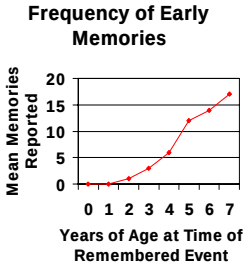
Announcements

- Experiment Participation Requirement
  - You MUST do 2 hours of experiments (or write 2 summaries)
  - You MAY do 2 *additional* hours of experiments (or write 2 additional summaries) for extra credit
- Article Summaries due Wednesday (bring to final)
- Non-Experimetrix Experiments must also be done by Wednesday (have experimenter email your TA or bring a credit slip to the final)
- Final – Wednesday 8am
- Review Session: Sunday 11am in Solis 104
- Coulson's Office Hours: Monday 10am – noon (CSB 161)
  - appointments outside of this time also possible

Infantile Amnesia

- Inaccessibility of early childhood memories
  - Very Few Memories from Before Age 4
  - Almost No Mems from Before Age 2



Bruce (2000)

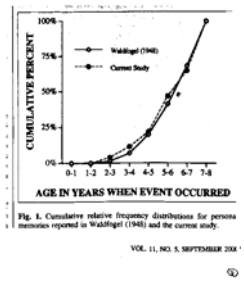


Fig. 1. Cumulative relative frequency distributions for persons memories reported in Waldfogel (1948) and the current study.

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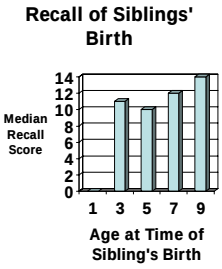
Specific Datable Event Mems

- Sheingold & Tenny
- Study 1
  - Kids quizzed about sibs' birth
  - 4s, 8s, & 12s all remember 10-12 items
- Study 2
  - Asked teenagers what they remembered about sibs' birth
  - 9 yrs = 3 yrs
  - < 3 No memories



Explanations

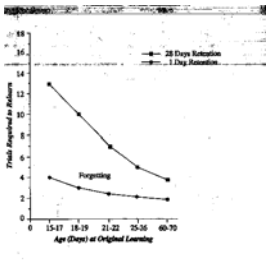
- Amnesia, what amnesia?
- Repression
- Episodic memory formation deficit
- Change in Encoding Techniques
- Context-dependence
- Neural reorganization

Amnesia, what amnesia?

- Normal Forgetting
- But
  - 80-year-olds can remember when they were 10 years old (retention interval 70 years!)
  - Wetzler & Sweeney: Disproportionate loss of early memories

Repression

- Freud
  - Greedy thoughts and desires (selfish Id)
  - Sexually inappropriate thoughts
- *But* animals show infantile amnesia as well
  - Rats
  - Guinea pigs



Episodic memory formation

- Lack brain structures for episodic memory formation?
  - Medial temporal lobe structures
- But toddlers can recall episodic memories (just not when asked later)
- Habituation/Dishabituation
  - Babies habituate
  - Monkeys habituate
  - Monkeys with medial temporal lobe lesions don't habituate

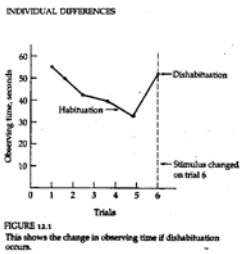


FIGURE 12.1
This shows the change in observing time if dishabituation occurs.

Encoding Techniques

- Language acquisition
- Storytelling ability

Context-dependence

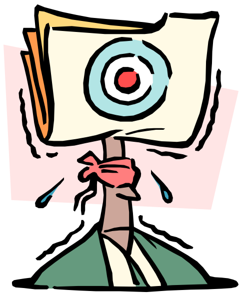
- Internal context radically different in infancy and adulthood
- Physical perspective
- Language acquisition (2-4 yrs)
- Sense of self

Neural re-organization

- Equivalent to context-dependence
- Brain undergoes substantial re-wiring as it matures
  - Especially medial temporal lobes and frontal lobes
- Infantile Amnesia in
  - Guinea pigs (brain maturation prenatal)
  - Rats (substantial post natal brain maturation)

Greatest Hits

Goals



- Facts
- Models/Theories → Experimental Evidence
- Develop scientific writing skills
- Applying Cognitive Science

Models & Theories

Models of Pattern Recognition

- Template Models
- Feature Models
- Prototype Models
- Neural Network Models

IAC Model

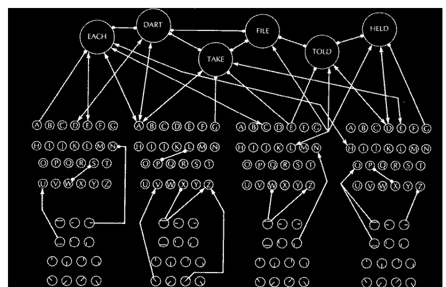


Figure 4.1 Basic architecture of McClelland and Rumelhart's (1981) word-recognition network. Connections may be excitatory (arrow) or inhibitory (filled circle). All of the feature and letter units that are used for each of the four letter positions in a four-letter word are shown; however, only a few connections and a few word units are shown.

Perceptron

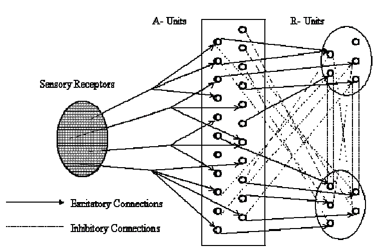


FIGURE 2: Schematization of a Perceptron (Adapted from Rosenblatt, 1958) The receptor units communicate an excitatory signal to the A(ssociation)-units. These then activate the appropriate R(esponse)-unit, which in turn act to inhibit both the other R-units, and their connected A-units. It's a "Winner-Take-All" system, with one layer of modifiable connections, between the A- and R- units.

Appeal of Neural Nets

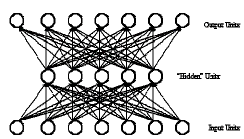


FIGURE 4: A Simple Connectionist Network A three-layer network with two layers of modifiable connections. The fan-in for the hidden units is equal to its fan-out, and connectivity is not localized.

- Parallel
  - Not subject to 100-step constraint
- Distributed Representations
  - Less Brittle
- Graded Rules
  - More Flexible

Biological Nets

- 10^{10} - 10^{11} neurons
- 10^{5} interconnections per neuron
- Excitatory & Inhibitory
- Learning involves modifying synapses

Connectionist Nets

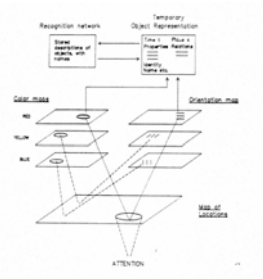
- Neuron basic processing unit
- Highly interconnected
- Excitatory & Inhibitory
- Learning done by changing strength of connections

Buzzwords

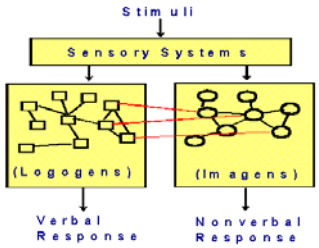
- Spontaneous Generalization
- Graceful Degradation
- Mutual Constraint Satisfaction
- Capacity for Learning and Self-Organization
- Biologically Plausible (?)

Role Attention in FIT

- Attention moves within the location map
- Selects whatever features are linked to that location
- Features of other objects are excluded
- Attended features are then entered into the current temporary object representation



Dual Coding



Mental Imagery

- Are images distinct from propositional representations?
- What is the relationship between imagery and perception?

Propositional

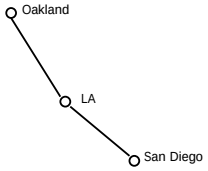
- Discrete
- Symbols needed for relation
- Rules for combo
- Abstract
- Unambiguous
- No spatial medium
- No point-for-point correspondence

Analogue

- Not discrete
- No symbol for relation
- One rule for combo
- Concrete
- Ambiguous
- Spatial medium
- Point-for-point correspondence

Internal Representation of Spatial Knowledge

- Network
- Node=Place
- Link=Relationships
  - Distance
  - Adjacency
  - Direction
- Route=pathway thru nodes



Route Representations

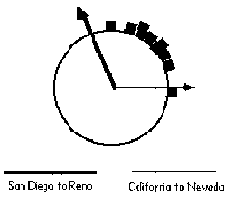
- Production Rules
- Unordered Productions
- Ordered Productions

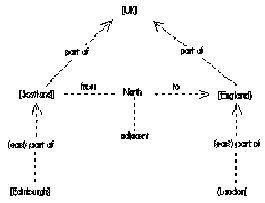
IF *the goal* is to go to TJ
and you are on Nobel
and you see the 5 entrance
THEN get on 5 South

Spatial Configuration

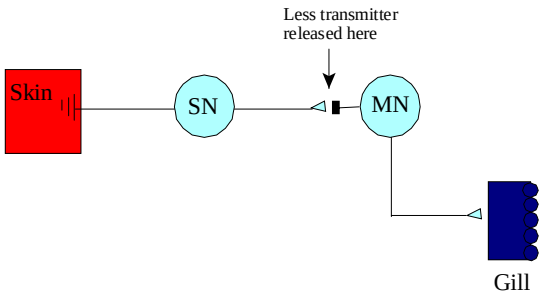
- Cognitive Maps contain distortions
  - Distance
  - Direction
- Egocentric Reps
- Topological Reps

Hierarchical Structuring

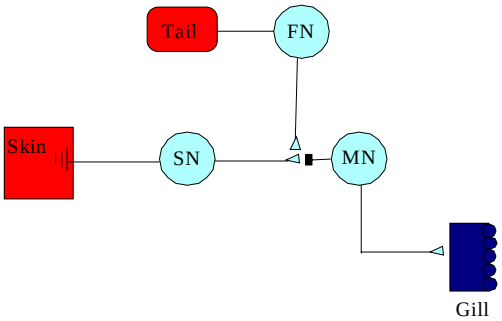




Habituation of the gill withdrawal reflex results from changes in the S-R pathway

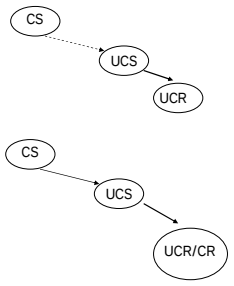


Sensitization occurs because tailshock augments the release of neurotransmitter from the sensory neuron



Pavlov

- Stimulus-substitution theory
  - A connection forms in the brain between the CS and the UCS activation sites
  - When the CS is activated alone following acquisition, it will automatically activate the UCS site in the brain
  - Therefore, the CR should be almost identical to the UCR (because the connection between UCS and UCR in the brain is hardwired)



Other stimulus-response models

- Preparatory Response Model
  - Kimble
  - CR is a response that serves to prepare the organism for the upcoming UCS
  - CR eyeblink may actually prepare the person for the upcoming airpuff such that the eye would be partially closed when the airpuff occurs
- Compensatory Response Model
  - Siegel
  - Learned association between CS and UCS serves to elicit a CR that compensates for effects of UCS
  - Sometimes CR=UCR
  - Sometimes CR opposite of UCR

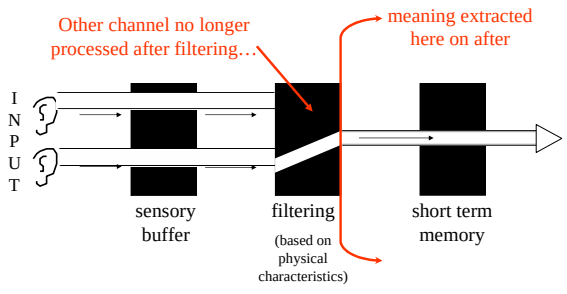
Rescorla-Wagner Model

- **Rescorla and Wagner used a mathematical model to make their "cognitive" account more rigorous**
  - $\Delta V_A = \alpha_A \beta [\lambda - V_{AX}]$
  - ΔV_A - Change in associative strength to CS_A
  - V_{AX} - Current associative strength to CS_{A+X} (context)
  - α_A - Salience of CS_A
  - β - Salience of UCS used in the Experiment
  - λ - Maximum associative strength possible

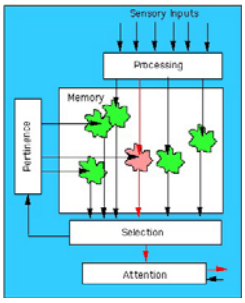
Early Flawed Assumptions

- Equipotentiality
  - All stimuli have equal potential for association with one another
  - Association determined by stimulus pairings
- Universality
  - "Pigeon, rat, monkey, which is which? It doesn't matter." B.F. Skinner (1961)
- No internal representations
  - Associations learned

Broadbent's Filter Model of selective attention

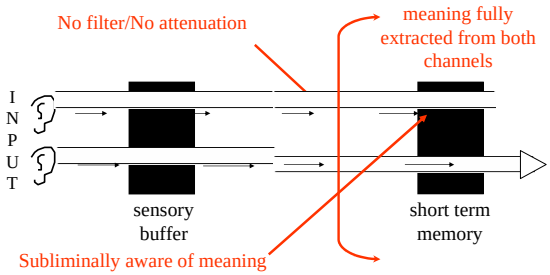


Norman's Model

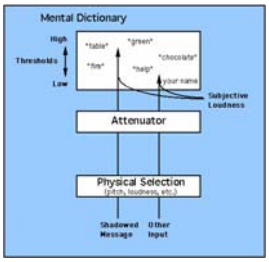


- Late Selection
  - All stimuli processed to recognition
  - Bottleneck after recognition just before the formulation of response
- Selection (pertinence) based on importance
- Memory devoted to selected inputs

Deutsch & Deutsch Model of (late) selective attention



Attenuator Model



- Attenuator affects "subjective loudness"
  - Pay attention – increase loudness
  - Shadowed msg "louder" than non-shadowed
- Concepts in Dictionary differ in loudness threshold
  - Name always low
  - Thresholds change w/goals

Johnston & Heinz's Hybrid Model

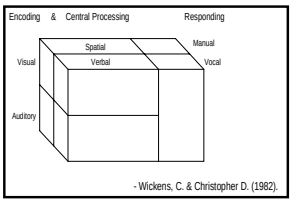
- We filter out channels *either*...
  - EARLY (based on physical characteristics)

    OR
  - LATE (based on meaning)

EASY

HARD

Multiple Resources



Automatic

- Without intention
- Not subject to introspection
- Few, if any, attentional resources
- Rapid (1 second or less)
- Inflexible

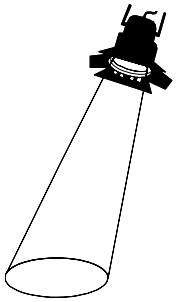
Controlled

- With intention
- Subject to introspection
- Uses most, if not all attentional resources
- Relatively slow (several seconds)
- Flexible

Instance Theory of Automaticity (Logan)

- Each time stimulus encountered, traces stored in memory
- Practice
  - More info about stim and what to do w/it
- Practice
  - Rapid retrieval of info in response to stim

Visual Attention



- Can be directed at particular regions of space
  - Exogenous Cues
  - Endogenous Cues
- Facilitates/Inhibits target detection
  - Attended/Unattended
- Adjustable Width

Parallel Theory (Baddely & Ecob)

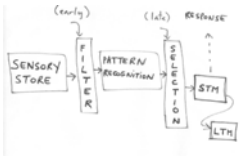
- Rate to perform comparisons depends on how active items are in WM
- Activity level depends on how many items in WM
  - A B C D (.25, .25, .25, .25)
  - A B (.5, .5)

Limited Capacity Parallel Retrieval

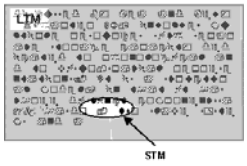
- Retrieval done in parallel
- "Strategic resources" available for task limited
- Processing time increases w/set size because resources distributed over the entire set
  - Larger sets, less resources for any given item

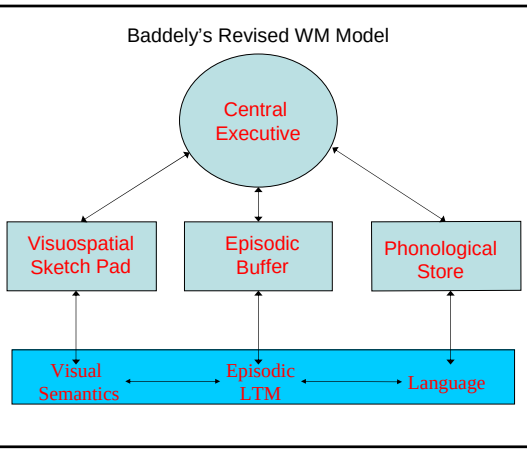
STM vs. LTM: 1 System or 2?

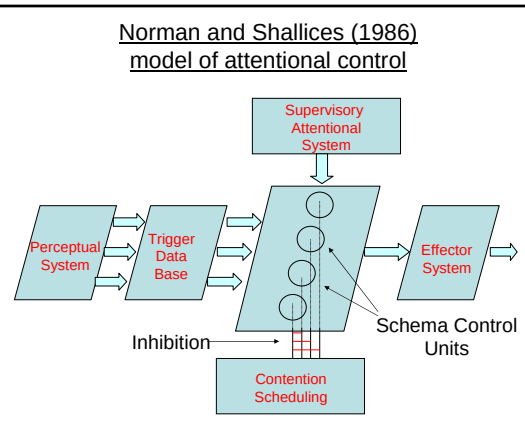
- Older View
- 2 Systems w/Distinct Characteristics



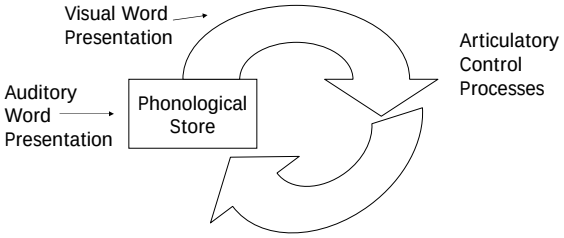
- Newer View
- Different States in a Single System



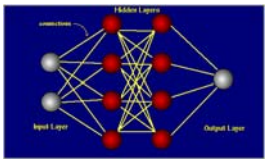




Phonological Loop: Take 2

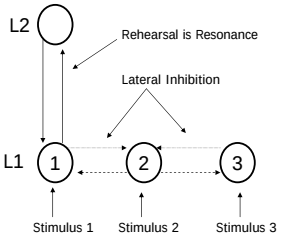


NN Approach to Memory



- LTM – connection strengths among nodes
- WM – activation
- "Transfer" to LTM is learning
- Capacity Limitations – limitations on total level of activation

WM in NNs



- Rehearsal
  - Resonant positive feedback loops
- Interference Effects
  - Lateral inhibition btw. nodes coding similar items
- Set Size Effects
  - Activation limitations
- Serial Order Effects
  - Lateral inhibition most affects items in the middle

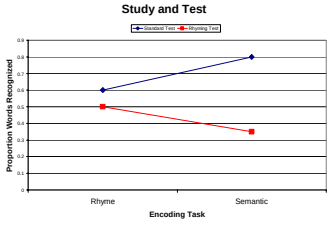
Levels of Processing

- Craik & Lockhart
  - Continuum of Processing
    - Shallow: surface, perceptual features
    - Deep: processed, meaningful interpretation
  - Level or "depth" of processing affects its memorability
  - Deeper encoding produces more elaborate, longer-lasting memory traces

Doubts about Depth

- Levels of Processing doesn't account for all factors that affect memorability
  - Importance of Organization
  - Memory for Personally Relevant Information
  - Self-Generation Effect
  - Elaboration
  - Distinctiveness

Doubts about Depth



- **Transfer Appropriate Processing**
- Morris and colleagues

Encoding Specificity

- The probability of recalling an item at test depends on the similarity of its encoding at test and its original encoding at study
- Thomson
  - Study: sky blue
  - Task: remember 2nd word
  - Recognition Test: blue vs. sky blue
  - 76% vs. 85%
  - Conceptual aspects of study context helpful in test context

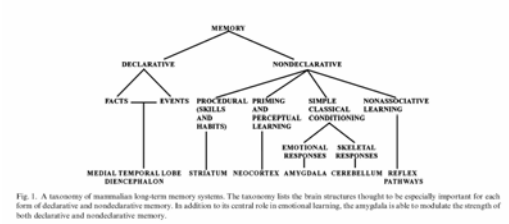
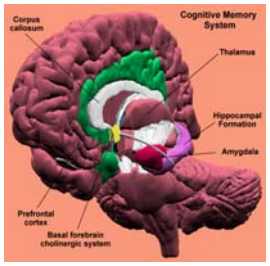


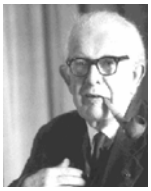
Fig. 1. A taxonomy of mammalian long-term memory systems. The taxonomy lists the brain structures thought to be especially important for each form of declarative and nondeclarative memory. In addition to its central role in emotional learning, the amygdala is able to modulate the strength of both declarative and nondeclarative memory.

Why do we have multiple memory systems?

- Explicit, declarative memory
  - Cortex, Medial temporal lobe structures
  - Fast, phylogenetically recent
  - Interference, retrieval failure
- Implicit, procedural memory
  - Phylogenetically early
  - Nonconscious ways of responding to world



Piagetian Approach to Cognitive Development



Piaget's Stages

- Sensorimotor
  - (birth – 2 yrs)
- Preoperational
  - (2 – 7 yrs)
- Concrete Operational
  - (7 – 11.5 yrs)
- Formal Operational
  - (11.5 yrs and on)

Key Piagetian Concepts

- Schemas
  - Action Patterns
- Assimilation
  - Interpreting environment w/schemas
- Accommodation
  - Changing schemas

Criticisms of Piaget

- Empirical Details
  - Piaget consistently underestimates age at which children able to do certain things
  - Perhaps his children were somewhat slow in developing?
- Stages versus gradually development
  - Objections to discrete series of stages versus idea of development as more of a gradual process
- Ethnocentric
  - Some have noted that Piaget's theory is how to become a Swiss scientists
  - Much of the changes outlined in childhood reflects the western educational system rather than inevitable changes related to maturation

Neo-Piagetians

- Agree w/Basic Stages
  - Faster
- Believe Piaget Underestimated Child's Capacities
  - Inter-sensory Relations
  - Object Permanence

Development of baby physics

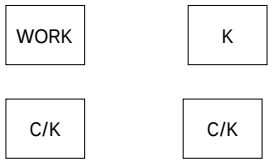
- Predisposition to learn critical physical facts rapidly
- "…infants are not born with substantive beliefs about objects…but with highly constrained mechanisms that guide the development of infant reasoning about objects." Renee Baillargeon

Explanations for Infantile Amnesia

- Amnesia, what amnesia?
- Repression
- Episodic memory formation deficit
- Change in Encoding Techniques
- Context-dependence
- Neural reorganization

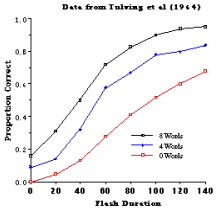
Cognitive Phenomena

Word Superiority Effect



Sentence Superiority Effect

- Tulving, Mandler, and Baumal
- Disorder (red)
- Filled with dirt and disorder (blue)
- The huge slum was filled with dirt and disorder (black)
- Dependent Variable is Proportion Correct
  - Higher on graph means better performance



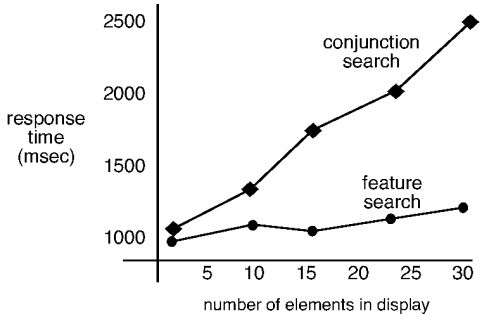
Phoneme Restoration Effect

The state governors met with their respective legi*latures convening in the capital city.

Word Superiority Effect

- WORD and WORK both begin to get activated because of WOR
- Activations feedback and activate K and D nodes
- But only K gets bottom-up activation
- D gets top-down activation that gets inhibited
- Letters presented alone don't get top-down activation from word level!

Pop Out Effect



Illusory Conjunctions

- Without focused attention features should be combined at random
  - Illusory Conjunctions

2 X T O 8

Agnosia

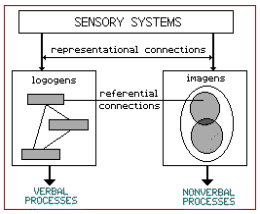
- Apperceptive
  - Object recognition failure due to perceptual processing
  - Difficulty recognizing pictures w/deleted segments
  - Unable to utilize top-down information for pattern recognition
- Associative
  - Perceptual processing intact but subject cannot use information to recognize objects
  - Can draw objects but not say what they are
  - Language otherwise intact
  - Often don't know other things about object (how it's used, etc.)

Prosopagnosia

- Specific inability to recognize faces
- Are faces and other objects in the world represented in fundamentally different ways in memory?
- Does face-memory depend on fundamentally different brain systems?

Free Recall

- Set of Pictures versus List of Words
- Pictures encoded by both systems
- Memory for pictures better than memory for words



Word Imaging & Concreteness

- Pavio et al. (1968)
  - Rate imagability, concreteness of words
  - Better memory for concrete, imagable words

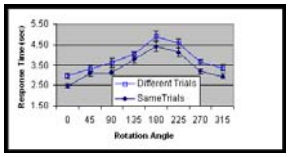
"cup" vs.

"truth" vs. ?

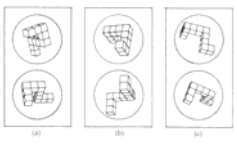
Repetition Effects

- Show subjects list of concrete nouns, either image or pronounce
  - Probability of imaged words *twice* pronounced
- Repetition Manipulation: image/pronounce, image/image, pronounce/pronounce
  - image/pronounce additive
  - pronounce/pronounce, image/image not

Cooper & Shephard



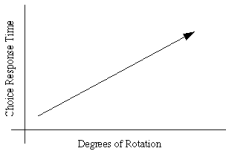
Rotations in 3-D



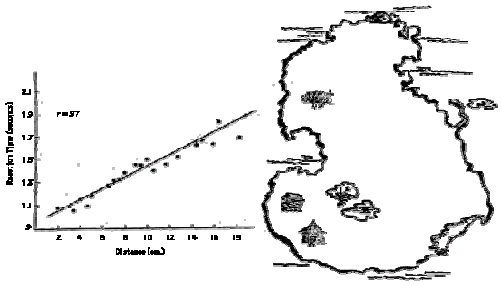
- Are 2 objects identical?

Angular disparity and RT are linearly related

- Rotation in plane
- Rotation in depth



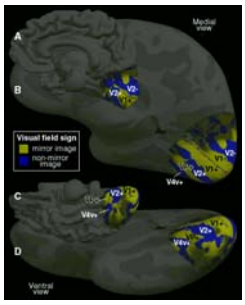
Map Experiment

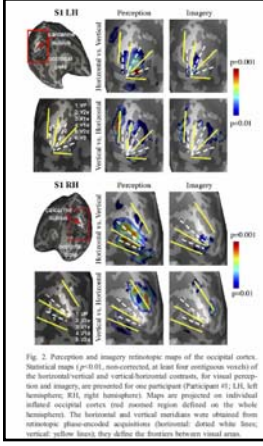


Finke & Pinker

- Would arrow point to dot?
- RTs increase linearly w/distance btw. arrow and dots
- Never told to scan in instructions
- No info to cause people to “fake” it

Retinotopic Areas





Klein et al. (2004) show clear evidence of activation in retinotopic areas during an imagery task.

Neglect Patients

- Trouble attending to left side of space
- Trouble imagining the left side of space

Change Blindness

- Inability to detect what should be obvious changes in a scene

Original Image | Blank/Mud | Modified Image

|← 400 ms →| 40-80 ms |← 400 ms →|

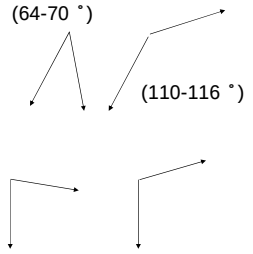
Distance Estimation

Byrne
- Estimate distance of 12 well-known routes
- 6 in Town Center
  - 3 straight
  - 3 w/2-4 curves
- 6 on Outskirts
  - 300, 540, 700 meters

- Short routes Overestimated
- Long routes Underestimated
- Short routes w/curves overestimated more than short straight routes
- Effects more pronounced for routes in *town center* than *outskirts*

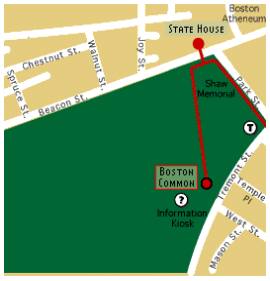
Direction Estimation

- Byrne (1979)
- Draw 10 Road Junctions
  - 5 Acute
  - 5 Obtuse
- Means: 83.5˚- 103.7˚
  - 89.7˚
  - 94.5˚



Direction Estimation

- Chase & Chi (1981)
  - Maps of CMU
  - Two Streets really 45˚, Drawn 90˚
- Lynch (1960)
  - People draw Boston Common w/4 sides
- Smith (1978)
  - Blind subjects directions off by a constant factor (= degrees the campus deviated from a true rectangle)



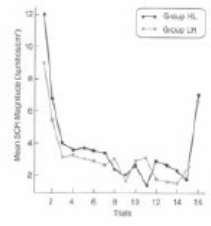
Direction Estimation

- Which is farther east, San Diego or Reno?
- Which is farther north, Seattle or Montreal?
- Which is farther west, the Atlantic or the Pacific entrance to the Panama Canal?

Distortions
Distortions

Habituation/Dishabituation

- GSR measured at onset of either high or low tone
  - Tone gradually elicits less anxiety
- 15th trial is the opposite tone
  - high for low group & low for high group



Sensitization

After the gill withdrawal reflex has habituated, a shock to the tail sensitizes the gill withdrawal reflex elicited by touching either the mantle or siphon

Classical Conditioning

- Process by which a neutral stimulus (CS) comes to be associated with another stimulus (UCS) that elicits a response (UCR)
- Results in elicitation of response by CS

Appetitive & Aversive Conditioning

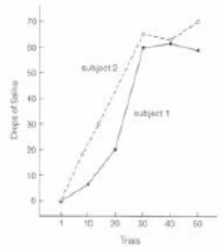
Appetitive

- US is an event the organism seeks out & considers pleasant
  - food
  - physical touch
  - warmth

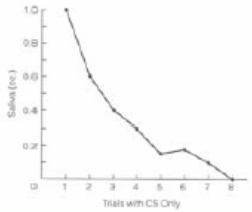
Aversive

- US is an event the organism avoids & considers unpleasant
  - shock
  - painful stimulus
  - air puff in eye

Acquisition & Extinction



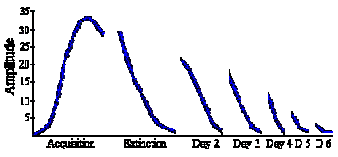
Data from Anrep, 1920



Data from Pavlov, 1927

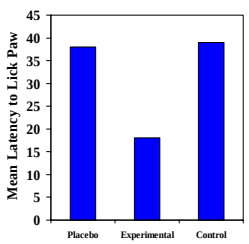
Acquisition and Extinction

- Spontaneous Recovery

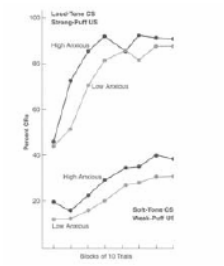


Conditioned Drug Tolerance

- Siegel, et al., 1978
  - *Experimental* Group: CS (light change & noise reduction) paired with UCS (injection of morphine) for 9 days
  - *Placebo* Control Group (CS paired with injection of saline)
  - Unpaired *Control* Group
- Test: present CS, inject every rat with morphine, place rat on hot surface
  - Measure latency to lick their paws (lick when they feel pain)



Factors that influence CC

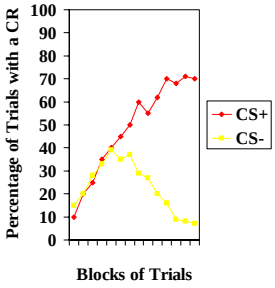


- Eye-blink conditioning
- CS Intentsity
  - Loud vs. Soft Tone
- US Intensity
  - Hard vs. Soft Puff
- Anxiety
  - High vs. Low

Stimulus Generalization

- Conditioned responses (CRs) occurring to stimuli other than the CS used for training
- Similarity
  - The more similar the second stimulus is to the CS the more generalization will occur
- Critical feature of learning
  - we rarely encounter the exact same stimulus twice

Discrimination

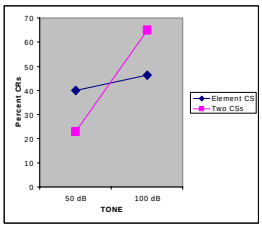


- Hypothetical example
- Initially the organism responds to both stimuli
  - shows generalization

Second-Order Conditioning

- Phase 1:
  - Pair CS_1 ---> UCS until learning occurs
- Phase 2:
  - Pair a new stimulus (CS_2) as the CS with the first one (CS_1) as the UCS
  - CS_2 ---> CS_1
- Because CS_1 reliably elicits a CR, the new stimulus, CS_2 that is paired with it, will begin to elicit the CR as well

Overshadowing

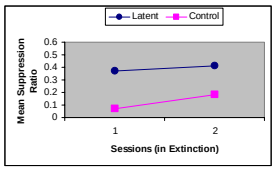


- Grice & Hunter, 1964
- Human eyeblink conditioning
- 3 Groups:
  - 100 trials w / CS (loud tone)
  - 100 trials w / CS (soft tone)
  - 50 trials w / CS(loud tone) & 50 trials w / CS (soft tone)

Blocking

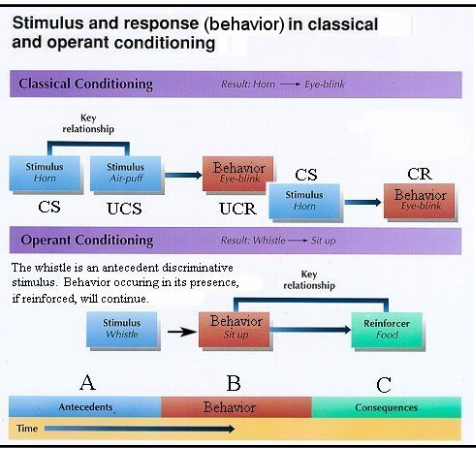
- Phase 1: Pair CS1 → UCS
- Phase 2: Pair compound stimulus with UCS: CS1CS2 → UCS
- Phase 3: Test element stimuli alone to determine amount of conditioning
- Conditioning to CS1 will be strong, but conditioning to CS2 will be weak: Blocking

Latent Inhibition



Hall & Minor, 1984

- CER Procedure:
  - Phase 1: Train thirsty rats to drink from tube
  - Phase 2: Separately present Tone during 3 Sessions; Controls had no Tone while in box
  - Phase 3: All rats had Tone→ Shock pairings
  - Test Phase: Present Tone while rats were drinking from water tube

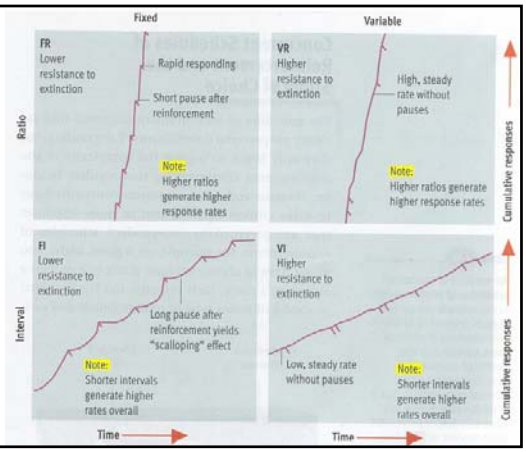


Superstitious Behavior

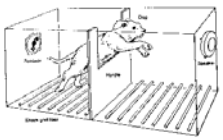
- Skinner
  - 8 Pigeons
  - Grain presented every 15 minutes
- Results
  - 6 of 8 developed clearly defined behaviors
    - turned in circles
    - bobbed head up and down
    - brushing movements toward floor as if pecking
    - raised head toward one of the corners
    - two swung head side to side
- Other Examples
  - Athletes
  - Gamblers

Reinforcement Schedules

- Fixed Ratio
  - Reinforcement occurs after a particular number of responses
  - Every 10 10:1
- Fixed Interval
  - Reinforcement occurs after a particular amount of time
  - Every 10 minutes
- Variable Ratio
  - Reinforcement occurs on average after a particular number of responses
  - 3,4,5,3,5,4
- Variable Interval
  - Reinforcement occurs after a variable amount of time
  - 3 minutes, 5 minutes, 3 minutes, 10 minutes



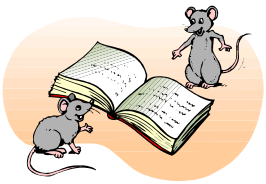
Learned Helplessness



- Animals must learn to jump barrier to avoid shock
- Results
  - Spot learns, Lassie yelps but eventually becomes passive and accepts shocks
- Contingency
  - Spot learns his actions matter
  - Lassie learned that it was helpless
- Contiguity
  - Spot learned to press lever
  - Lassie learned to act passively

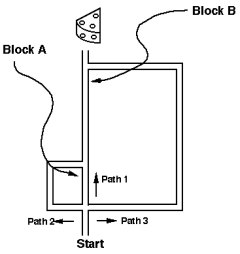
Garcia Effect

- Are all stimuli equally associable?
- Radiation vs. Shock on Taste Aversion vs. Tone Aversion
  - Light/sound paired w/
    - Shock
    - X-Rays
  - Sweet water paired w/
    - Shock
    - X-Rays



Cognitive Maps

- Tolman's research suggests need for intervening variables
- S [int. var.] R
- Path 1 shortest
- A blocked, take 2
- B blocked, now what?



What do we notice while shadowing?

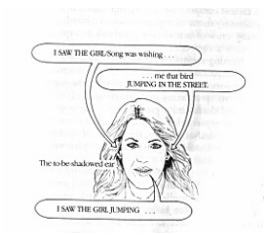
- Listeners are **good** at detecting physical info
  - could tell whether unattended channel was…
    - ✓ Male vs. Female
    - ✓ Speech vs. Buzzing
- Listeners are **bad** at detecting meaning info
  - couldn't identify any word/phrase
  - couldn't tell whether unattended channel was…
    - ✗ Forward vs. Backward
    - ✗ English vs. German
- So, attention is
  - sensitive to physical properties
  - **in**sensitive to meaning

Evidence Against

- Cocktail Party Effect (Moray)
  - Shadow 1 Channel
  - Report Salient Words from Un-shadowed Channel
    - e.g. Own Name
    - Fire!

Errors in Shadowing

- Treisman (1964)
- Subjects sometimes report mixtures of things from both ears



Von Wright and colleagues (1975)

- GSR -- indicates increased arousal
- Training: shock for certain words
- Later: present to unattended ear during shadowing
- Emotional response to word (altho not aware of hearing it!)

Evidence for the model

- Sophisticated meaning analysis of unattended channel
  - Mackay (1973).

They threw stones towards the bank ← **subject shadows this**

… … … … … money

or

… … … … … river

QUESTION: what does the sentence mean?

Subjects favored the interpretation of the sentence suggested by the unattended word.

Treisman & Geffen (1967)

- Method
  - Task 1: shadow message in one ear
  - Task 2: tap pencil when you hear the target word "green"
- Results
  - Tapping to *green* in shadowed ear: 87%
  - Tapping to *green* in the other ear: 8%

Task Similarity

- MacCleod (1977)
- Continuous Tracking
  - (Manual Response)
- Tone Identification
  - Manual Response
  - Spoken Response
- Spoken Response Easier
- Treisman & Davies
- Monitor
  - Visual
  - Auditory
- Detect
  - Visual
  - Auditory
- Aud/Vis, Vis/Aud Easy
- Aud/Aud, Vis/Vis Hard

Task Difficulty

- Sullivan (1976)
- Method:
  - Dichotic Listening
  - Tone Detection on Unattended Channel
  - Shadowing Simple Message
  - Shadowing Complex Message
- Result:
  - Tone Detection Worse when Shadowed Message *Complex*

Practice, Practice, Practice

- Spelke et al.
  - Read stories
  - Write down dictated words
- Hirst et al.
  - Read stories
  - Write down dictated sentences

Stroop Effect

- Experiment I: Say the word.

Incongruent	*Congruent*	
GREEN	BLUE	
43.3 secs	41.0 secs	(100 words)

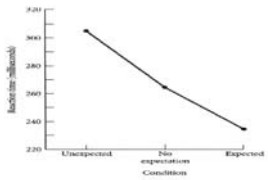
- Experiment II: Say what color the word is printed in.

Incongruent	*Congruent*	
GREEN	BLUE	
110.3 secs	63.3 secs	(100 words)

The Attentional Spotlight and the Fovea

The Attentional spotlight and the fovea

Posner, Nissen, and Ogden (1978)

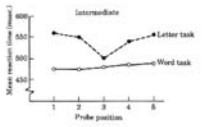


LaBerge (1983)

LaBerge (1983)

*

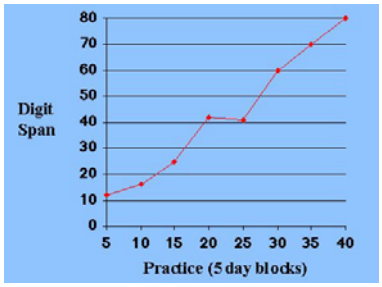
HOUSE



Memory Span Tasks

- Forwards Memory Span
  - Experimenter: 8 1 3 9 1
  - Subject: 8 1 3 9 1
  - 5-7 Digits
- Backwards Memory Span
  - Experimenter: 8 1 3 9 1
  - Subject: 1 9 3 1 8
  - 5-7 Digits
- People can only store a small amount of unrelated information temporarily

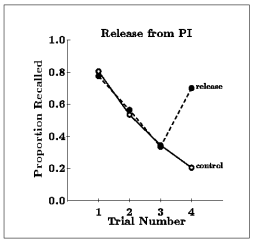
The Power of Chunking



Chess champions chunking

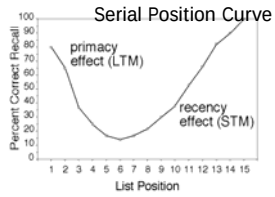
- Task: recreate chess board from memory
  - Novice vs. Expert
- Chess boards from the middle of actual chess games
  - Experts WAAAY better than Novices
  - 91% vs. 41% correct
- Chess pieces randomly arranged on the board
  - Experts = Novices

Release from PI



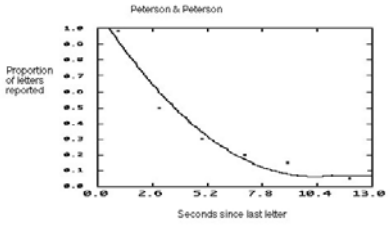
- Recall improvement that results when recall category is switched
- E: shirt, socks, tie, blazer
- S: shirt, socks, tie, blazer

Duration

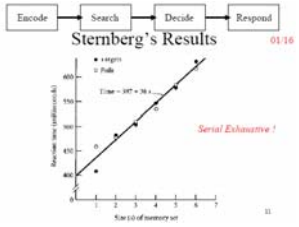


- Apparent Duration in STM: short
  - seconds
- Apparent Duration in LTM: long
  - years

Brown-Peterson Paradigm



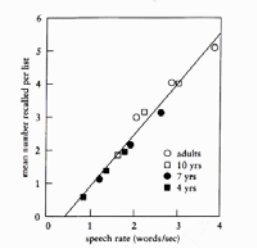
Sternberg's Findings



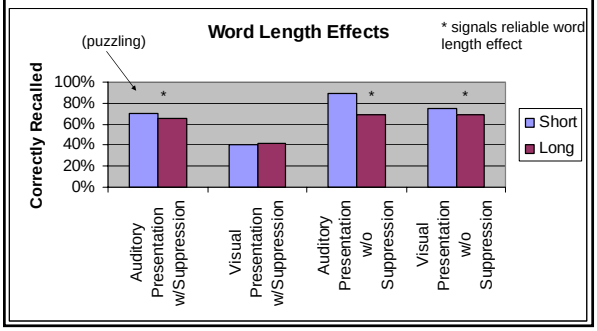
Word Length Effect

- Chad
- Burma
- Greece
- Cuba
- Malta
- 4.17/5
- Czecholslovakia
- Somaliland
- Nicaragua
- Afghanistan
- Yugoslavia
- 2.8/5

Speech Rate & Serial Recall



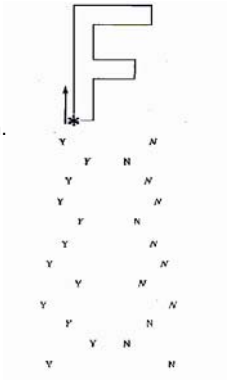
Word Length Effect Depends on Articulatory Loop



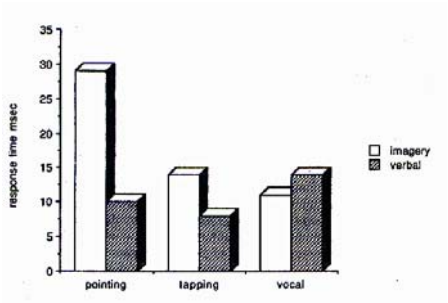
Brooks

The cow jumped over the moon.
(no, yes, no, no, no, yes)

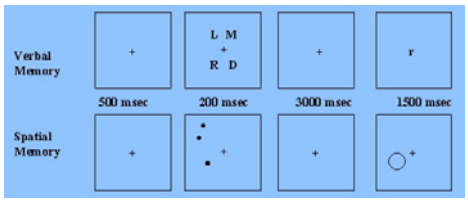
- Verbal Response
- Pointing Response
- Tapping Response



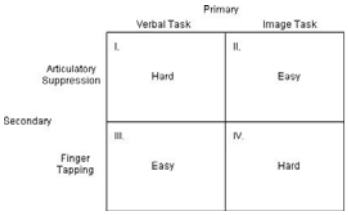
Brooks' Data



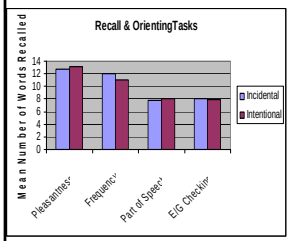
Visuospatial Sketchpad



Loop vs. Sketchpad

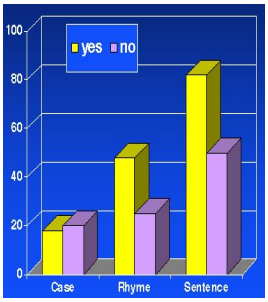


Hyde & Jenkins



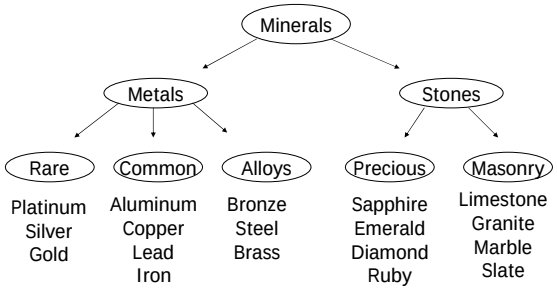
- Better Recall for Semantic Encoding Tasks
  - Pleasantness, Frequency > PoS, E/G checking
- Performance Equivalent on Intentional and Incidental Learning Tasks
  - The mere intention to remember does not affect memorability unless it changes encoding strategies

Craik & Tulving Data

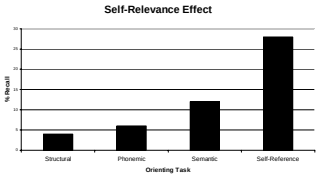


- Sentence Task Best!
- Congruency Effect
  - Finding that people do better on "yes" items than "no"
  - Due to differences in retrieval cues
  - Is a yacht a ship?
  - Is a robin a ship?

Bower & Colleagues



Memory for Personally Relevant Info



- Self-Relevance Effect – finding that judgments about self-relevance lead to better recall than other common encoding tasks

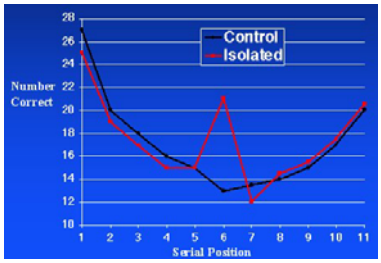
Self-Generation Effect

- Generation Effect (Slamecka & Graf)
- Subs who generate their own associations for words remember more than those who take the experimenters'
  - Rhymes with 'sow' and begins w/a 'b'
  - Sow—Bow

Elaboration

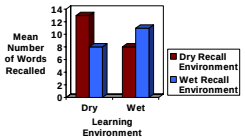
- Levels of processing not full account
- Craik & Tulving
  - She cooked the _____
  - The great bird swooped down and carried off the struggling _____
- *Kind* of elaboration matters
- Bransford & colleagues
  - A mosquito is like a doctor because they both draw blood.
  - A mosquito is like a racoon because they both have heads, legs, and jaws.

Von Restorff Effect

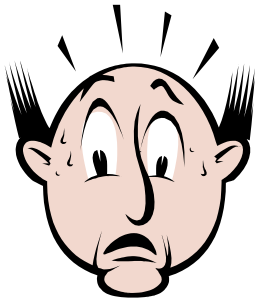


Context-Dependent Learning

- Divers learned 40 unrelated words
  - On shore
  - 20 feet underwater
- Recall list in same or different environment

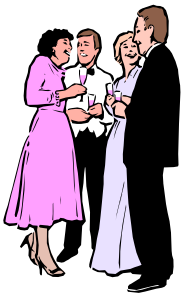


Emotional Context



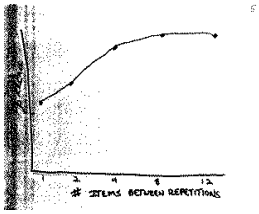
- Bower, Monteiro, and Gilligan
  - Learn 2 lists
  - Hypnotically induced positive/negative state
  - Recall test under either (hyp. Ind.) positive/negative state
- Better memory when emotional state at test matched emotional state at study

State-Dependent Learning

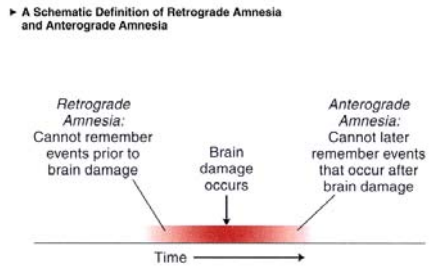


- Recall easier when in same physical/emotional state as learning
- Drunks
  - Where did I hide that gallon of scotch?
  - Where did I hide the last $10 from my paycheck?

Spacing Effect



- Finding that memory better for repeated information if repetitions are spaced apart, rather than massed together
- Melton
  - Present words 2x per list w/repetition varying in number of intervening items
  - When # of intervening items increases, so does the probability of recall

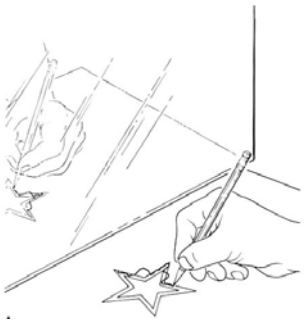


HM: Amnesic

- Profound failure to create new memories
  - Can't find new home (after 10 mos.)
  - Can't remember new people, names, tasks
  - Events/People since operation
  - Language essentially frozen in 50's
  - Exceptions: Ayatollah, rock 'n roll

HM: Amnesic

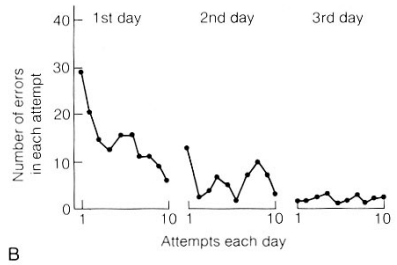
- Mirror tracing task, Milner, 1965



HM: Amnesic

Mirror tracing task, Milner, 1965

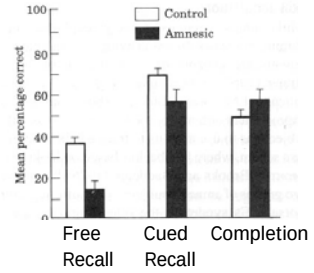
- improvement in H.M.
- no conscious recollection of previous training episodes



Behavioral Features

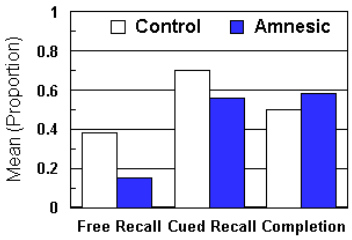
- STM functioning
  - Normal performance among amnesiac in digit span
- Procedural memory
  - HM (Corkin 1984)
    - Severe episodic memory impairment
    - Pursuit rotor task (see next slide)
    - Demonstrated learning within and across sessions
    - No memory of having done the task before

HM: Stem-Completion

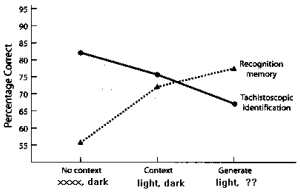


HM: No memory for studying of list

Dissociations & Patients



Dissociations in Normals



Subjects in the "no context" condition saw words and read them aloud; subjects in the "generate" condition had to generate the words (antonyms) on their own (and did not see them). Subjects in the "context" condition saw the words, but had a meaningful context (antonyms) and so only had to glance at the words in order to identify them. The "generate" condition was the best preparation for a direct test ("Are these the words you saw before?") but worst for an indirect test (tachistoscopic identification). [After Jacoby, 1983.]

Amnesia & Episodic/Semantic Distinction

- Amnesics remember what words mean, basic facts about the world, but don't remember what happens to them
- However,
  - Little conclusive evidence that different brain systems mediate episodic and semantic memory

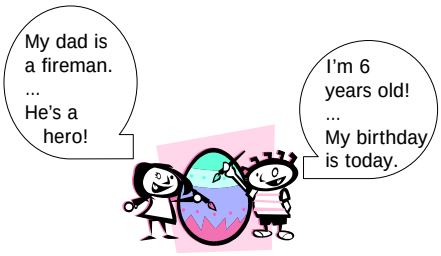
Retrograde Amnesia

- Difficulty
  - Identify people and events from different decades
  - Autobiographical cueing
    - Date memories retrieved in response to specific cue words
  - Temporal gradient
    - Memories formed early in life are more likely to survive than memories formed later in life
    - The vulnerability of a memory to brain injury is inversely related to its age

Retrograde Amnesia in PZ

- Scientist who became amnesic after writing an autobiography
- Memory for events in life
  - Temporal Gradient
- Memory for scientific facts
  - Temporal Gradient
- Suggests memory for events and for facts more tied together than previously thought

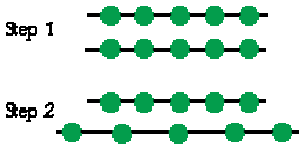
Egocentrism



Mountain Task

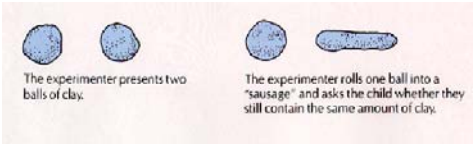
- What can the doll see?
- Mountain w/trees, Mountain w/cross, Snowy Mountain

Conservation of Number



- Are there the same number of objects in each row?

Conservation of Mass

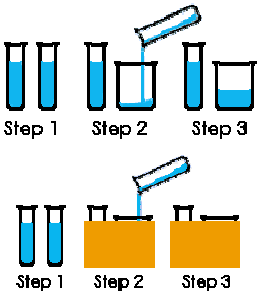


- Is there the same amount of clay in each ball?
- Is there still the same amount of clay?

Conservation of Liquid

- Which glass has more water in it?

Conservation of Liquid

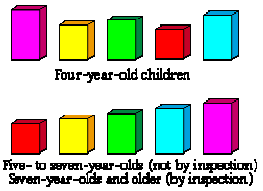


- Bruner
  - Child succeeds when tall beaker is covered
- Physical Appearance Overwhelming
  - Child *does* understand conservation

Transitivity

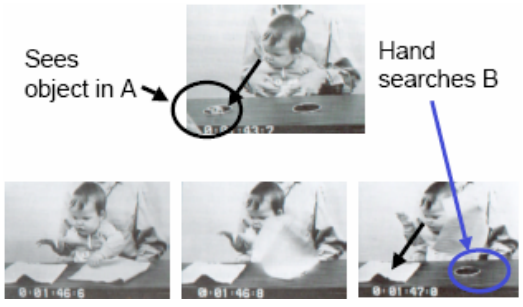
- 8-9 years of age
- Important for Seriation

Seriation

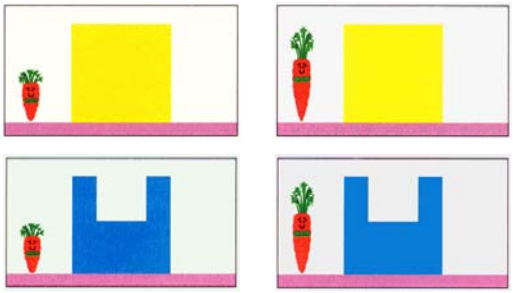


- Ability to put things in an ordered series
- 4-year-olds baffled!
- 5-year-olds use pairwise comparisons
- 7-year-olds have adult competence

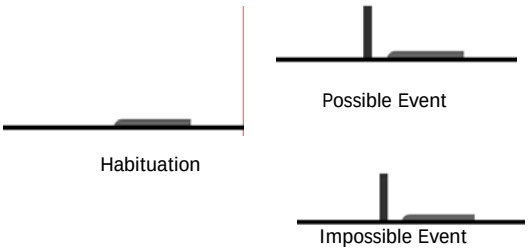
B not-A Error



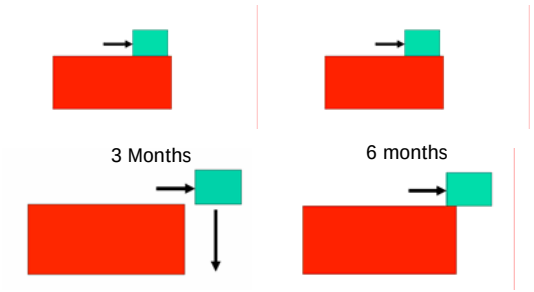
Object Permanence



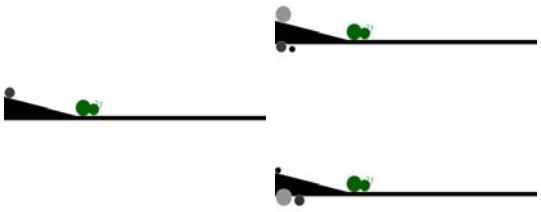
Barrier Phenomena



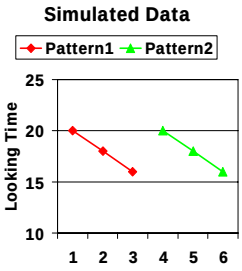
Baby Physics



Collision Phenomena



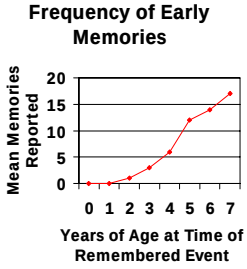
Infant Sensory Memory



- Habituation
  - Propensity to look less at previously presented pattern
- Dishabituation
  - Increase in looking time when new pattern introduced

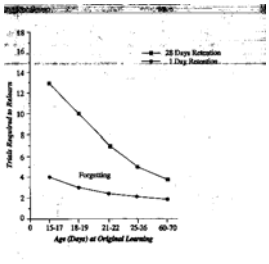
Infantile Amnesia

- Inaccessibility of early childhood memories
  - Very Few Memories from Before Age 4
  - Almost No Mems from Before Age 2



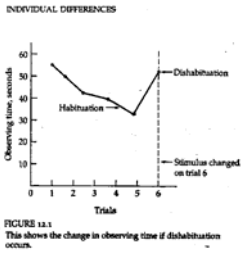
Repression

- Freud
  - Greedy thoughts and desires (selfish Id)
  - Sexually inappropriate thoughts
- *But* animals show infantile amnesia as well
  - Rats
  - Guinea pigs

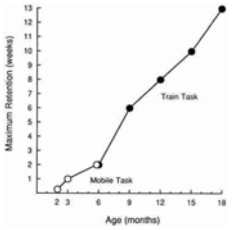


Episodic memory formation

- Lack brain structures for episodic memory formation?
  - Medial temporal lobe structures
- But toddlers can recall episodic memories (just not when asked later)
- Habituation/Dishabituation
  - Babies habituate
  - Monkeys habituate
  - Monkeys with medial temporal lobe lesions don't habituate



Continuity of Memory Development



Deferred Imitation

bauer_fig1

- Evident in children as young as 6 months
- Not evident in adult anterograde amnesics

Applications

How to Study

- Identify Text Organization
- Preview
- Question
- Read and Relate
  - Connect material to your own knowledge and experience
- Reduce
- Review

Advertising

- Pair products with stimuli that elicit positive emotions
- Second-order conditioning

Taste Aversion

- Chemotherapy
- Give children distinctive-flavored Lifesaver candy (CS) between their evening meal and the chemo session (UCS)
  - 12/15 children ate the food at the meal again later
- Control: no lifesaver
  - 6/15 children would eat that meal again

Treating Phobias

- Peter
- Jones (1924) brought a rabbit into the same room but far away from Peter while he was eating his cookies and milk snack
  - Rabbit: CS that elicits anxiety
  - Snack: CS that elicits good feelings
- Brought the rabbit closer and closer until there was no fear to the rabbit
  - Eventually the rabbit was put into his lap!

Practice

- Both amount & distribution of practice matter
- Better to have less practice/day distributed across more days
- Better to have repetitions separated by other things to learn
- Best practice comes from retrieving the information at expanding intervals

Encoding: Practical implications

- Memory influenced by exhaustiveness of processing
  - Self-generation effect
  - Maintenance Rehearsal
    - Inefficient but it works!
  - Elaborative Rehearsal
    - Most Effective Strategy

Real-life Examples

Reinforcement schedules in everyday life. Complex human behaviors are regulated by schedules of reinforcement. Piecework in factories is reinforced on a fixed-ratio schedule. Playing a slot machine is based on variable-ratio reinforcement. Watching the clock at work is rewarded on a fixed-interval basis (the arrival of quitting time is the reinforcer). Surfers waiting for a big wave are rewarded on a variable-interval basis. (Top left, © Julian Cotton/International Stock; top right, © David Falconer/Folio, Inc.; bottom left, © David Woods/The Stock Market; bottom right, © Rick Doyle/Visionhaven)

Shaping

- Reward animal for closer and closer approximations to the desired behavior
- Main way of training animals to do tricks