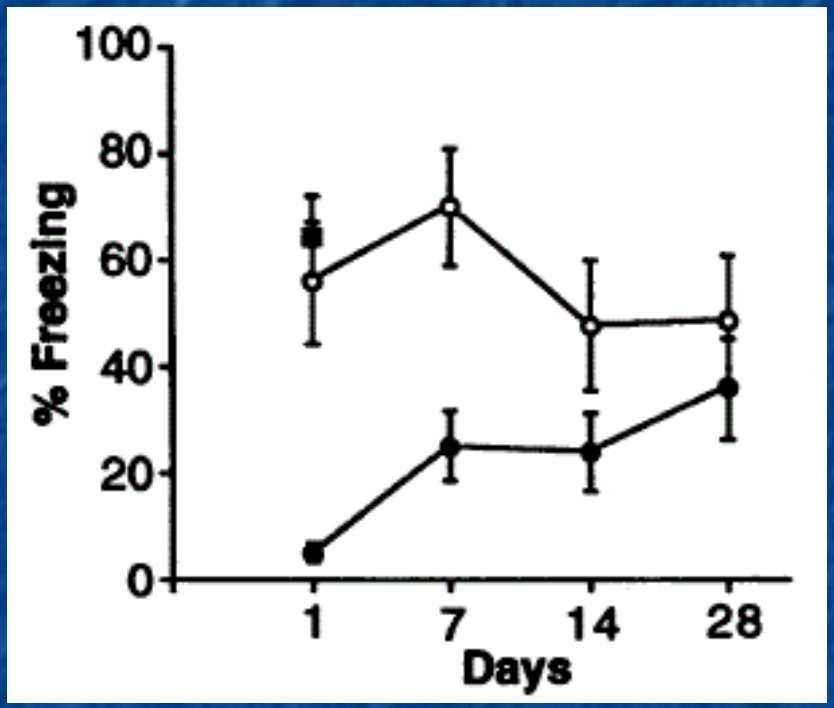




(Zola-Morgan & Squire, 1990)

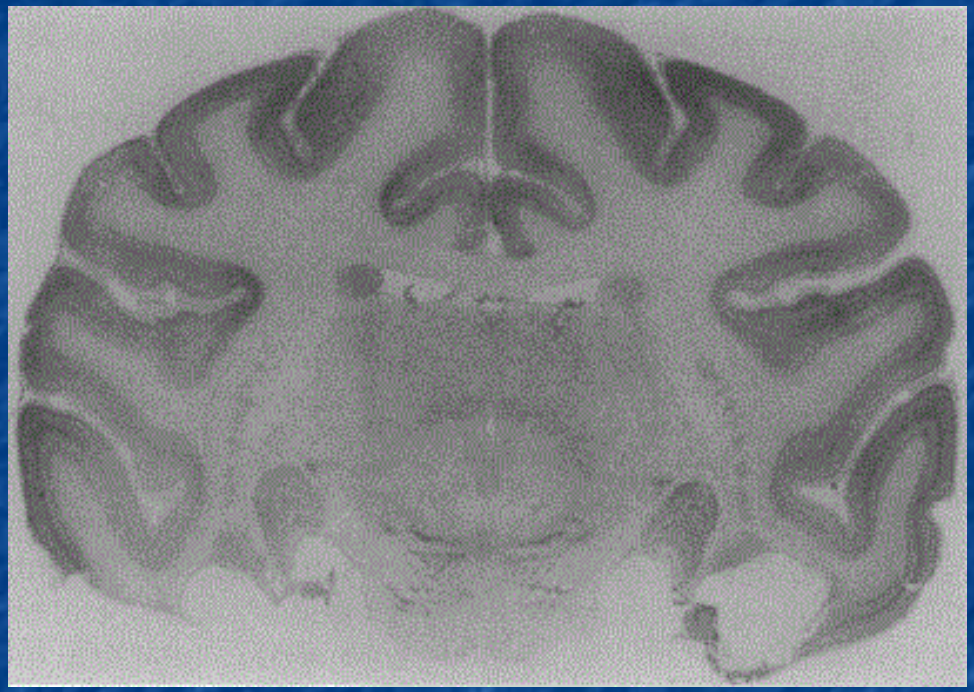
Animal Models
Consolidation

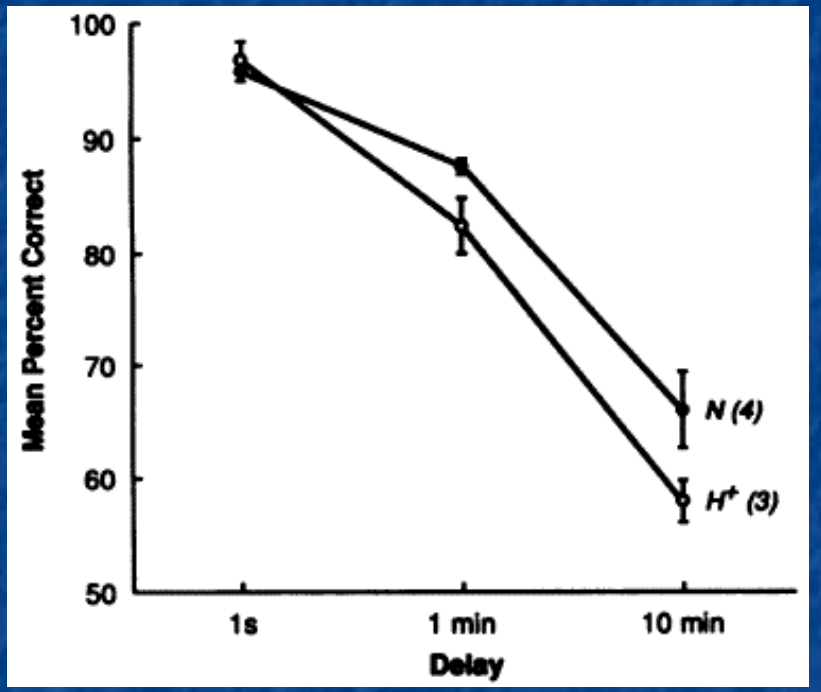




(Kim & Fanselow, 1992)

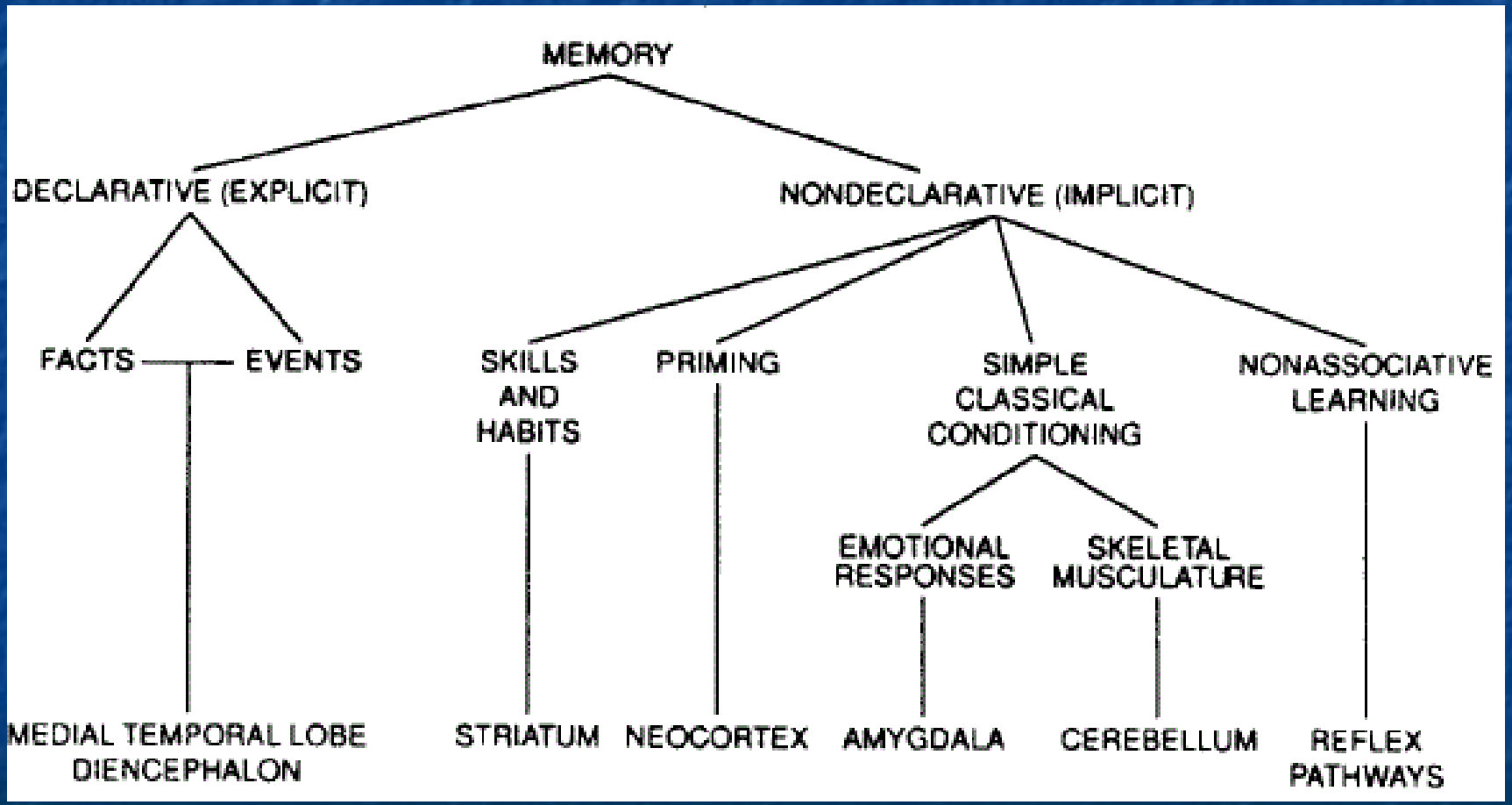
Animal Models
STM vs. LTM





(Alvarez, Zola-Morgan & Squire, 1994)

Architecture of Memory



(Squire & Knowlton, 1995; Vargha-Khadem, 1997)

The End

Example Exam Questions

1. How have neuropsychological investigations revealed multiple memory systems?
2. How has H.M. informed the neuropsychology of memory