

Week 14

- KW 18 : Learning & Memory

Psychology 465 - Human Neuropsychology - Spring 2017

947

KW 18 : Learning & Memory

Psychology 465 - Human Neuropsychology - Spring 2017

948

Overview of Learning & Memory

- Short History of Learning & Amnesia
- Taxonomy of Memory Systems
- Patients “HM” & “KC”
- Long Term Memory Systems
 - Explicit
 - Implicit
 - Emotional Memory
- Short Term Memory
- Uncommon minds: Asperger’s and Savantism

Psychology 465 - Human Neuropsychology - Spring 2017

949

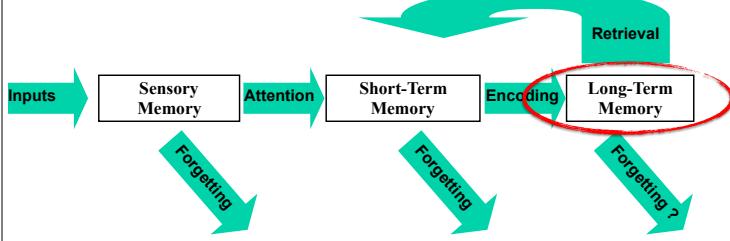
History of Memory & Amnesia

- 1880s - Ebbinghaus - first formal studies of human memory
- 1900s - autopsies of brains with severe memory impairment
 - often showed medial temporal cortex atrophy
- 1916 - Karl Lashley - lesion studies in animals - behavioral measures (e.g. maze pathfinding)
 - unable to find specific site of “memory”, but more damage = more memory loss
 - “not possible to demonstrate the isolated localization of a memory trace...”
- (N.B: this may be why the result of HM’s surgery were a surprise)
- 1950s - HM and other patients

Psychology 465 - Human Neuropsychology - Spring 2017

950

3 Memory Systems



Psychology 465 - Human Neuropsychology - Spring 2017

951

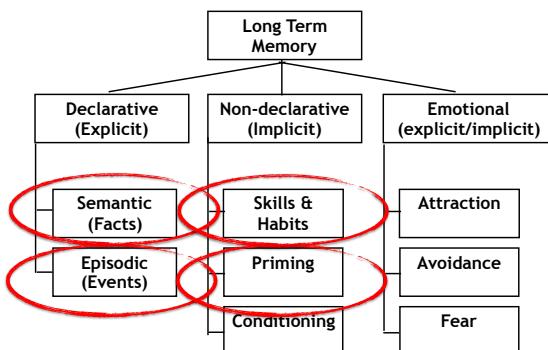
Taxonomy of Human Memory Systems

- Sensory Memory
- Short Term Memory (Working Memory)
 - sensory, cognitive, motor
- Long Term Memory
 - Explicit (conscious)
 - Episodic (events)
 - personal, autobiographical
 - Semantic (facts)
 - general knowledge
 - Implicit (unconscious)
 - skills & habits, priming, conditioning
 - Emotional (conscious & unconscious)
 - attraction, avoidance, fear

Psychology 465 - Human Neuropsychology - Spring 2017

952

Taxonomy of Long-Term Memories



Psychology 465 - Human Neuropsychology - Spring 2017

954

Explicit Versus Implicit Memory

• Explicit (Declarative):

- Knowledge that can be retrieved and then reflected on consciously.
 - Verbal, Visual
- “Knowing That”
- Example:
 - knowing a bicycle has two wheels

• Implicit (Nondeclarative):

- Knowledge that can influence thought and behavior without needing conscious awareness.
- “Knowing How”
 - actually being able to ride a bike

Psychology 465 - Human Neuropsychology - Spring 2017

955

Episodic Versus Semantic Memory

- Episodic (Events):
 - Autobiographical memory -- stores personally experienced events -- “What did you do on your last birthday party?”
- Semantic (Facts):
 - Stores general world knowledge : concepts and categories -- “What is a birthday party?”

Psychology 465 - Human Neuropsychology - Spring 2017

956

Amnesia

- Definition
- Causes
 - Infantile Amnesia
 - Fugue State
 - Transient Global Amnesia
 - Delirium, intoxication, drugs or ECT
- Common Kinds of Amnesia

Psychology 465 - Human Neuropsychology - Spring 2017

957

Amnesia

- Loss of memory or memory abilities due to brain damage, disease, or other condition
- Usual Definitions:
 - affects conscious (explicit) episodic memory only
 - other forms of memory intact:
 - sensory memory normal
 - STM or Working Memory intact
 - Semantic memory intact
 - Implicit memory intact
 - Often permanent although temporary Amnesias are possible

Psychology 465 - Human Neuropsychology - Spring 2017

958

Childhood (Infantile) Amnesia

- Infantile amnesia - lack of episodic memory for first few years of life
 - birth to 2.5 years: very few true memories
 - most “memories” are incorrect
 - 2.5 to 10 years : true memories mixed with false memories
 - 10+ years : memories are more adult-like
- Freud: due to trauma
- Modern thinking : memory systems undeveloped

Psychology 465 - Human Neuropsychology - Spring 2017

959

Psychogenic or Dissociative Amnesia

- Uncommon
- Sudden onset following physical or psychological stress
- Most commonly, personal information is forgotten
 - Sometimes the patient is unable to recall anything about his or her past
- During memory loss cognitive skills are intact
- Recovery is usually complete within 48 hours
 - but cases lasting days or weeks have been documented
- Also known as
 - “Fugue State”
 - “soap opera amnesia”

Psychology 465 - Human Neuropsychology - Spring 2017

960

Transient Global Amnesia

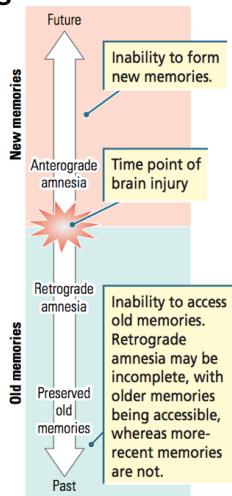
- Transient Global Amnesia
 - acute state
 - loss of old memories
 - inability to form new ones
- Causes?
 - concussion, migraine, hypoglycemia, seizure, stroke, drug intoxication, delirium

Psychology 465 - Human Neuropsychology - Spring 2017

961

Anterograde vs. Retrograde

- Anterograde: Loss of memory for events after the injury
 - Caused by damage to the hippocampus and temporal lobes
 - Mechanism: Failure of Learning or Retrieval?
- Retrograde: Loss of memory for events before the injury
 - Most common with neural degenerative disorders (e.g., Alzheimer's)
 - often temporally-graded
 - Mechanism: Failure of Learning, or Retrieval?



Psychology 465 - Human Neuropsychology - Spring 2017

963

K.C. (Kent Cochrane)

- Widespread brain injury, especially frontal regions, in a motorcycle accident.
- Complete loss of episodic memory “he cannot remember...a single thing he has ever done or experienced in the past... from either before or after his accident”
- Can not “time travel” - (can not imagine future or past events or plans) - loss of “autonoetic consciousness”
- Episodic: Amnesia -- Anterograde? Retrograde?
- Semantic: normal.
- Confabulation? -- brother's funeral was “very sad”
- b. 1951, d. March 2014

Psychology 465 - Human Neuropsychology - Spring 2017

967

Case History: “HM” (Henry Molaison)

- HM : 27 year old male with long history of epilepsy (worsening frequency & severity), post 7 year old bike accident
- Surgery: experimental, removed medial-temporal-lobe
- Results:
 - normal memory for life prior to surgery
 - above average IQ (118)
 - almost zero ability to learn new conscious information
 - after working 6 months at a new job, unable to recall a single detail, though he did learn to navigate within 2 blocks new home (8 yrs)
 - skill learning : preserved
 - emotional changes (reduced prosody & sensitivity to emotional stimuli)

Psychology 465 - Human Neuropsychology - Spring 2017

974

H.M.

- Hippocampus removed on both sides (small, but important areas)
- Attention, STM and Retrieval of LTM for events before the surgery were intact
- IQ 118
- Complete Anterograde amnesia -- unable to learn form new episodic memories
- Implicit memory intact
 - Mirror-drawing performance improved, but zero memory of having practiced

Psychology 465 - Human Neuropsychology - Spring 2017

975

K.C. vs. H.M.

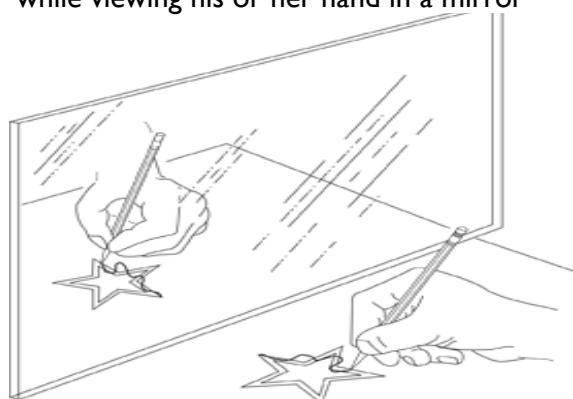
- Patient K.C.
Episodic memory processes disrupted, but semantic memory processes intact.
- Patient H.M.
Unable to transfer new information into LTM, but able to retrieve already stored memories from LTM.

Psychology 465 - Human Neuropsychology - Spring 2017

976

Mirror Drawing Task

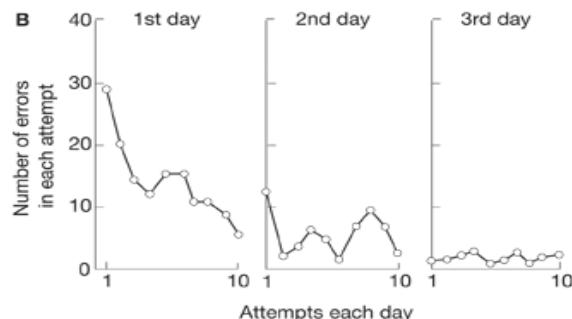
In this test, the subject's task is to trace between the two outlines of the star while viewing his or her hand in a mirror



Psychology 465 - Human Neuropsychology - Spring 2017

977

Mirror Drawing Task



H.M. shows clear improvement in motor learning star task, showing implicit learning and memory - Yet he has no conscious (explicit) memory of the task.

Psychology 465 - Human Neuropsychology - Spring 2017

978

H.M.

- Hippocampus is critical for transfer of explicit memories from STM to LTM
 - Gateway to LTM
 - Not a site of storage
- Amnesia is not due to injury of brain regions which process or store info

Psychology 465 - Human Neuropsychology - Spring 2017

979

Retrograde Amnesia & Consolidation

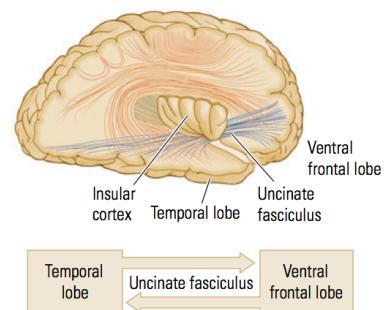
- Data
 - Patients with hippocampus damage show similar pattern
 - profound anterograde amnesia
 - moderate retrograde amnesia
 - time-dependent (aka "temporally graded")
- Theory:
 - hippocampus temporarily holds memories and helps consolidate them (move them to the cortex for permanent storage)

Psychology 465 - Human Neuropsychology - Spring 2017

980

Neurobiology of Episodic Memory

- Temporal Lobe and Ventral frontal lobe
- Connected via uncinate fasciculus



Psychology 465 - Human Neuropsychology - Spring 2017

981

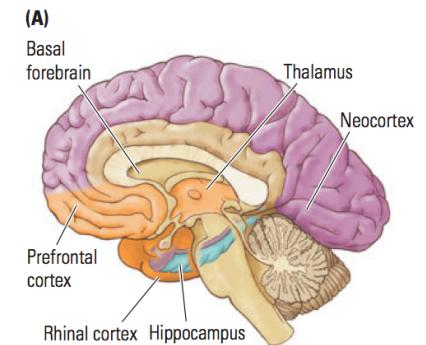
Neurobiology of Explicit Memory

982

Psychology 465 - Human Neuropsychology - Spring 2017

Neural Substrates of Explicit Memory

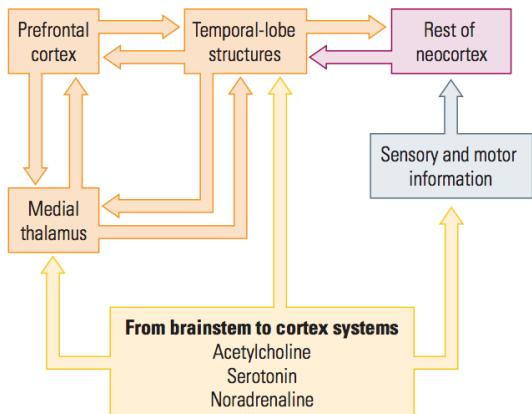
- Prefrontal Cortex
- Temporal Lobe
- Medial Thalamus
- Rest of cortex
- Brainstem



Psychology 465 - Human Neuropsychology - Spring 2017

983

Neural Substrates of Explicit Memory



984

Psychology 465 - Human Neuropsychology - Spring 2017

Explicit Memory : Focal Damage

- Focal damage to many areas can cause some form of explicit memory impairment
- Pattern of impairment follows pattern of damage
 - e.g. compare HM to KC

Psychology 465 - Human Neuropsychology - Spring 2017

985

Explicit Memory : Diffuse Damage

- Diffuse damage also can cause explicit memory impairments
- Examples
 - Herpes Simplex Encephalitis
 - brain infection due to herpesvirus
 - tends to cause retrograde, and anterograde amnesia
 - Alzheimer's Disease
 - loss of ACh projections to cortex
 - first anterograde, then retrograde amnesia
 - Korsakoff's Syndrome
 - alcoholism that induces severe thiamine (B1) deficiency
 - confabulation is a major symptom

986

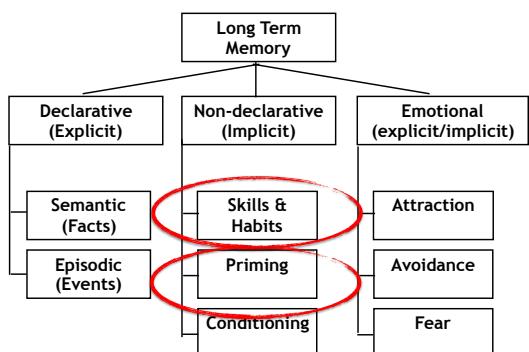
Psychology 465 - Human Neuropsychology - Spring 2017

Neurobiology of Implicit Memory

Psychology 465 - Human Neuropsychology - Spring 2017

987

Review: Taxonomy of Long-Term Memories



988

Psychology 465 - Human Neuropsychology - Spring 2017

989

Psychology 465 - Human Neuropsychology - Spring 2017

Priming : Implicit memory

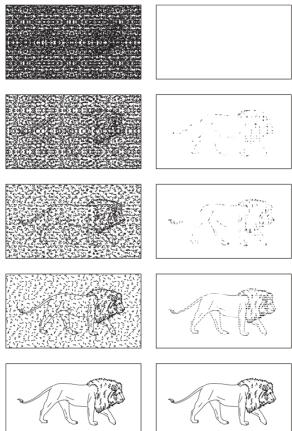
- Priming is usually spared in Amnesia

- Examples:

- Gollin Incomplete Figures Test...
- Word-Stem Completion...

Priming: Gollin Incomplete Figures Test

- Subjects see sequence of pictures to identify object
- On later repetition, reaction time & accuracy improve
- Effect independent of conscious (explicit) memory for test



990

Psychology 465 - Human Neuropsychology - Spring 2017

Test 1 - learn list
Table, box, carpet

Test 2 - fill in blank
TAB____
BO____
CAR____

Psychology 465 - Human Neuropsychology - Spring 2017

991

Priming: Word-Stem Completion

- Subjects see sequence of words to remember.
- Later asked to fill in the blanks
- Words previously seen more likely to be used
- Effect independent of conscious (explicit) memory for test

Case “JK” : Implicit Amnesia

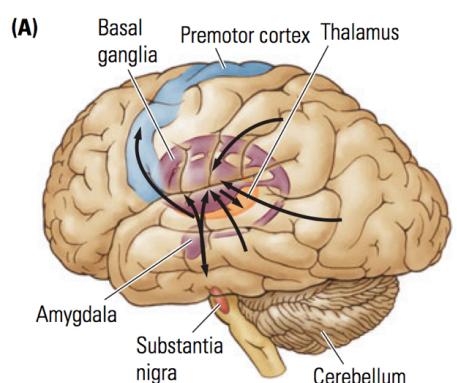
- Can people have amnesia for Implicit memories?
- JK, b 1914, above average IQ, worked as engineer for 45 years. When in 70s Dx. Parkinson’s disease.
- At 78 memory difficulties
 - difficulty recalling how to do common tasks:
 - turn on the lights
 - turn off the radio

Psychology 465 - Human Neuropsychology - Spring 2017

992

Neural Substrates of Implicit Memory

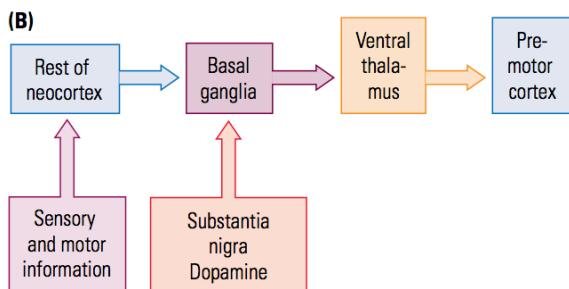
- Basal Ganglia
- Ventral Thalamus
- Pre-motor Cortex
- Rest of cortex
- Substantia Nigra
- Cerebellum
- Conclusions:
- Deep brain structures, associated with movement



Psychology 465 - Human Neuropsychology - Spring 2017

993

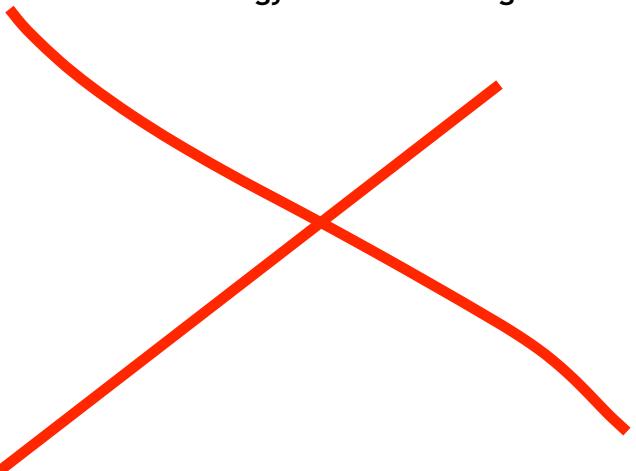
Neural Substrates of Implicit Memory



Psychology 465 - Human Neuropsychology - Spring 2017

994

Neurobiology of Conditioning



Psychology 465 - Human Neuropsychology - Spring 2017

995

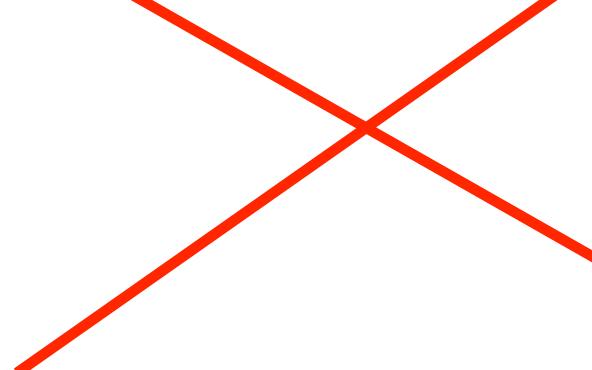
Cerebellum - classical conditioning



Psychology 465 - Human Neuropsychology - Spring 2017

996

Neurobiology of Emotional Memory



Psychology 465 - Human Neuropsychology - Spring 2017

997

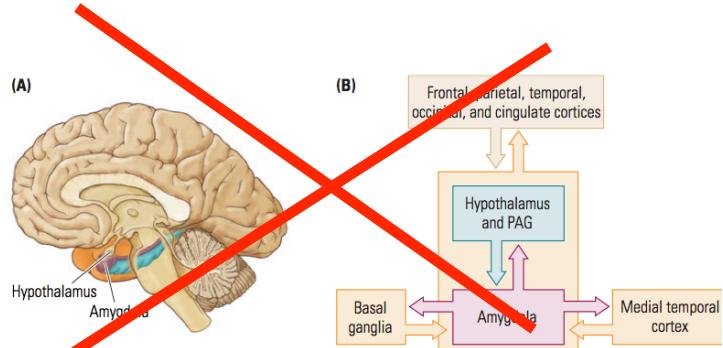
Example : Fear conditioning

- Pairing of noxious or painful stimuli with neutral stimuli
- Establishes a conditioned “fear response”
- Example: Dr. Claparede had amnesia patient. Shook hands with a sharp pin in the hand. Eventually patient refused to shake Dr's hand, but could not explain why

Psychology 465 - Human Neuropsychology - Spring 2017

998

Neural Substrates of Emotional Memory



Psychology 465 - Human Neuropsychology - Spring 2017

999

Neurobiology of Short Term Memory

1,000

Psychology 465 - Human Neuropsychology - Spring 2017

Short Term Memory patients

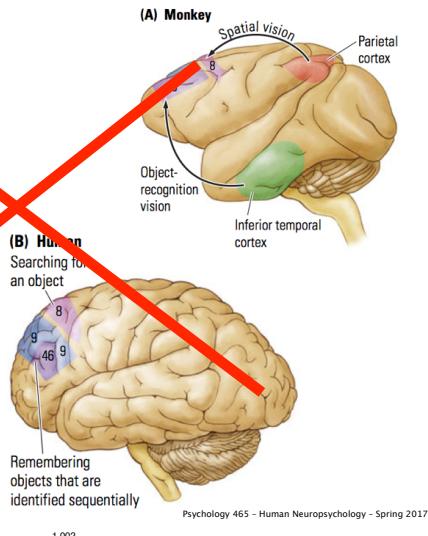
- Patient "KF"
 - Inability to repeat sequences of letters, words, digits, or sentences
 - Long term recall : normal
- Luria reports two patients with impaired STM : one impaired for digits presented aurally but not visually, the other has the opposite pattern.

1,001

Psychology 465 - Human Neuropsychology - Spring 2017

Neural Substrates of STM

- Areas 8, 9, 46
- Other cortical areas
- Conclusions:
- Primarily frontal-lobe and connected areas
- Multiple systems for different sensory modalities



1,002

Psychology 465 - Human Neuropsychology - Spring 2017

Unusual Memory Abilities

- Savantism
 - Asperger's syndrome
 - Autism

1,003

Psychology 465 - Human Neuropsychology - Spring 2017

Case History "S"

- S : a newspaper reporter studied by Luria
- incredible episodic memory
- could report, verbatim, an entire meeting
- Table (on right) after 2-3 minutes, could repeat forward, backwards, diagonal, etc. He remembered it 16 years later
- Luria felt he suffered in other areas - he was dull, superficial, lacked abstract thought, couldn't understand poetry...

Table 18.1 Example of tables memorized by S.

6	6	8	0
5	4	3	2
1	6	8	4
7	9	3	5
4	2	3	7
3	8	9	1
1	0	0	2
3	4	5	1
2	7	6	8
1	9	2	6
2	9	6	7
5	5	2	0
x	0	1	x

Note: With only 2 to 3 minutes' study of such a table, S. was able to reproduce it in reverse order, horizontally, or vertically and to reproduce the diagonals.

1,004

Psychology 465 - Human Neuropsychology - Spring 2017

Autism / Savantism

- Autism
 - spectrum of disorders characterized by impaired social interaction, restricted interests, obsessions, and repetitive behavior
 - Prevalence 1-2 out of 1000
 - Asperger's syndrome : an Autism-spectrum-disorder
- Savant Syndrome
 - One or more areas of mental brilliance or excellence.
 - About 50% are autistic, about 50% have developmental disorder, mental retardation, brain injury or disease
 - Very rare: perhaps 100 worldwide

1,005

Psychology 465 - Human Neuropsychology - Spring 2017