Outline

- Priming
  - Define priming
  - Principles of priming
  - Neural substrates of priming
- Conditioning

Perceptual Overlap and Generation: Explicit and Implicit Dissociations

STUDY:

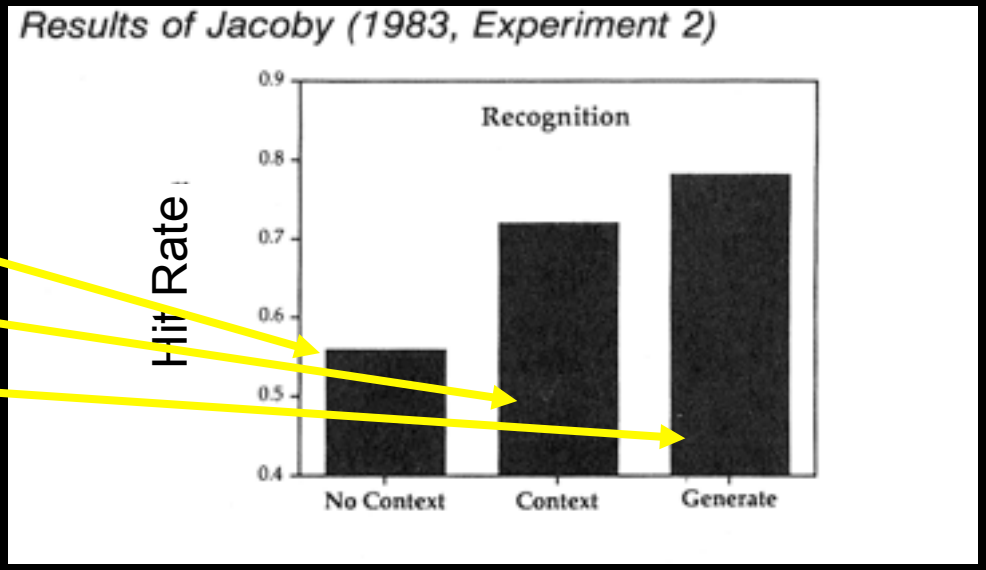
XXXX - COLD

HOT - COLD

HOT - _____

RECOGNITION:

COLD ("old"/"new"?)



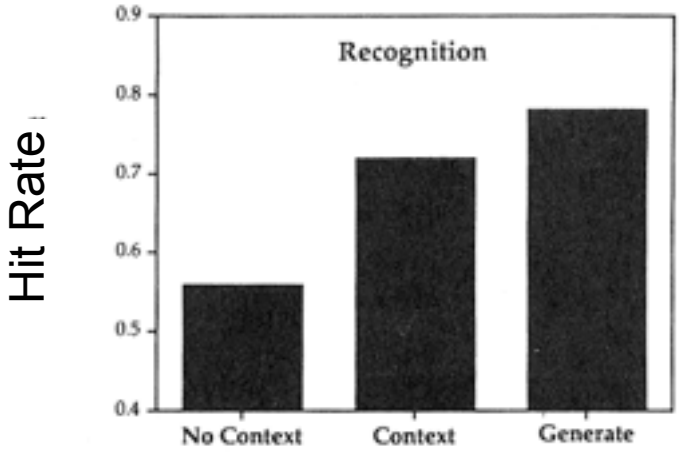
Perceptual Overlap and Generation: Explicit and Implicit Dissociations

STUDY:
XXXX - COLD
HOT - COLD
HOT - _____

RECOGNITION:
COLD ("old"/"new"?)

PERCEPTUAL IDENTIFICATION:
Flash COLD for 34 msec
Subject attempts to identify flashed word

Results of Jacoby (1983, Experiment 2)



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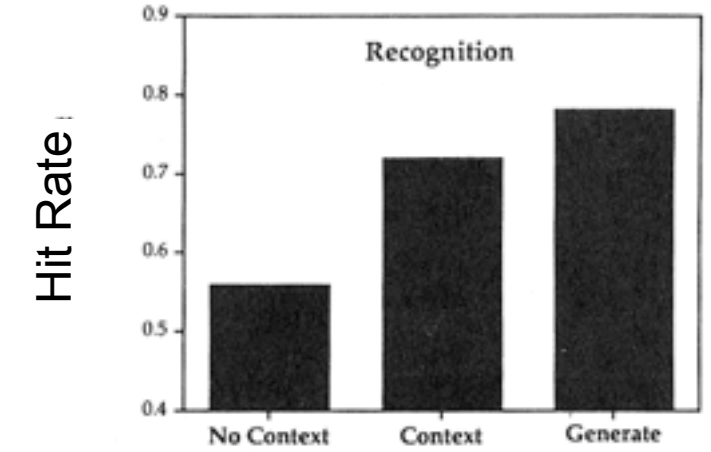


Priming (Old - New)

Note. The study manipulation produced opposite results on recognition memory (an explicit test) and on primed perceptual identification (an implicit test). From "Remembering the Data: Analyzing Interactive Processes in Reading" by L. L. Jacoby, 1983, *Journal of Verbal Learning and Verbal Behavior*, 22, p. 493. Copyright 1983 by Academic Press. Adapted by permission.

Perceptual Overlap and Generation: Explicit and Implicit Dissociations

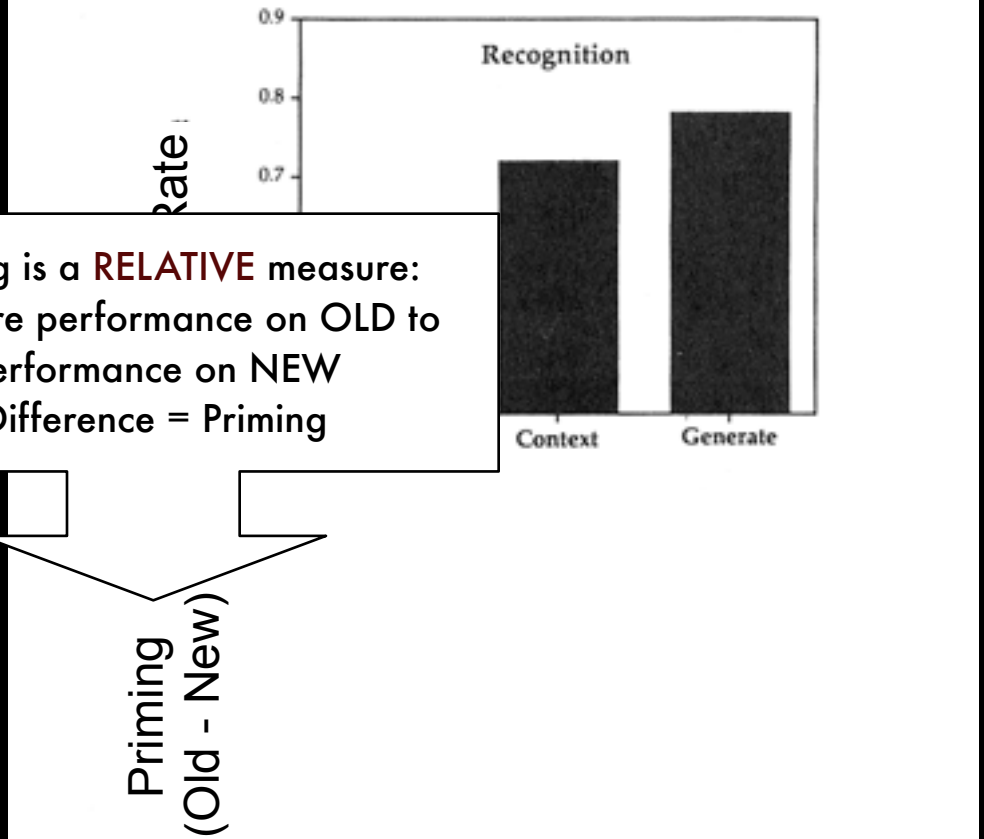
STUDY:
XXXX - COLD
HOT - COLD
HOT - _____

RECOGNITION.
COLD ("old"/"new"?)

PERCEPTUAL IDENTIFICATION:
Flash COLD for 34 msec
Subject attempts to identify flashed word

Priming is a RELATIVE measure:
Compare performance on OLD to performance on NEW
Difference = Priming

Results of Jacoby (1983, Experiment 2)



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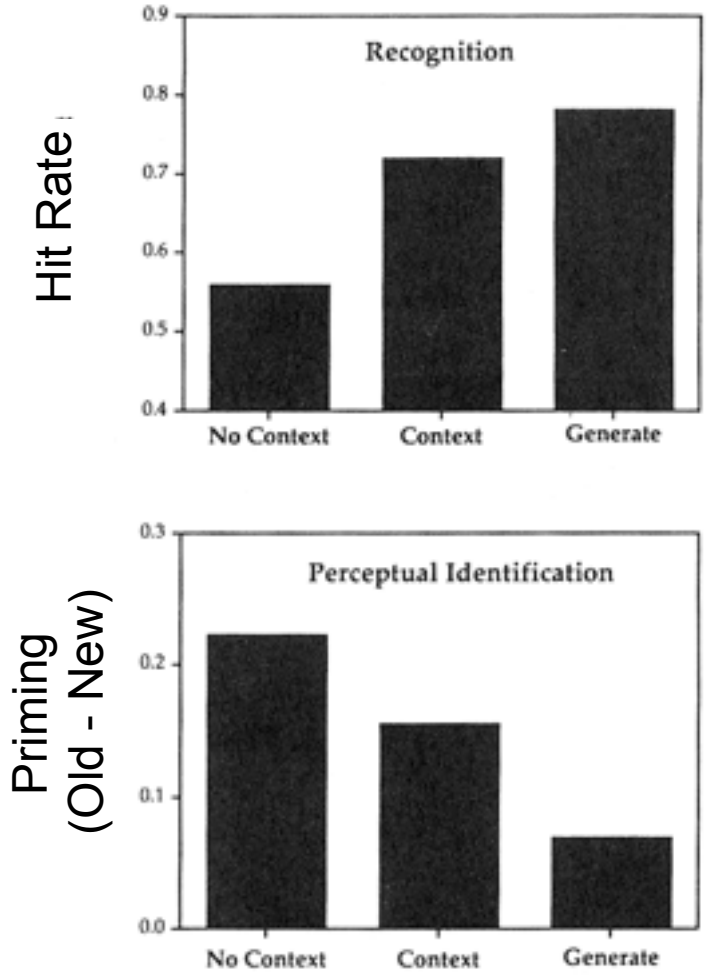

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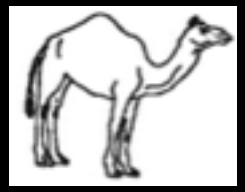
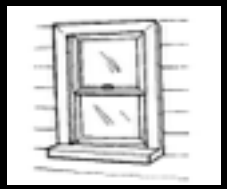
Perceptual Specificity of Priming

STUDY:

Pictures or Words



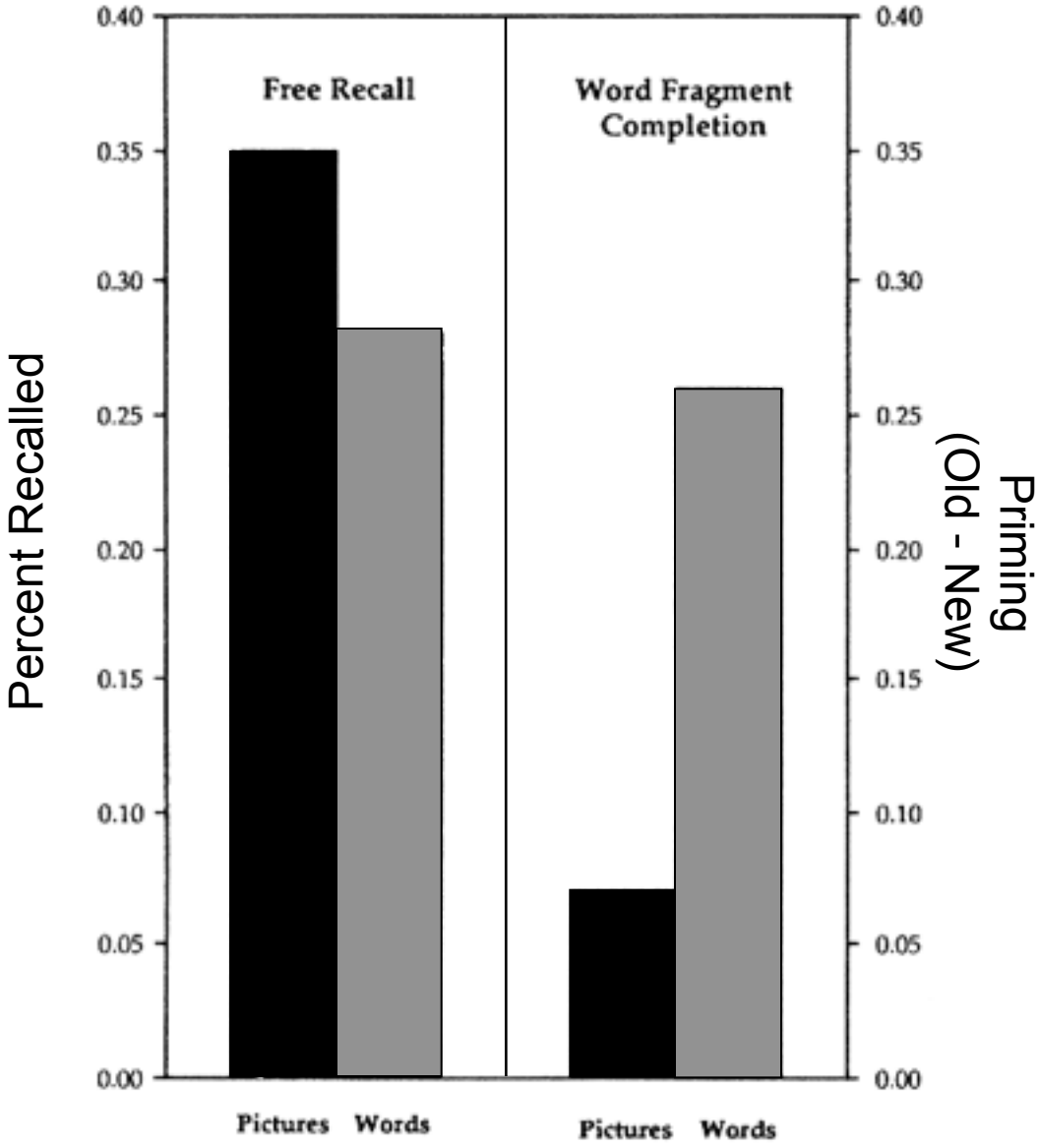
camel



window

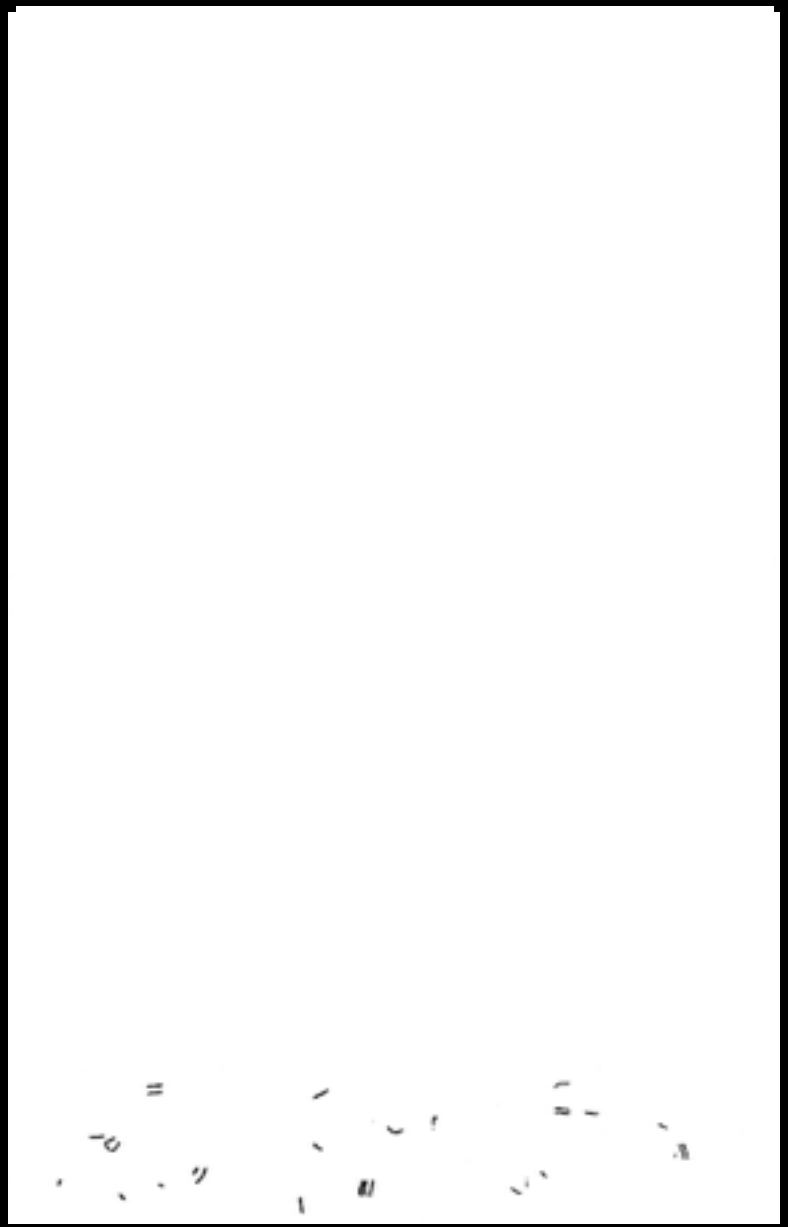
TEST:

- **Free Recall**
- **Word-fragment completion:**
  w__d_w



Weldon and Roediger, 1987

A brief test



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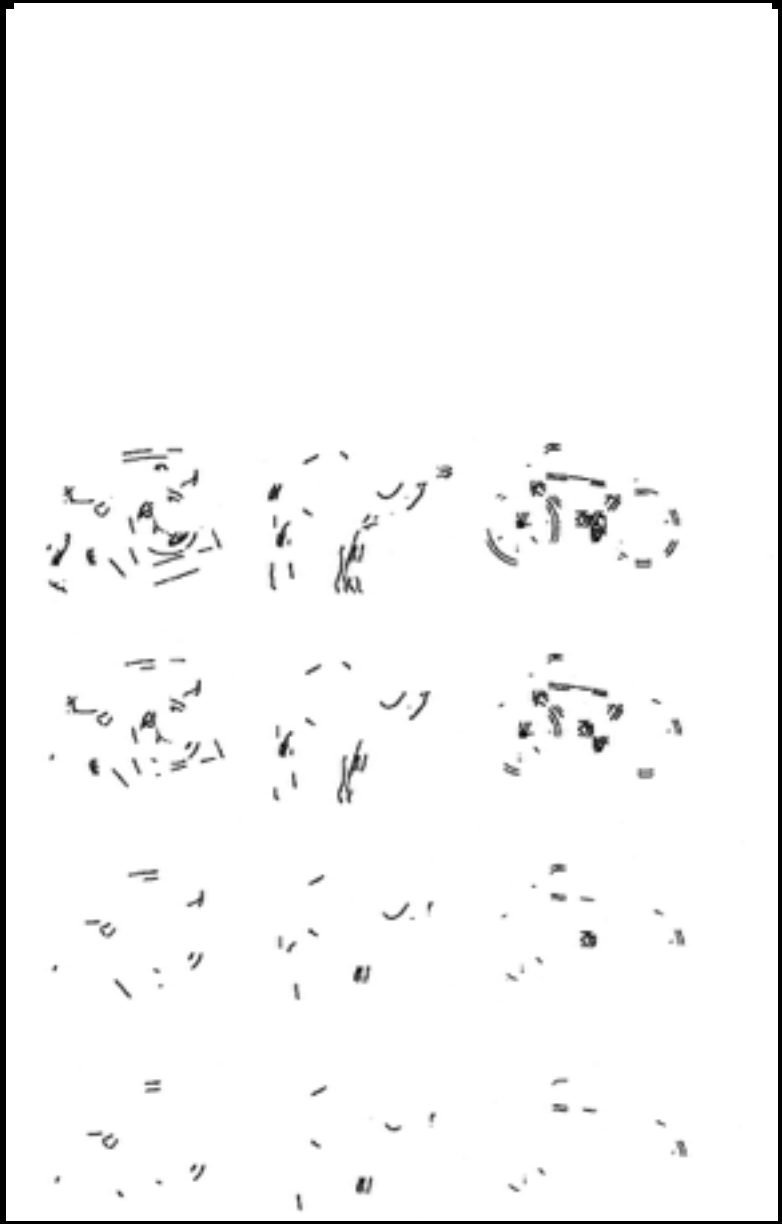

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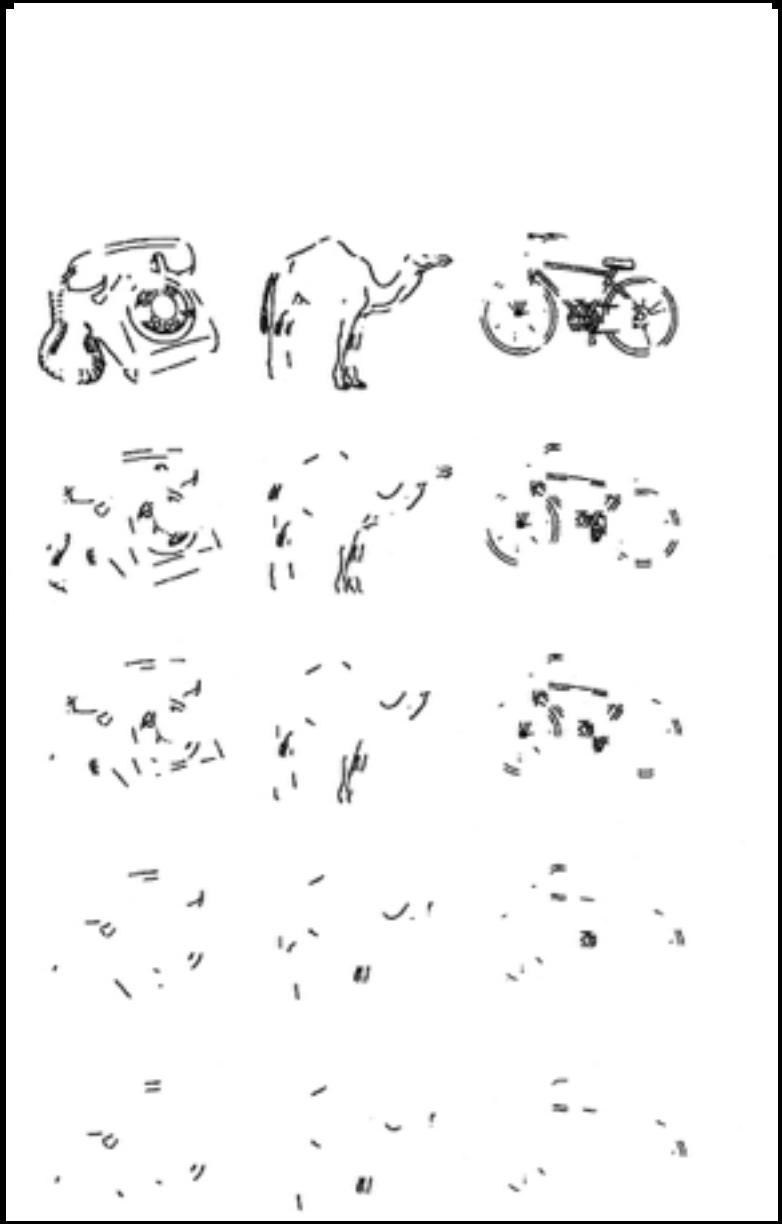

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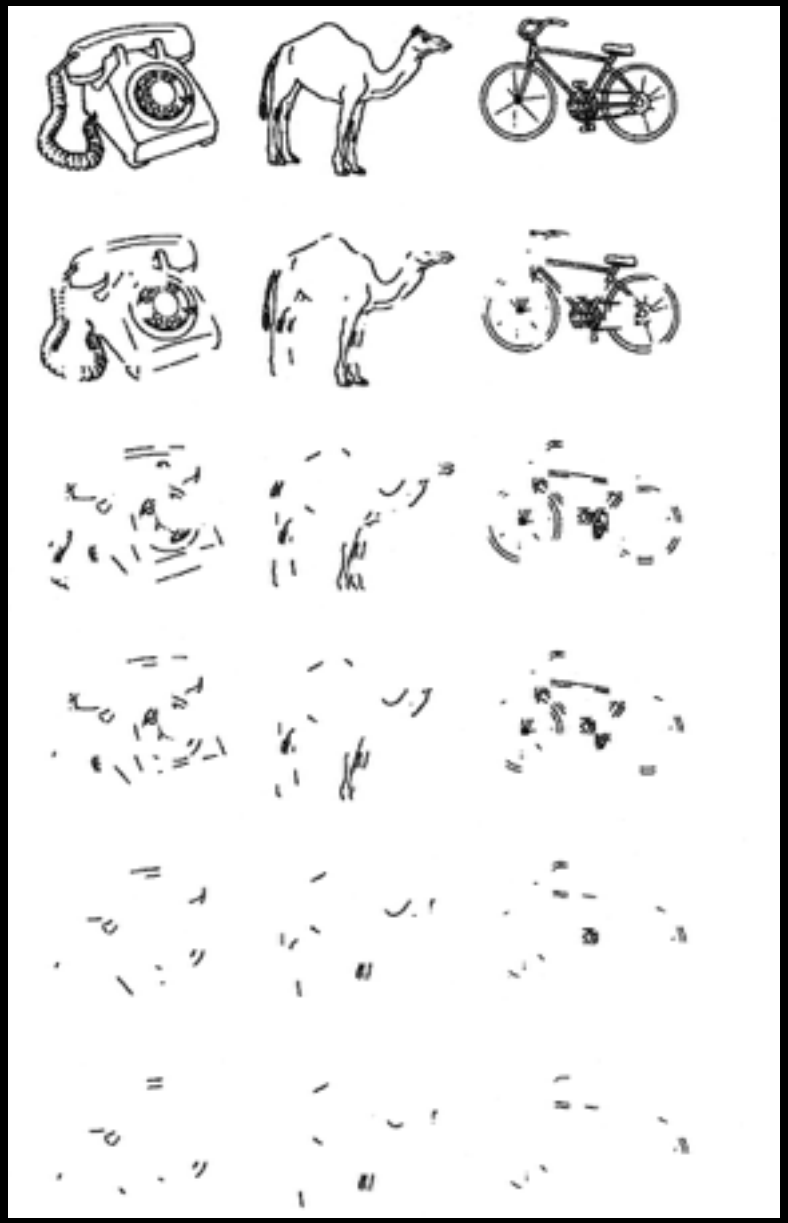
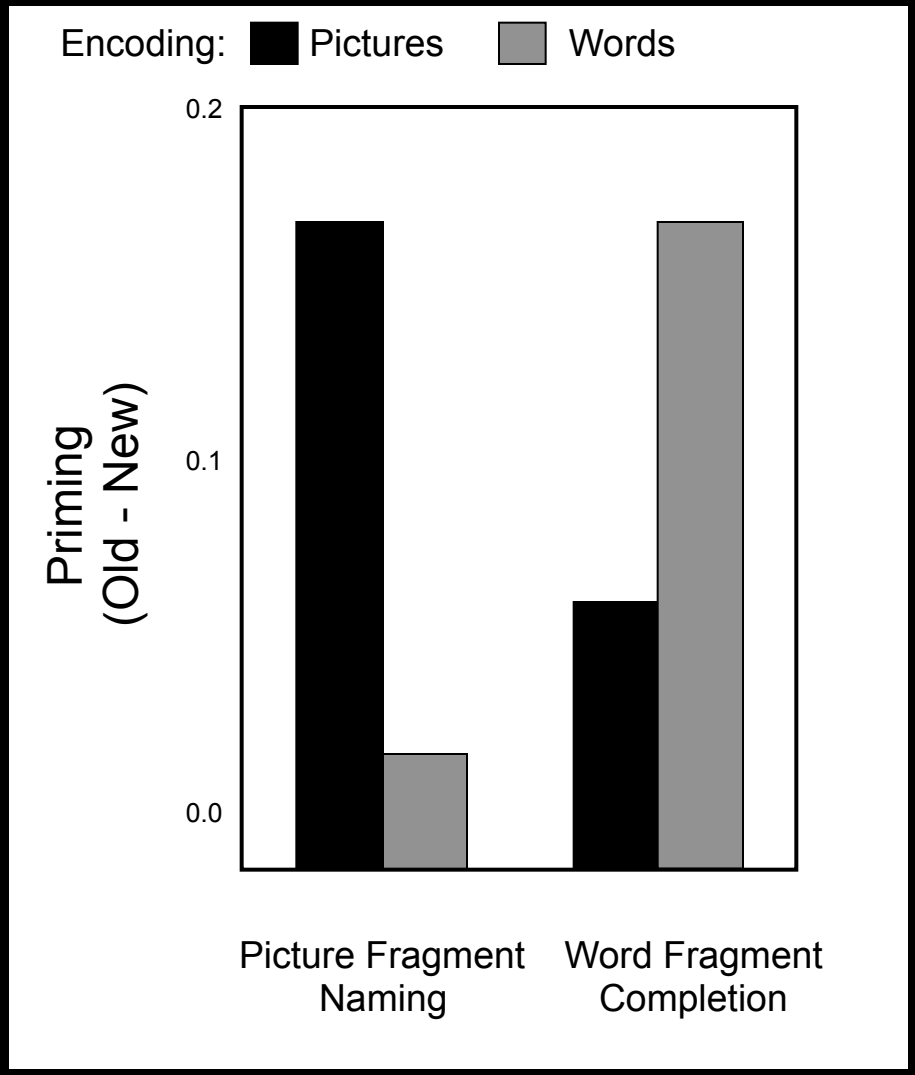


Perceptual Specificity of Priming



Perceptual Specificity

Pict→Pict > Pict→Word

Word→Word > Word→Pict

Priming

A facilitative change or bias in the ability to identify, generate, or process an item due to a specific prior encounter with the item

- priming is implicit in behavior; does not depend on conscious, intentional remembrance or awareness of the past
- priming on perceptual identification (word or object identification) and completion (word stem, word fragment, or object fragment) tasks is sensitive to study–test perceptual similarity
  - enhanced processing of perceptual form due to prior perceptual processing
- patients with global amnesia demonstrate preserved perceptual priming even after long delays (i.e., reflect long-term memory)

Outline

- Priming
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Principles of Priming

Transfer appropriate **processing**

- distinction between perceptual (sensory-driven) vs. conceptual (semantic) processes
  - priming will occur when the processes engaged at study are required at test (TAP)

Multiple Memory **systems**

- dissociation between priming and episodic memory reveals distinct memory systems
  - declarative / explicit memory depends on MTL
  - non-declarative / implicit memory operates independently of MTL

Conceptual Priming: Biasing Person-Trait Attributions

STUDY

Read: RELIGIOUS

Generate: "Attended church three times a week - R_____"

(Smith and Branscombe, 1988)

Conceptual Priming: Biasing Person-Trait Attributions

STUDY

Read: RELIGIOUS

Generate: "Attended church three times a week - R_____"

Free Recall

Word-Fragment Completion:
R__I___O_S

Category Accessibility:
Given a description of ambiguous behaviors of a person and asked to provide a one-word trait describing the person

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Table 1
Proportion of Words Correctly Recalled, Completed, or Accessed in the Three Test Conditions as a Function of Study Conditions

	Study condition		
Test condition	Read	Generate	Nonstudied
Free recall	.45	.61	—

Note. Numbers in parentheses indicate priming (studied–nonstudied performance) in the implicit memory conditions. From "Category Accessibility as Implicit Memory" by E. R. Smith and N. Branscombe, 1988, *Journal of Experimental Social Psychology, 24*, p. 498. Copyright 1988 by Academic Press. Reprinted by permission.

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Category accessibility	.43 (.09)	.52 (.18)	.34

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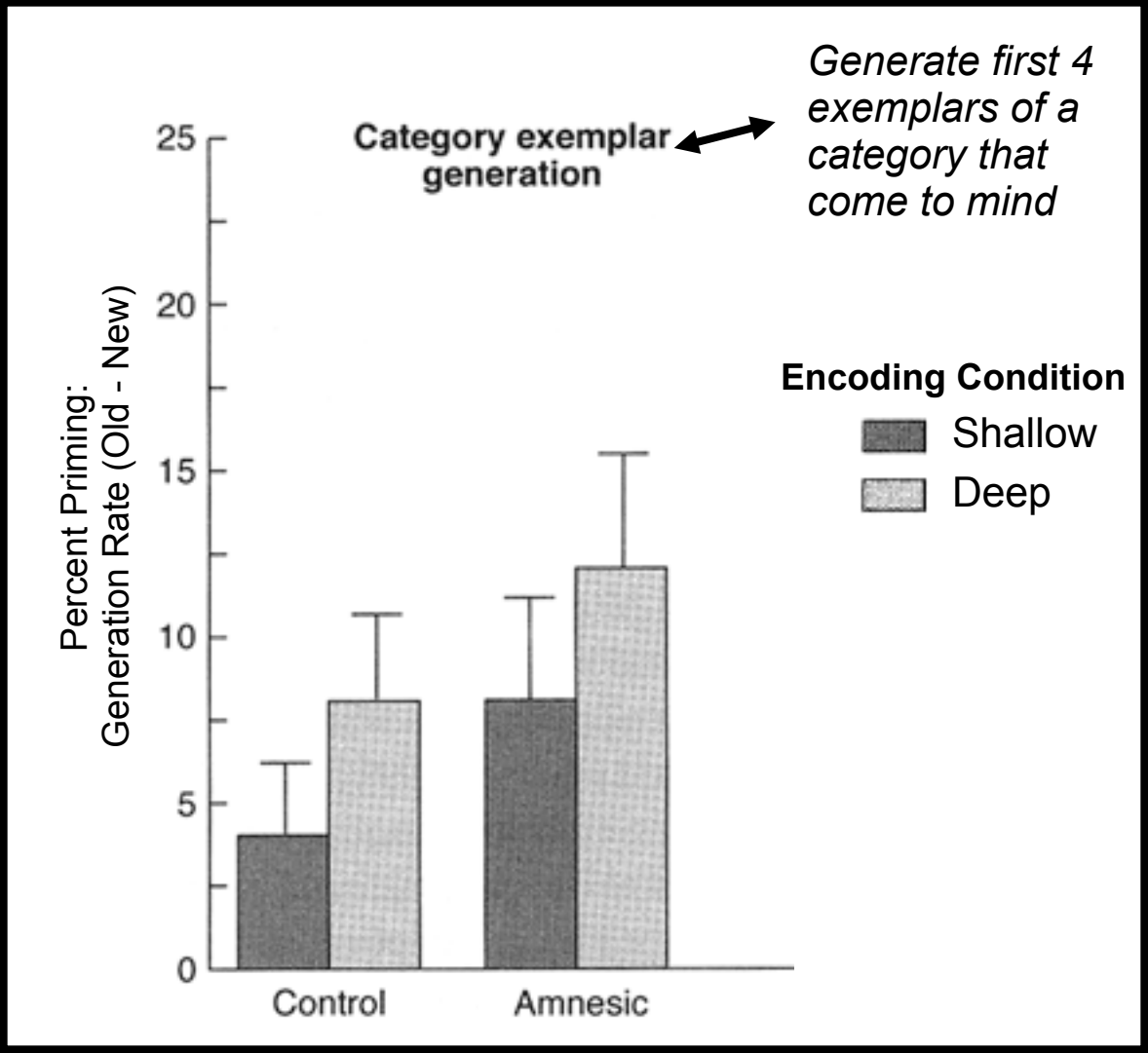
Conceptual Priming in Amnesia



Conceptual priming benefits from prior semantic ("deep") elaboration

Amnesics show intact conceptual priming

(Vaidya et al., 1998)

Conceptual vs. Perceptual Tasks: Transfer Appropriate Processing

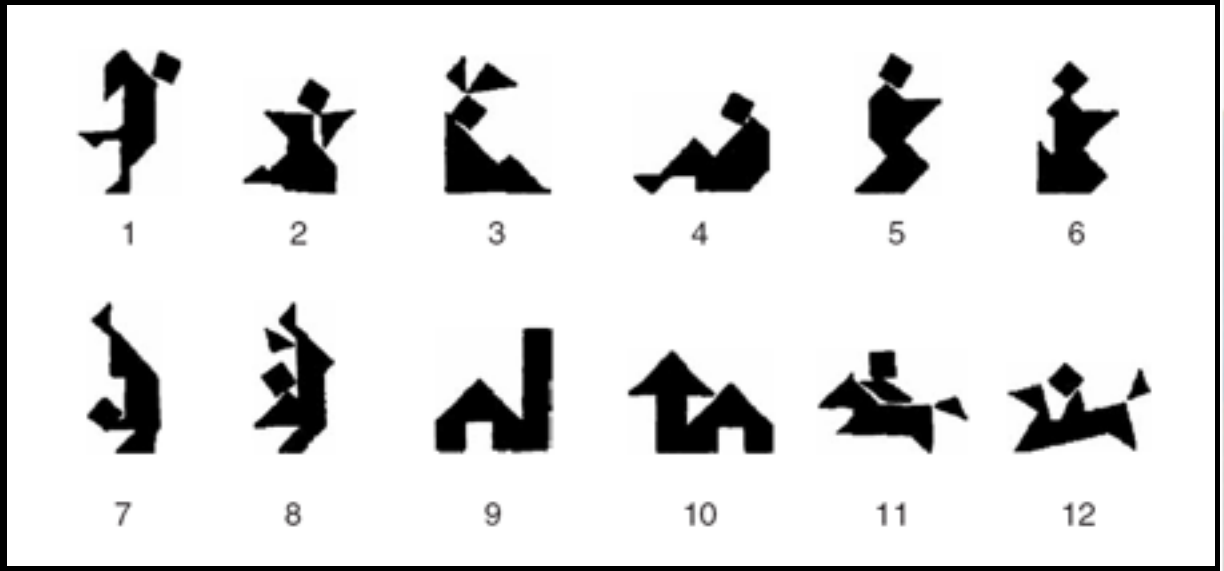
Conceptual priming

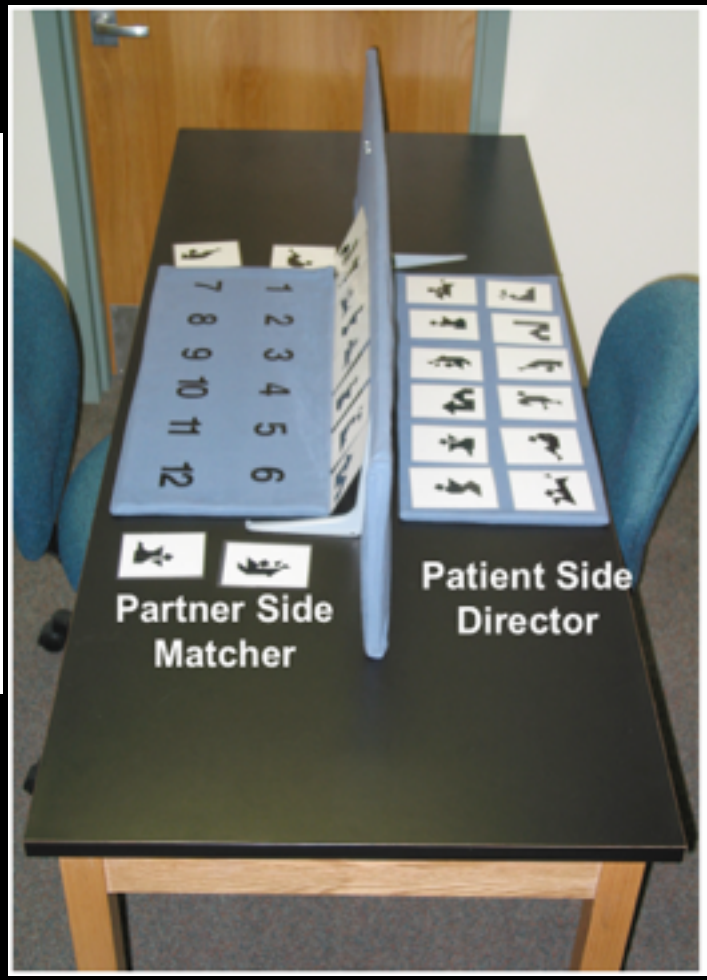
- shows a “generation effect”: generate > presented
- insensitive to changes in study–test modality/perceptual similarity
- shows a depth-of-processing effect

Perceptual priming

- shows a “reverse–generation effect”: presented > generate
- sensitive to changes in study–test modality/perceptual similarity
- shows no depth-of-processing effect

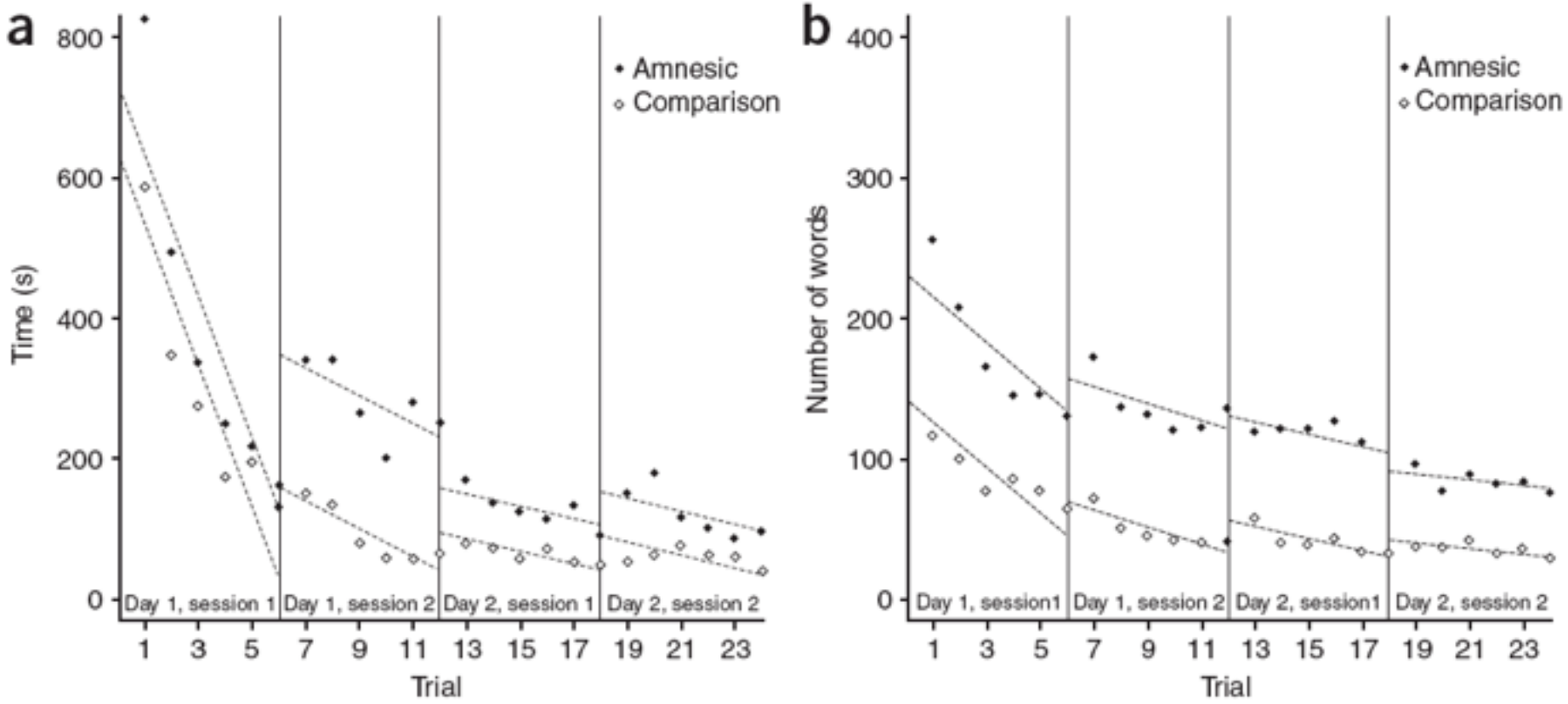
The Power of Conceptual Priming: Effects on Language





(Duff et al., 2006)

The Power of Conceptual Priming: Effects on Language



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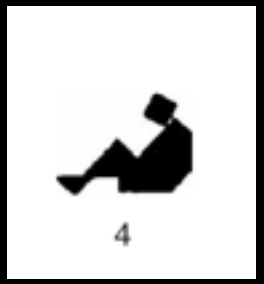

4

Table 1 Description of card 4 across all 24 trials for the same amnesic patient and partner

Session number and trial number	Card description
Session 1	
Trial 1	The next one looks almost…the opposite of somebody kind uh slumped down, on the ground, with the same type of sh: head.
Trial 2	The guy that looks like he's sleeping with his knees bent and he's got- **Sitting?**
Trial 3	The guy that's slumped over re- or sleeping or reading a book or something. **Kinda siesta time?**
Trial 4	This would be the siesta guy.
Trial 5	The person that looks like he is siestaing.
Trial 6	The guy taking the siesta.
Session 4	
Trial 1	Siesta man.
Trial 2	Siesta man.
Trial 3	Siesta man.
Trial 4	Siesta man.
Trial 5	Siesta man.
Trial 6	Siesta man.

Bold text is familiar communication partner; "…", a pause in speech of less than 1 s; ":", prolonged sound.

(Duff et al., 2006)

Another example: E.P.'s repeated description of the former size of computers

Participation Prompt #3

- There are many ways in which learning from past experience impacts behavior in the present. Sometimes priming impacts behavior without our awareness—that is, we are unaware that memory is shaping our current thoughts and actions.

- Describe one instance in which priming might have impacted your thoughts or actions.

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- Priming
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Declarative Memory vs. Priming

Declarative Memory

a type of memory that depends on plasticity *across* multiple neocortical zones and that requires cross-cortical conjunctions mediated via cortico-hippocampal networks

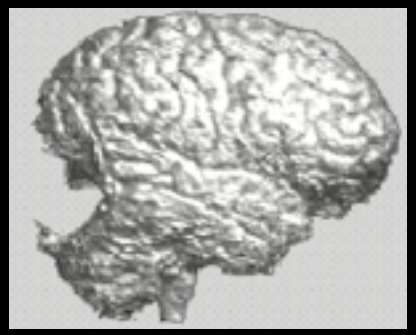
often consciously aware of memory's operation and expressed explicitly

Priming

a type of neocortical memory that depends on plasticity *within* single neocortical zones that are responsible for distinct functions

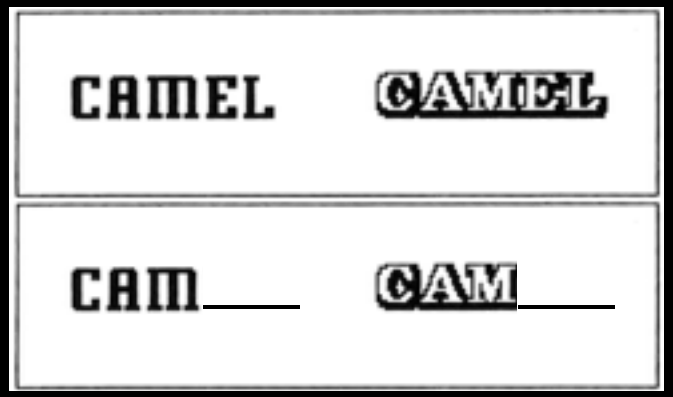
often unaware of memory's operation and expressed implicitly

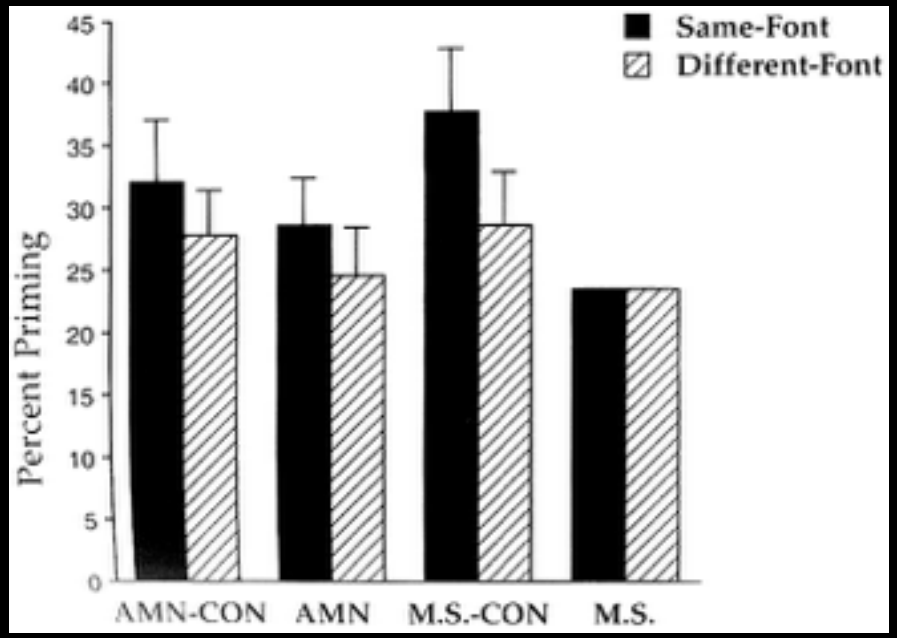
Visual Cortex and Visual Word-Form Priming



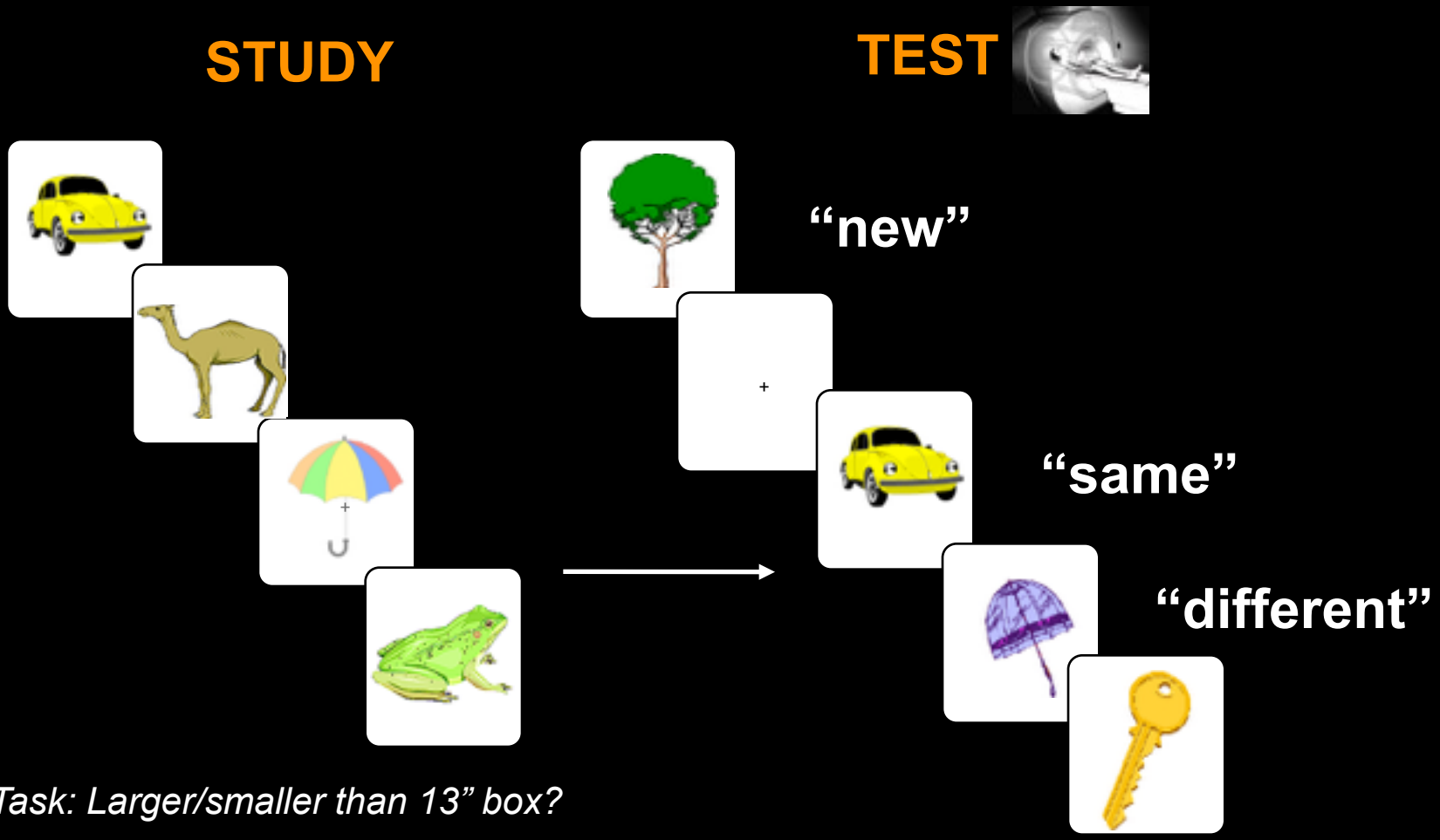
M.S. fails to demonstrate font-specific priming in word-stem completion

M.S. shows intact font-independent priming





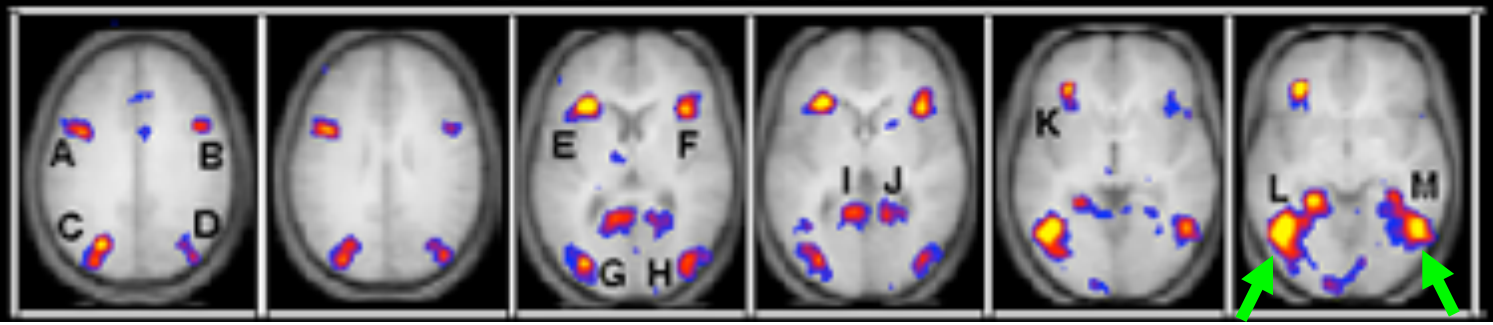
Visual Cortex and Visual Object Priming



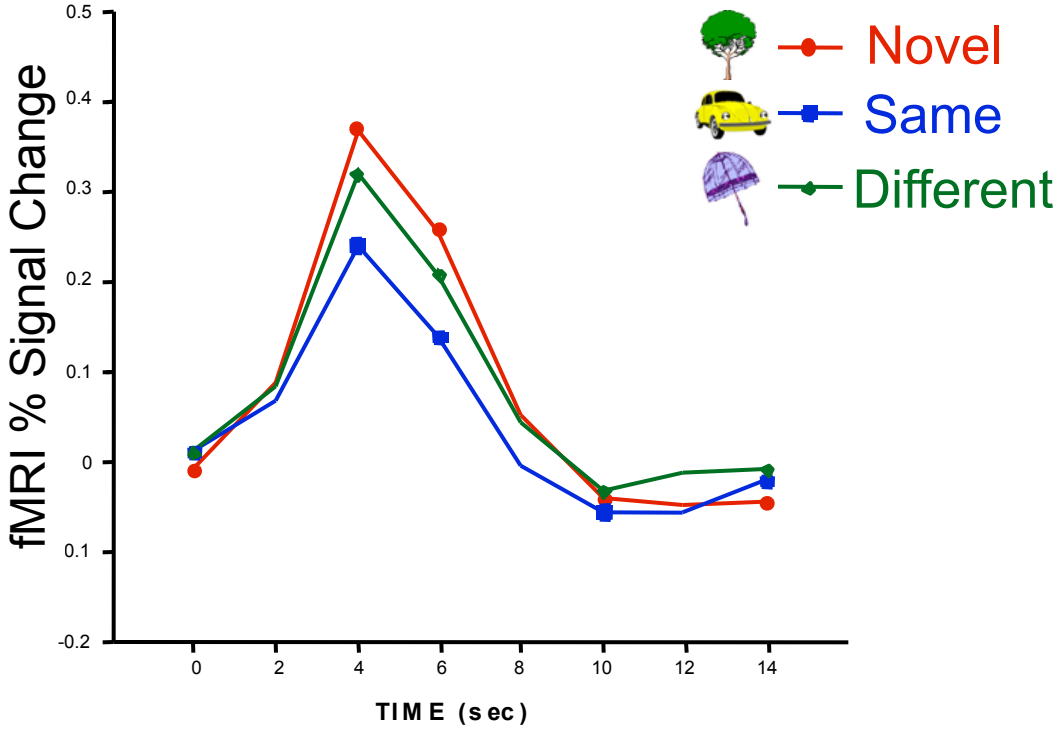
(Koutstaal et al., 2001)

Visual Cortex and Visual Object Priming

NOVEL > ALL REPEATED



Left Fusiform Gyrus



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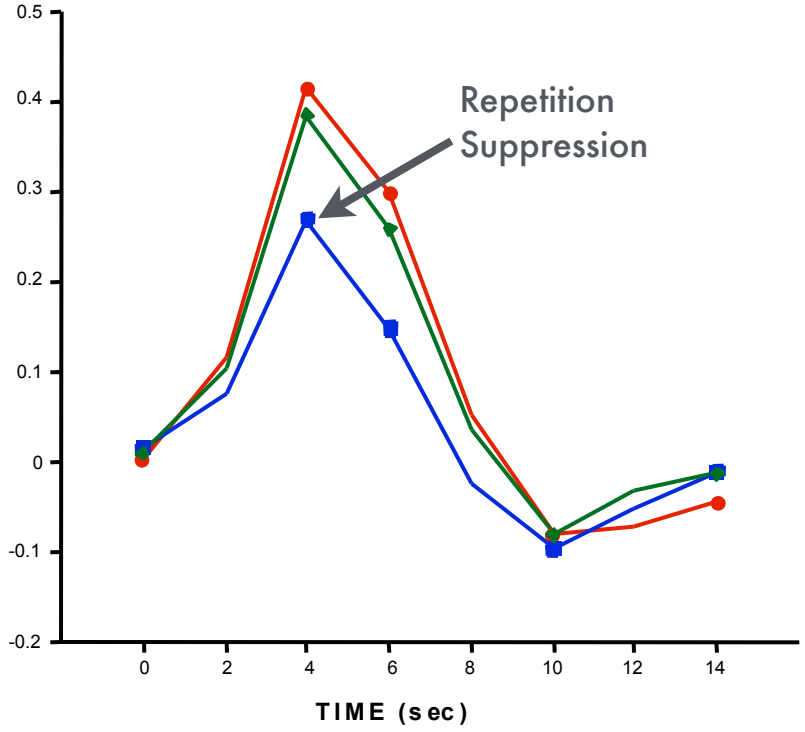

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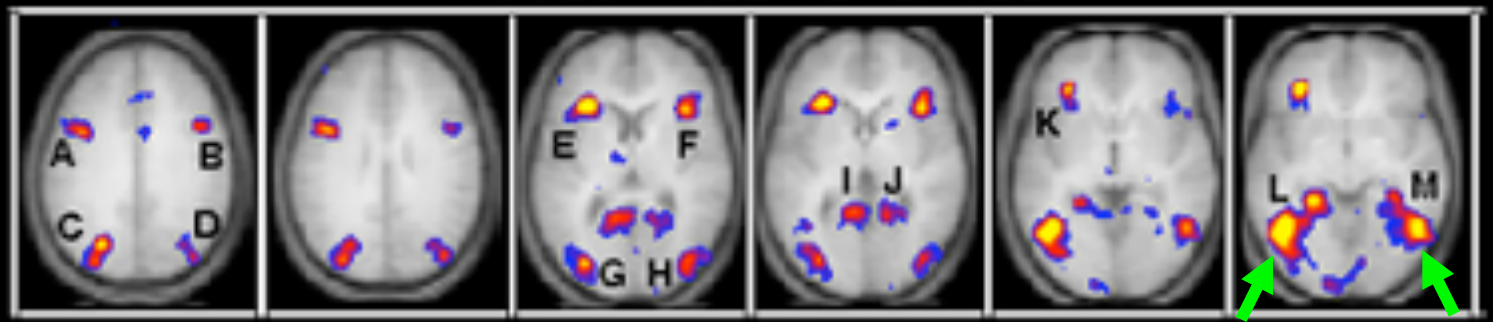

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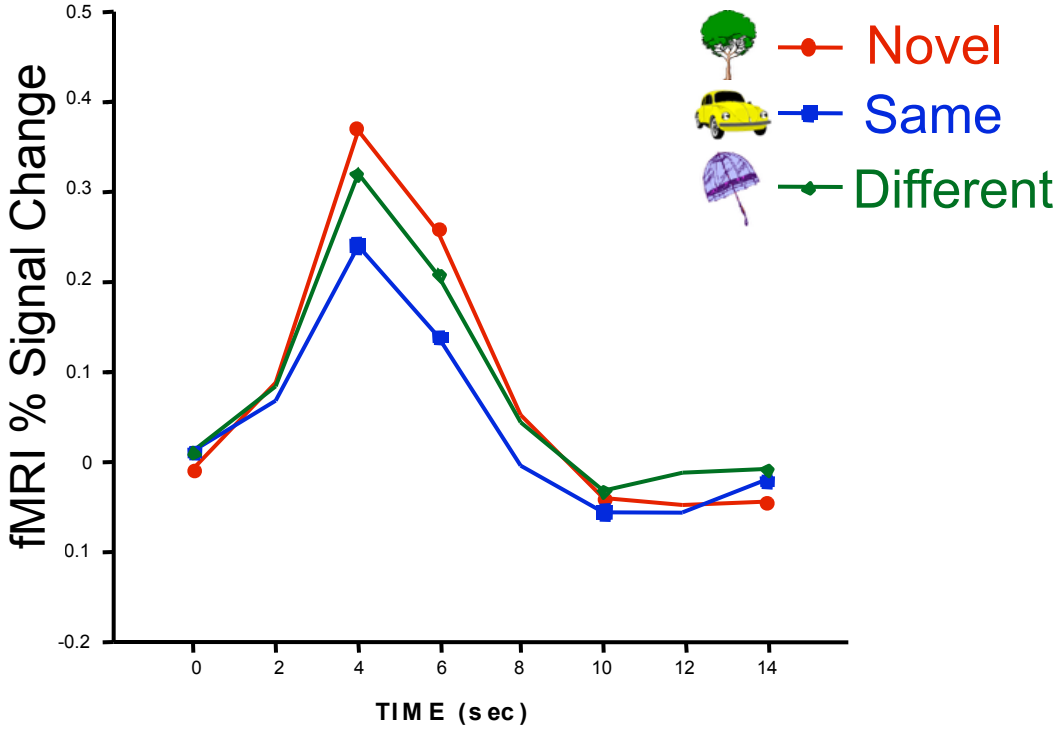

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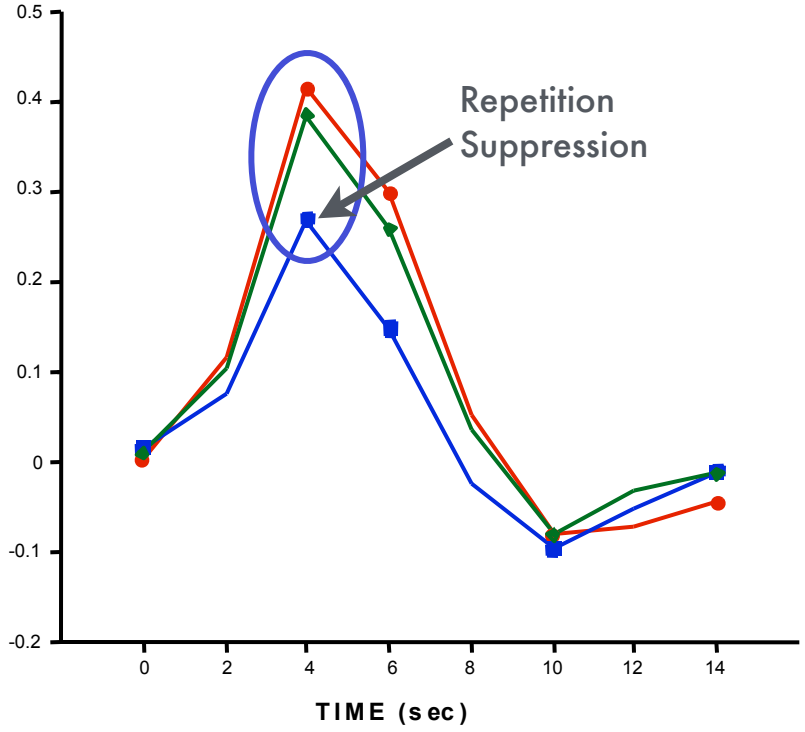

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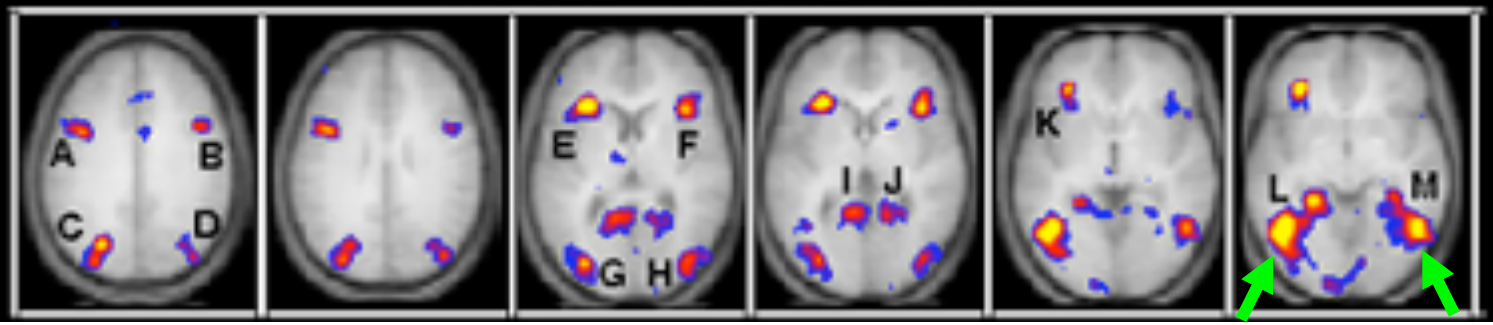

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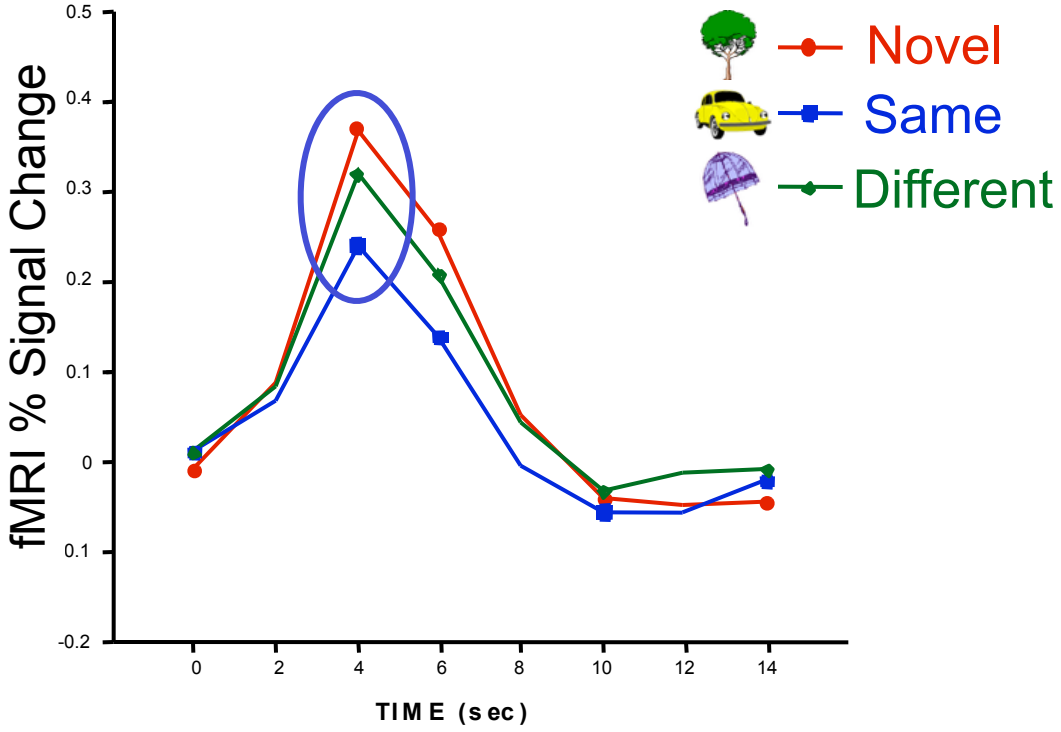

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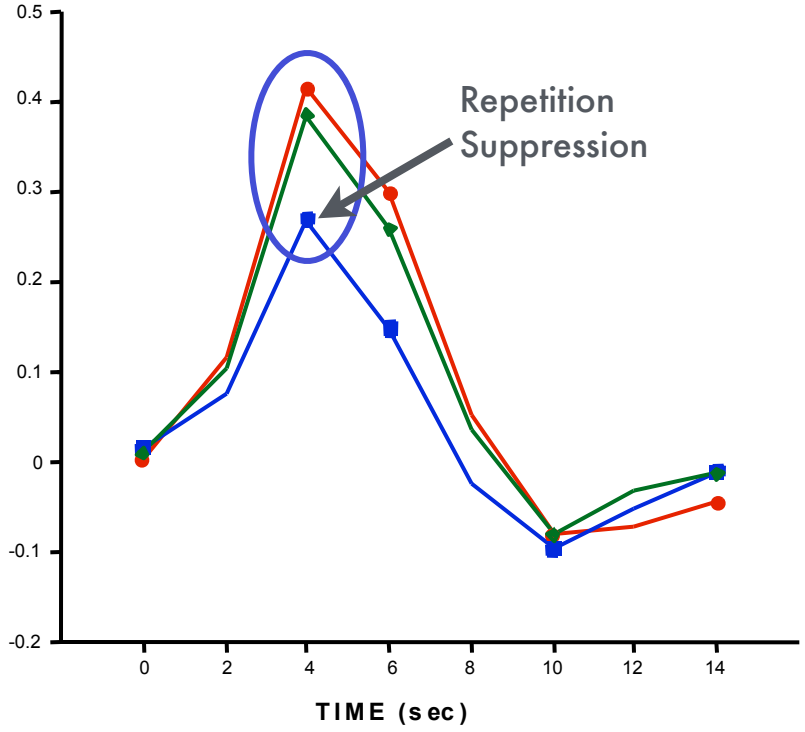
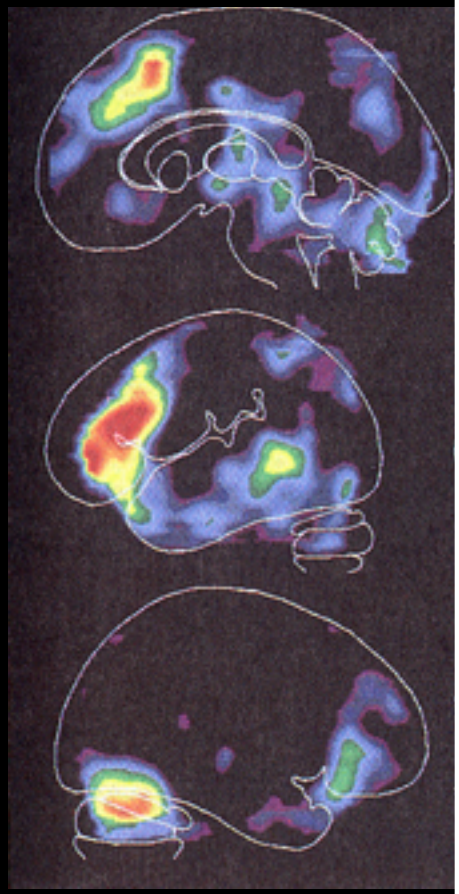


(Koutstaal et al., 2001)

Cortical Bases of Conceptual Priming: Item vs. Task-Level Learning?

CAKE - ?

NOVEL



(Raichle et al., 1994)

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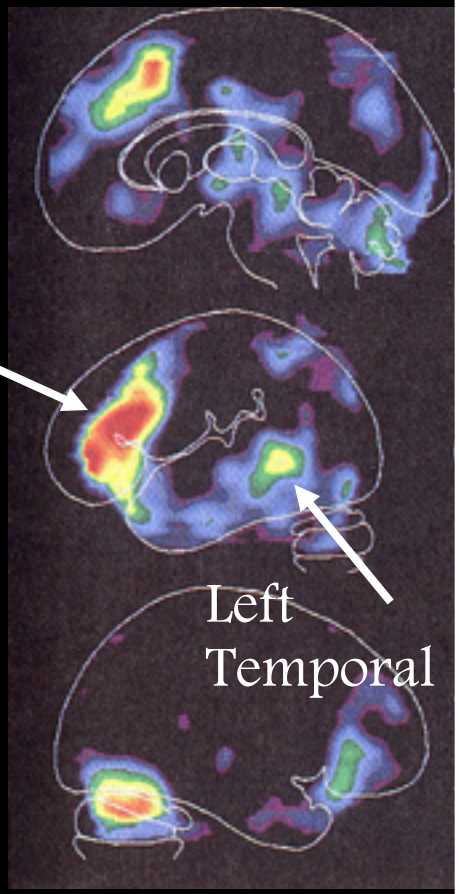

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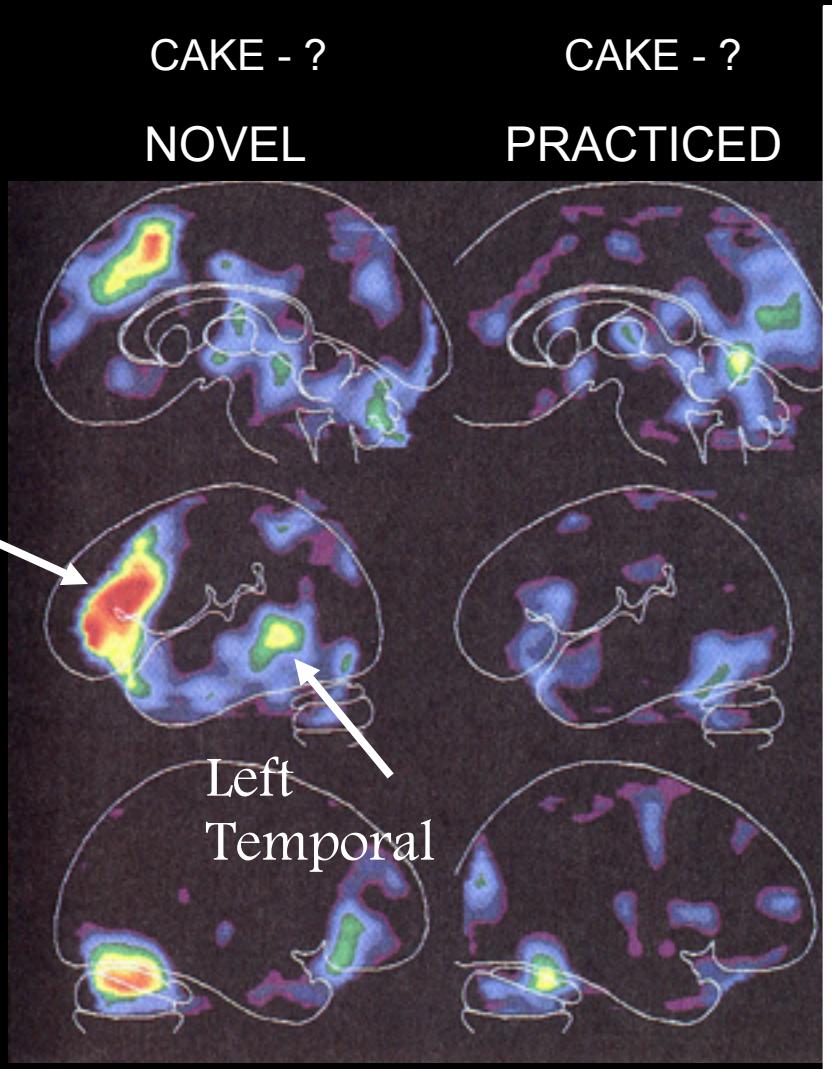

Conceptual priming: Repetition suppression in left lateral PFC & left temporal cortex.

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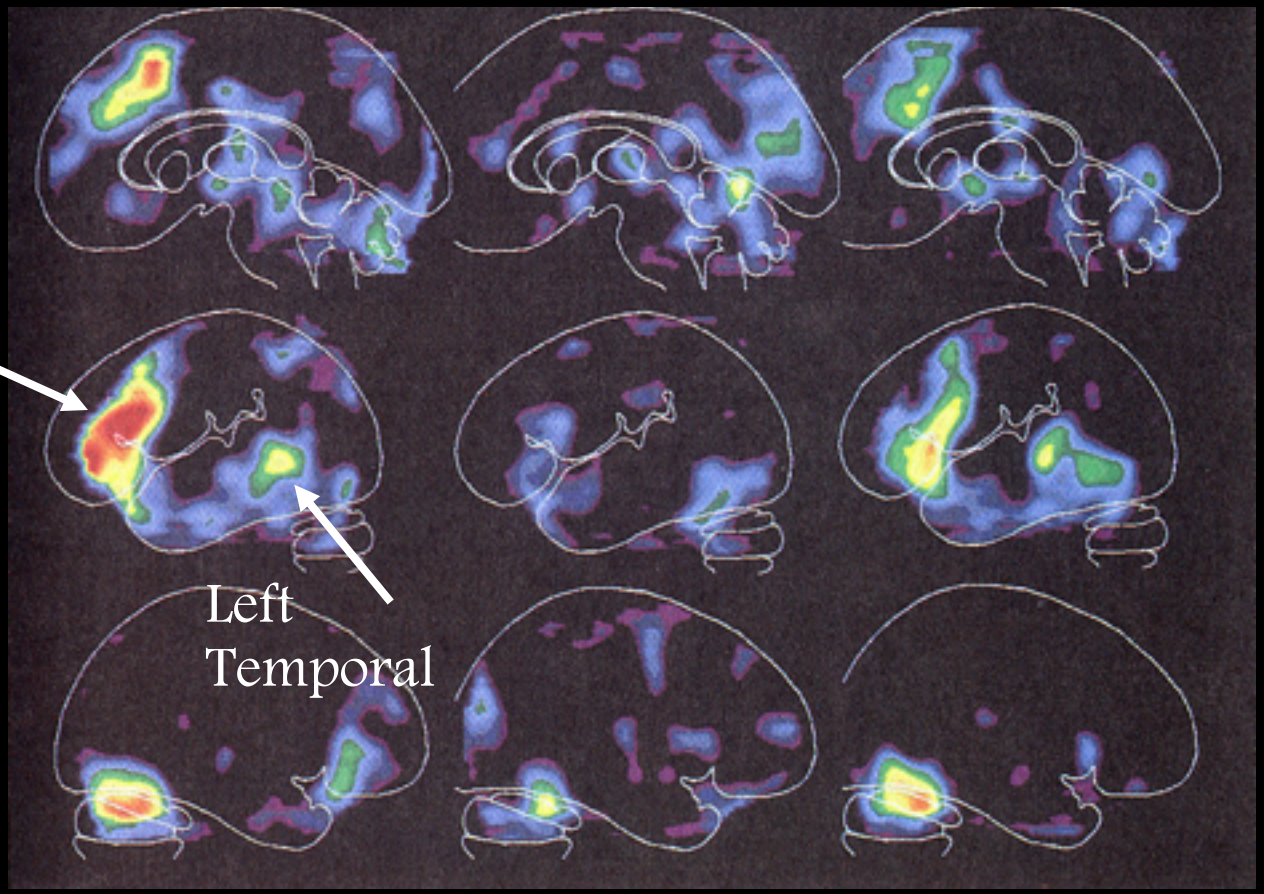

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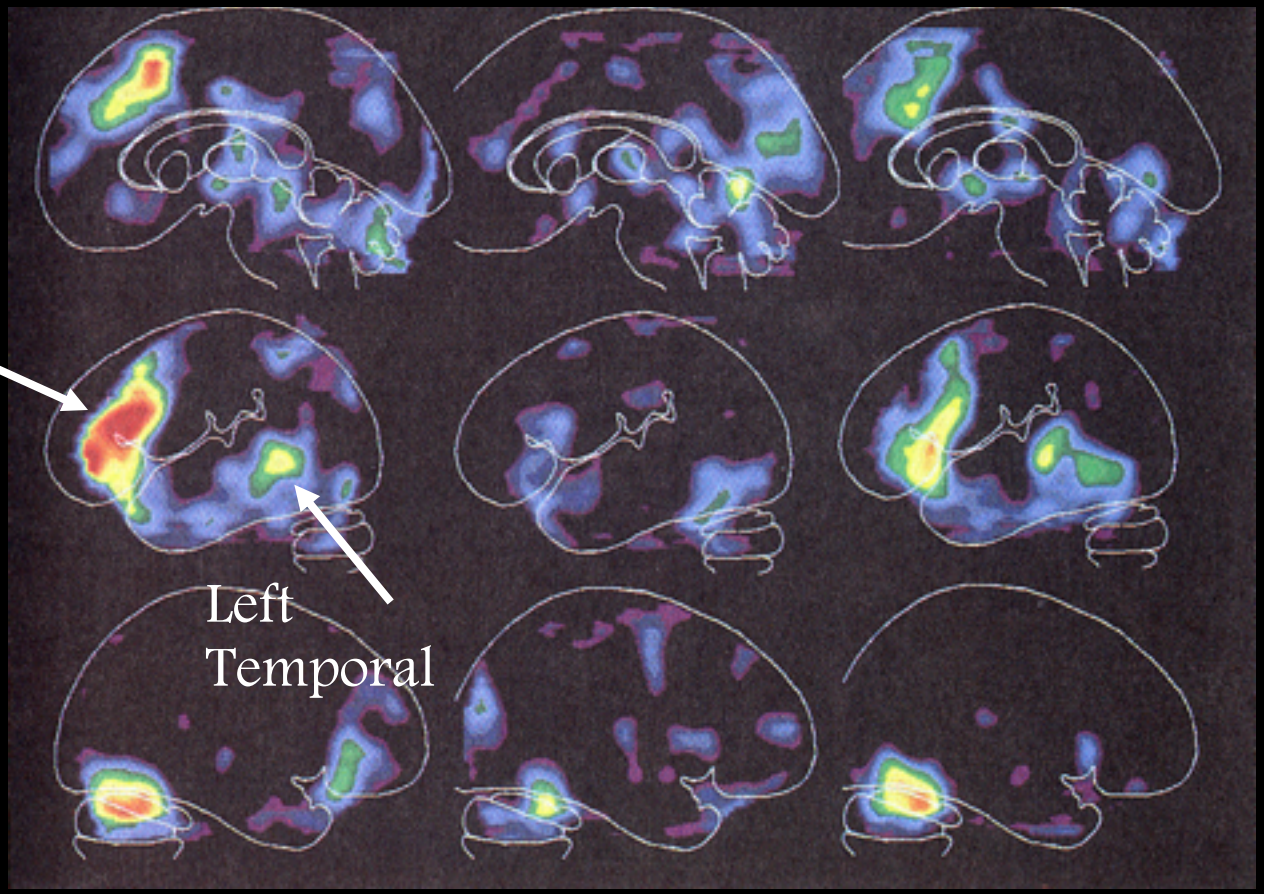
(Raichle et al., 1994)

Cortical Bases of Conceptual Priming: Item vs. Task-Level Learning?



Conceptual priming: Repetition suppression in left lateral PFC & left temporal cortex.

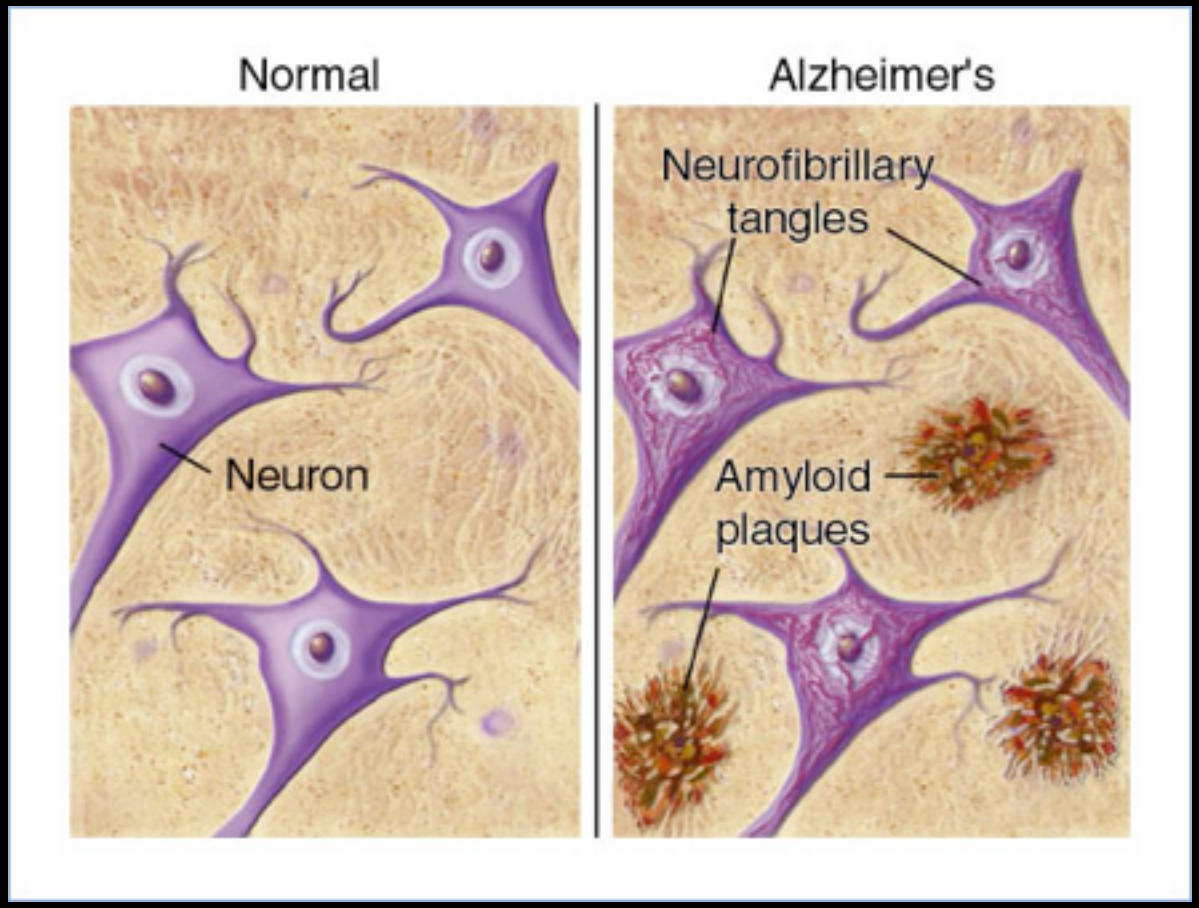
Priming is item-specific; does not reflect general task learning.

(Raichle et al., 1994)

Alzheimer's Disease

Alzheimer's Disease

- progressive disorder, typically first impacting entorhinal cortex
- *beta-amyloid* plaques – clumps of protein that accumulate outside neurons
- neurofibrillary tangles – twisted strands of the *tau* protein form inside cells



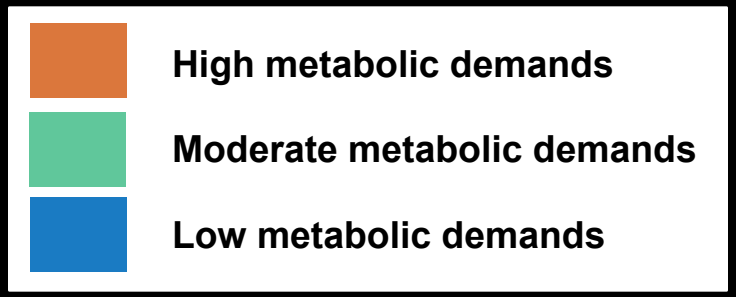
Alzheimer's Disease

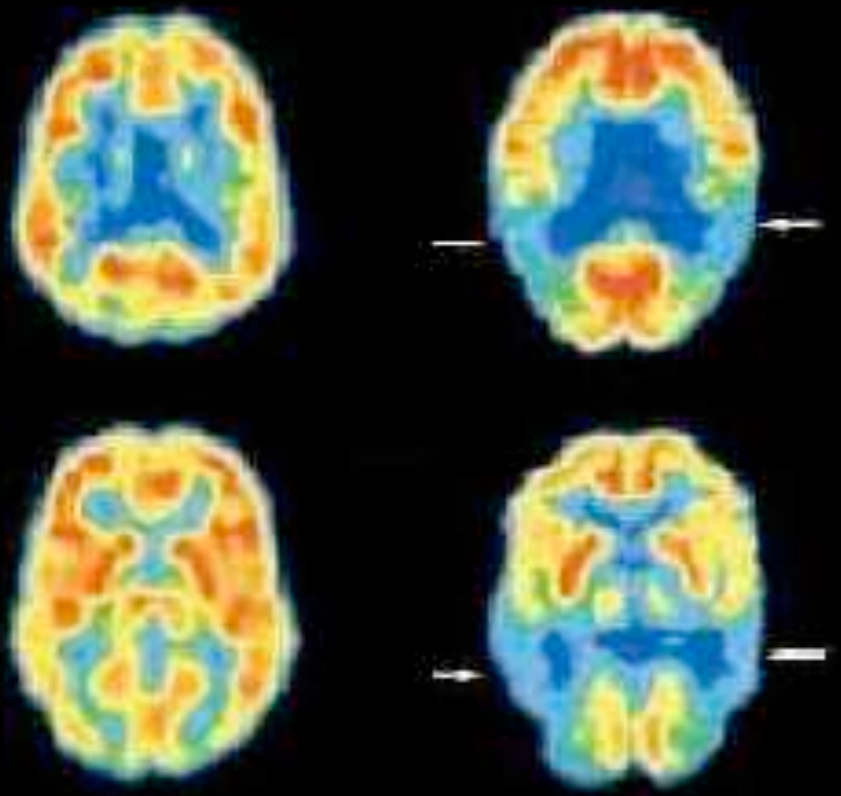
Alzheimer's Disease – typically affects temporal, parietal, & frontal cortical areas more than occipital cortex

PET imaging of resting metabolism:

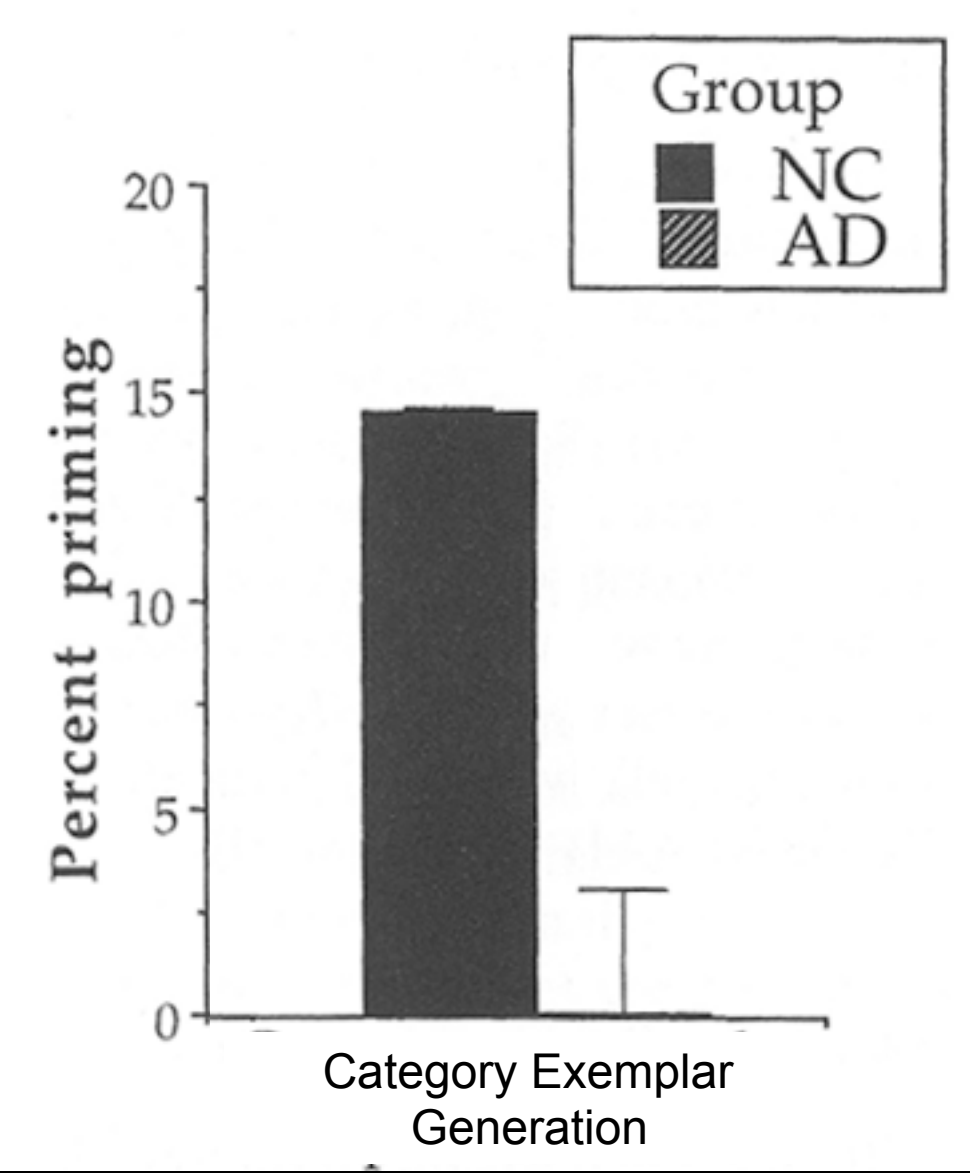
Healthy Adults

AD Patients





Neural Bases of Conceptual Priming: Alzheimer's Disease



(Vaidya et al., 1999)

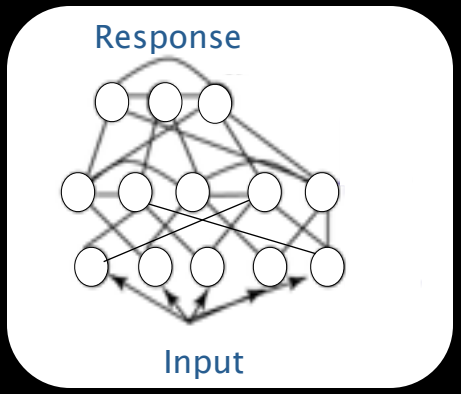
Alzheimer's Disease

- impaired conceptual priming (shown at left)
- can demonstrate intact perceptual priming (data not shown)

Dissociations btwn Memory Systems

Condition	Declarative memory	Perceptual priming	Conceptual priming	Skills & Habits
MTL amnesia	Impaired	Intact	Intact	Intact
Alzheimer's disease	Impaired	Intact	Impaired	Intact
Right occipital lesion	Intact	Impaired	Intact	Intact
Basal Gan. dysfunction	Intact	Intact	Intact	Impaired

Models of Priming and Repetition Suppression



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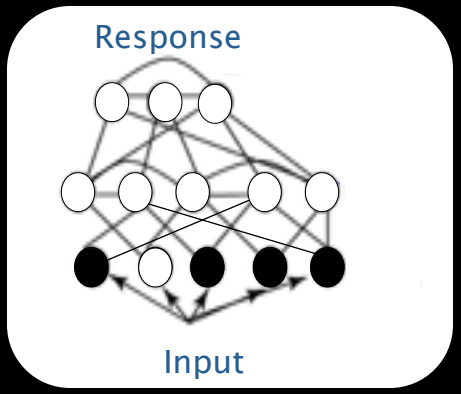

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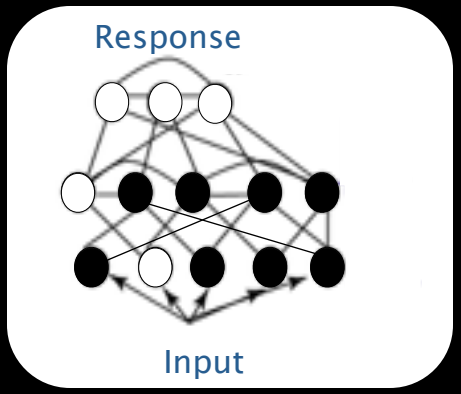

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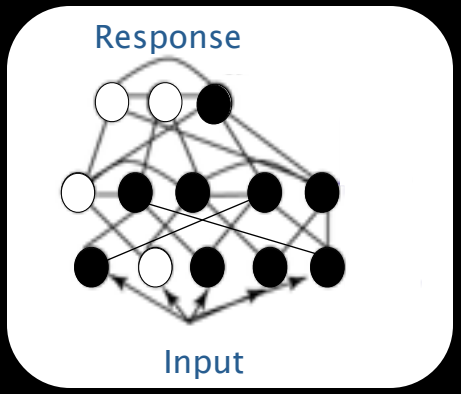

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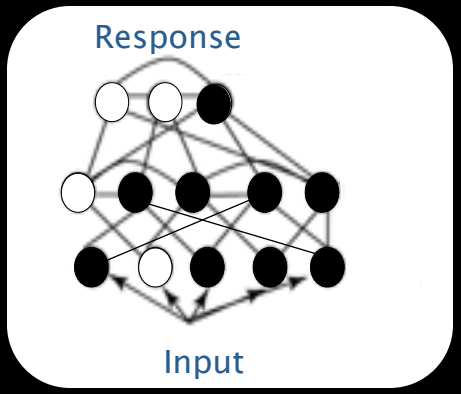
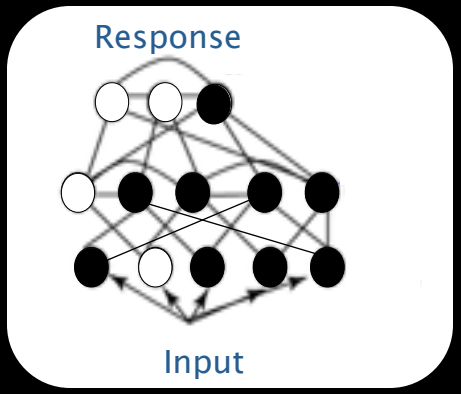


Strengthening

Models of Priming and Repetition Suppression



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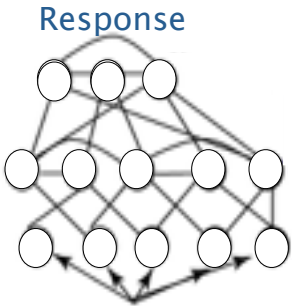
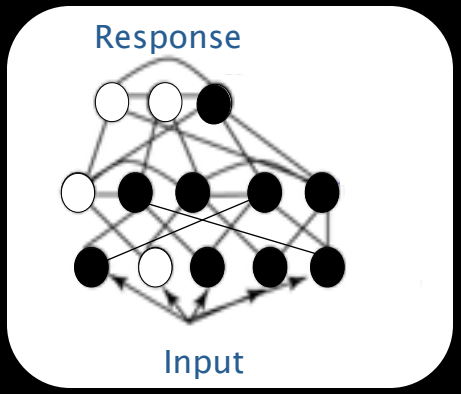


- Strengthened feedforward connections
- Enables more rapid settling on stimulus representation

Models of Priming and Repetition Suppression



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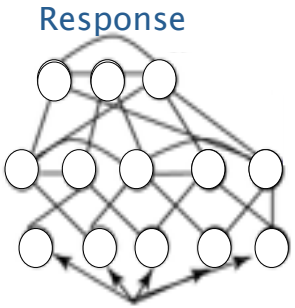

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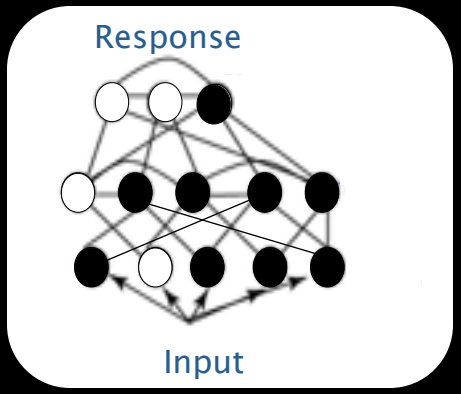

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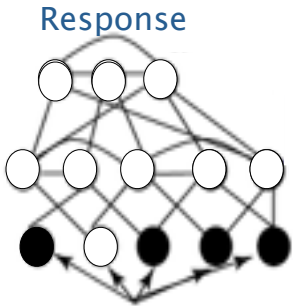

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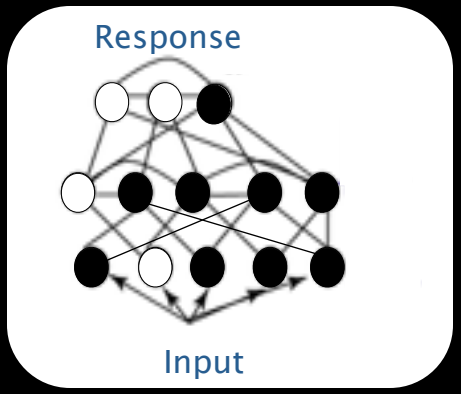

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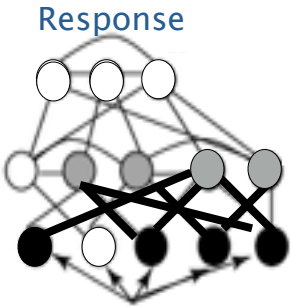

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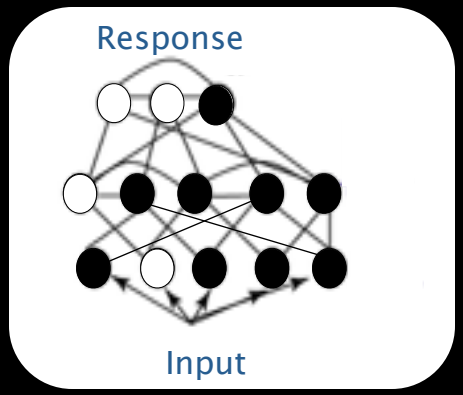

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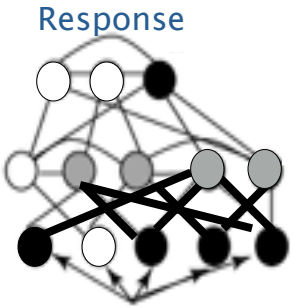

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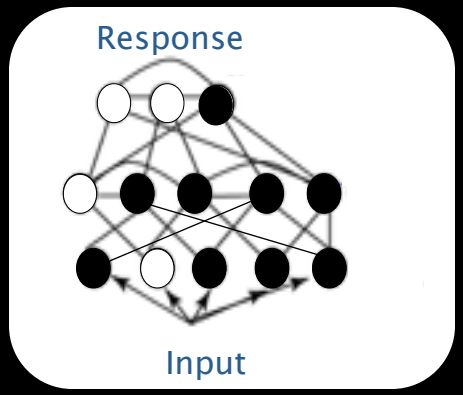
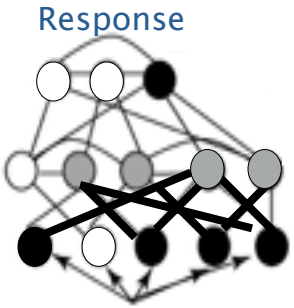


Sharpening

Strengthening



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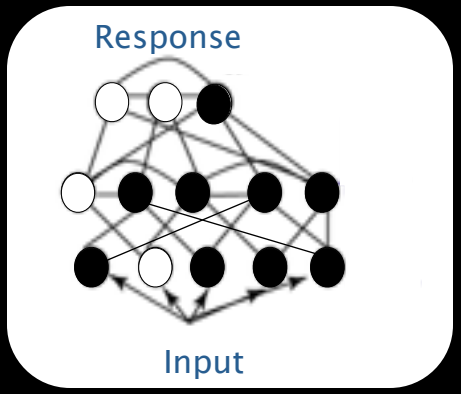

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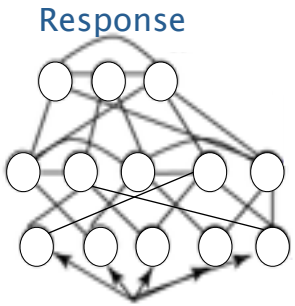

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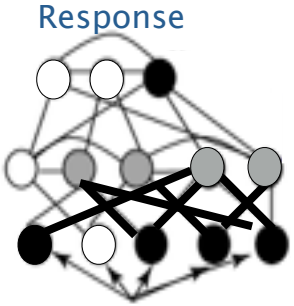

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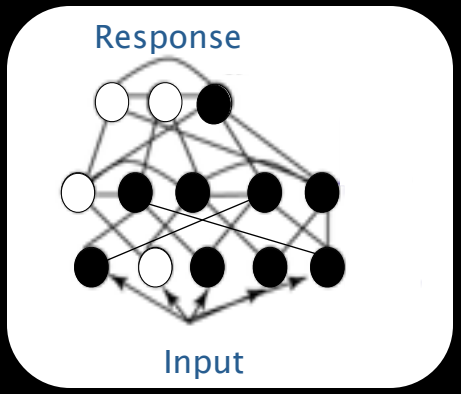

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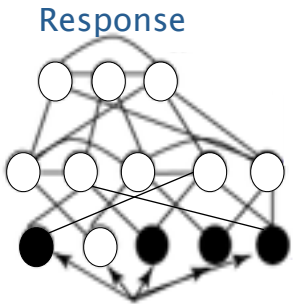

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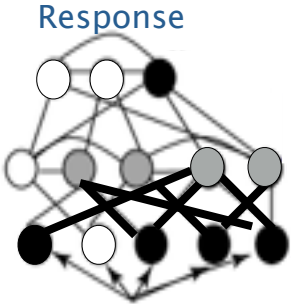

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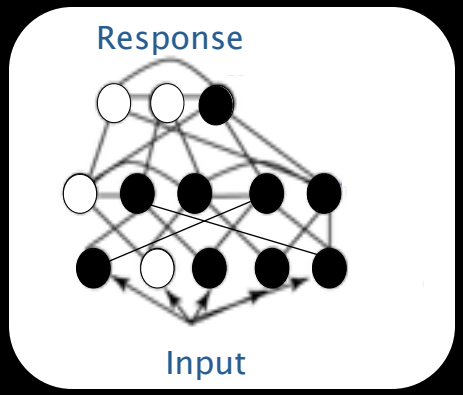

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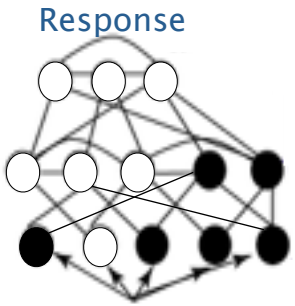

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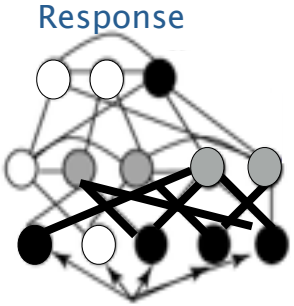

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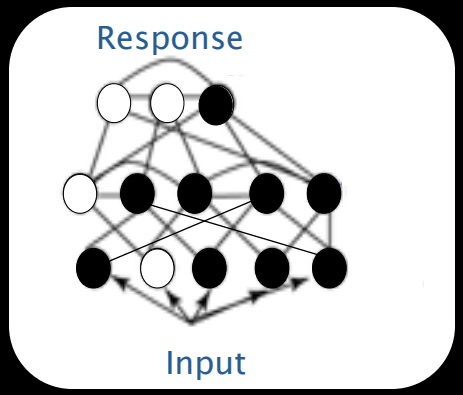

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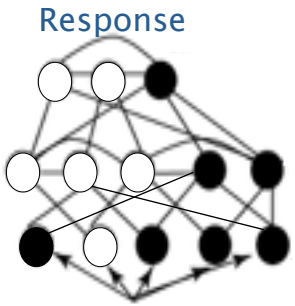

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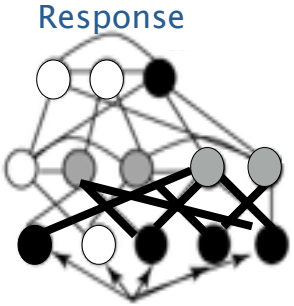

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Conditioning

Classical Conditioning

- Principles and Stages of conditioning
- Model of Classical Conditioning

Operant Conditioning

- Schedule of Reinforcement

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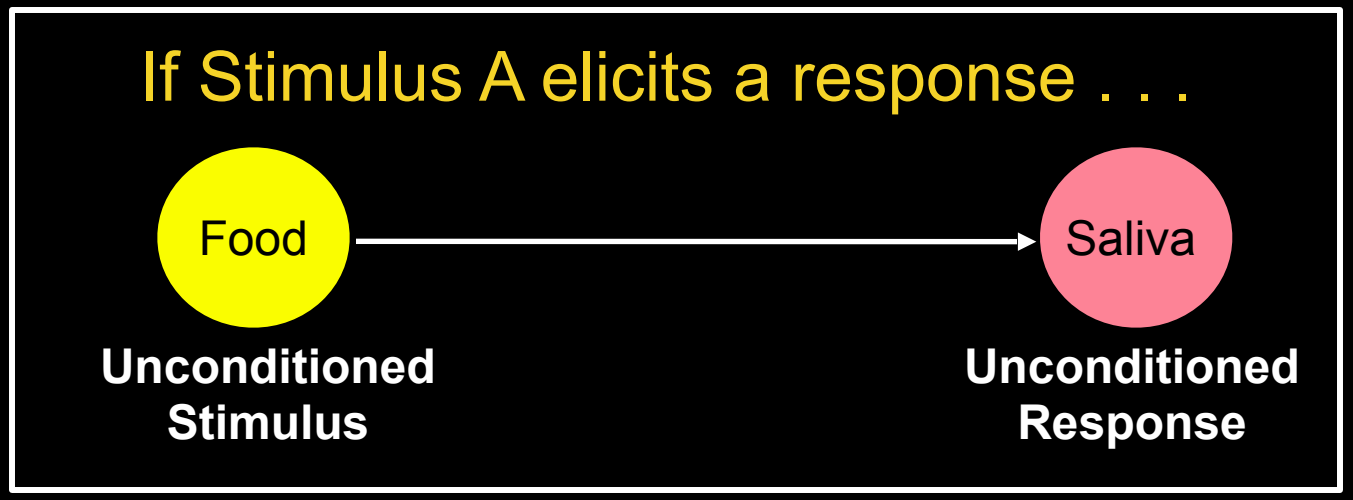
What is Classical Conditioning?



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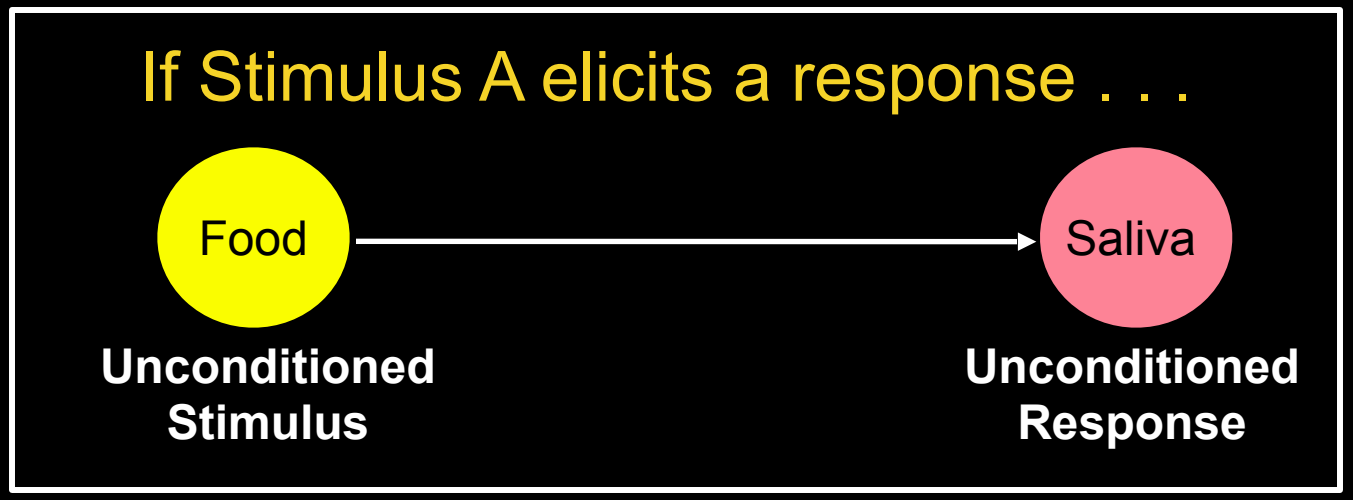

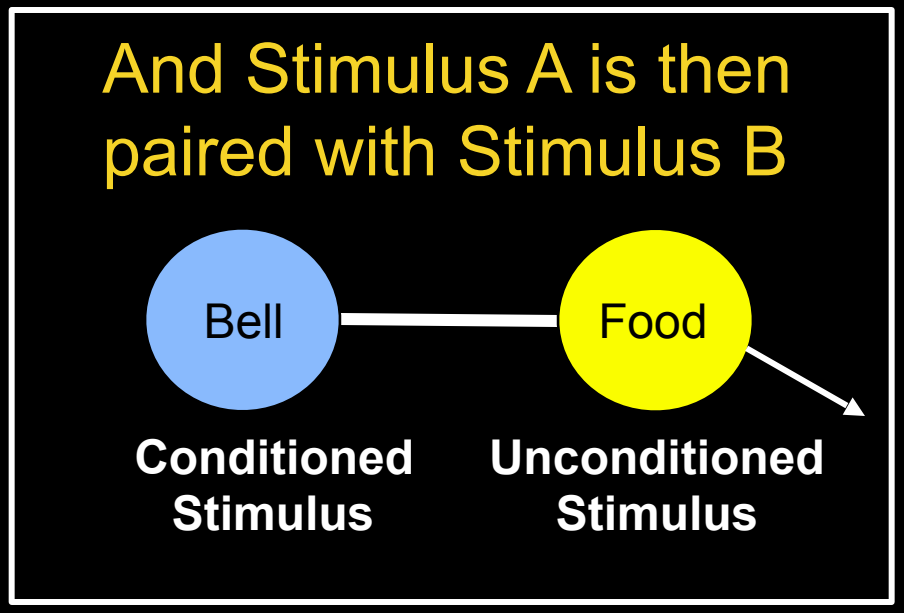

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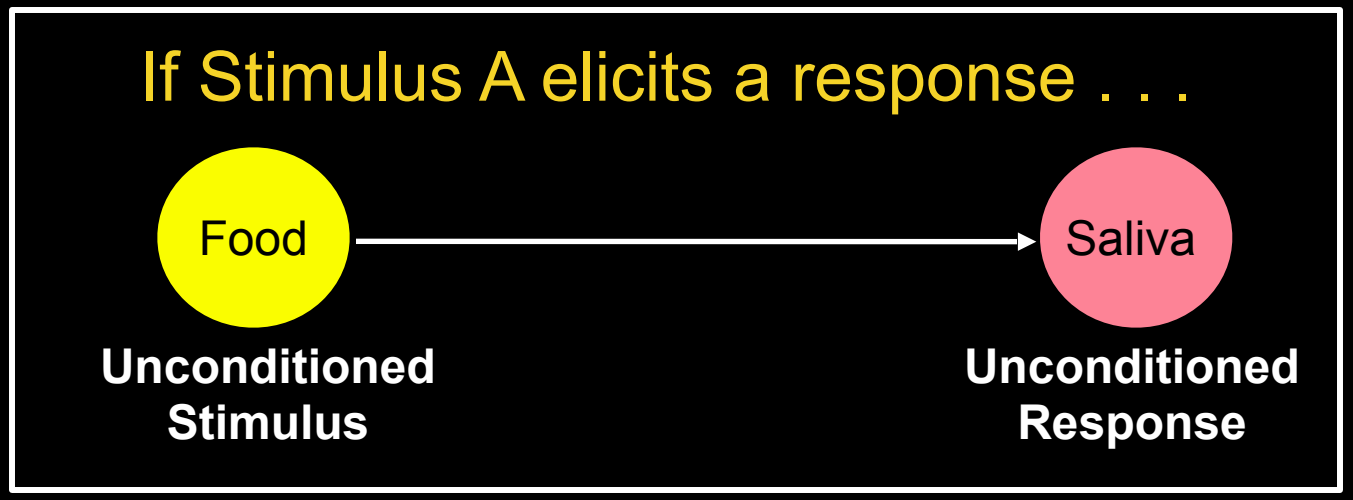
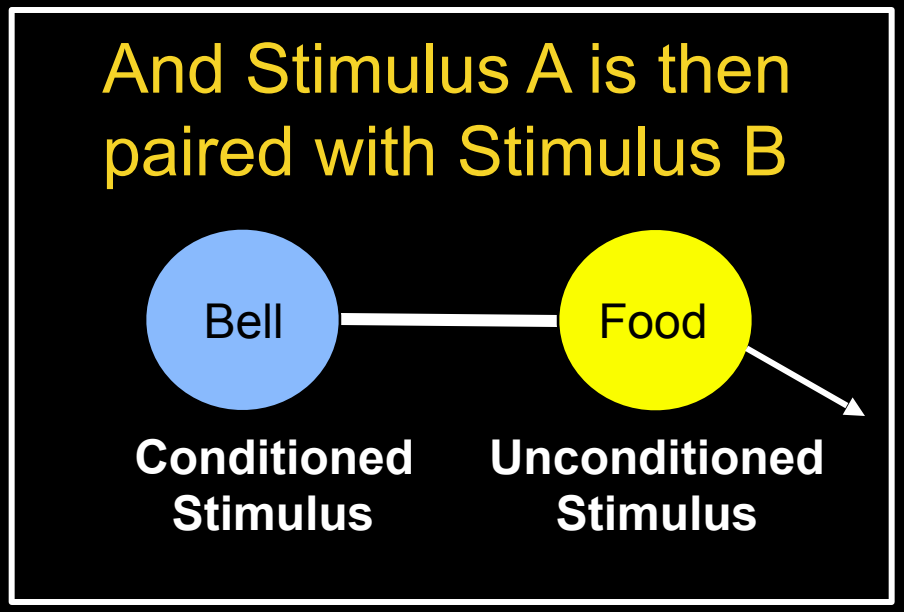
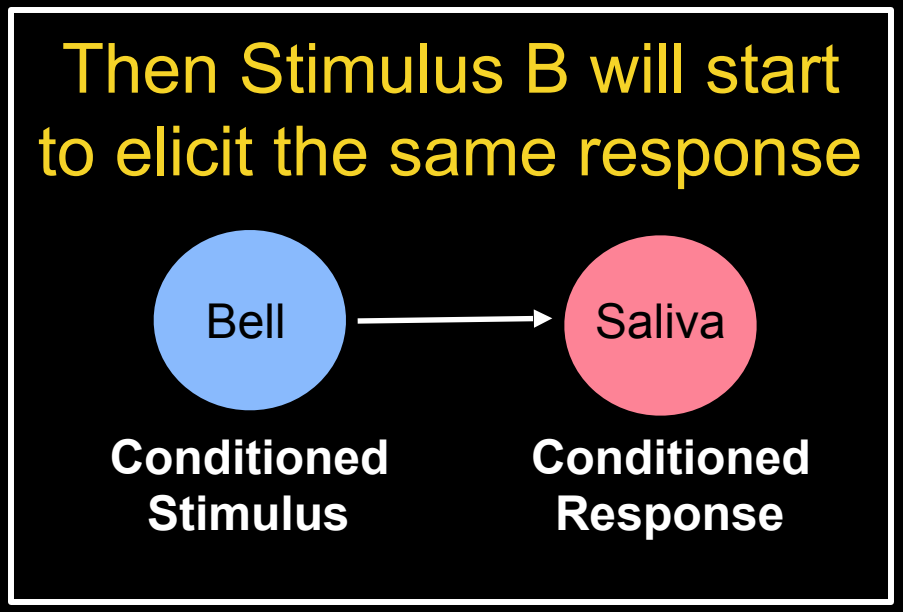




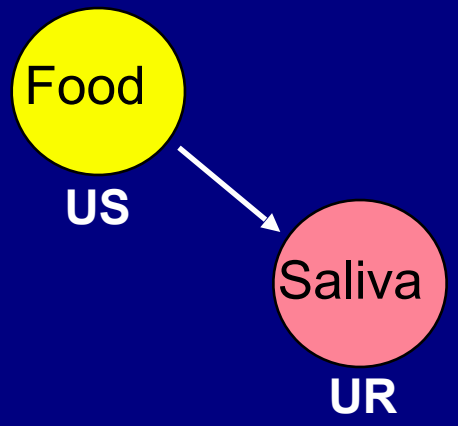


Stages of Classical Conditioning

(a) Initial State – Acquisition

Experimenter Presents:

Organism's Response:



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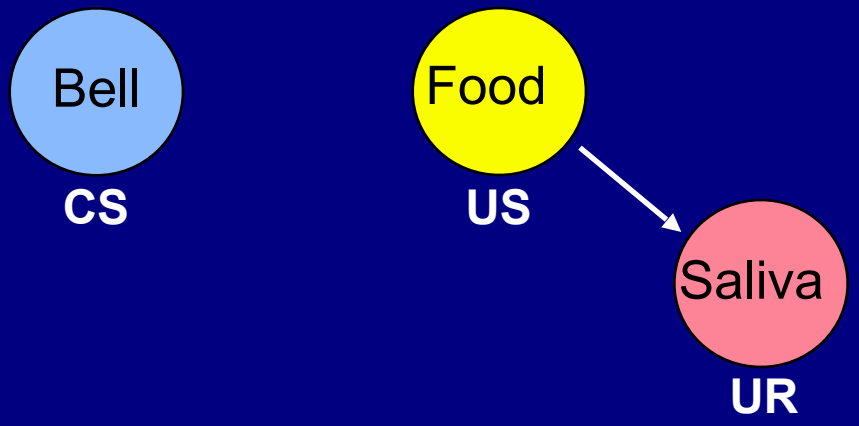

Organism's Response:

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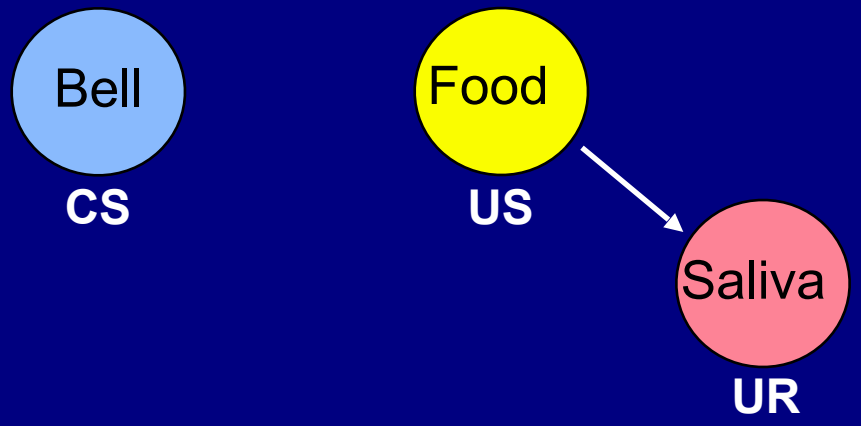

(b) Conditioned Response

Experimenter Presents:

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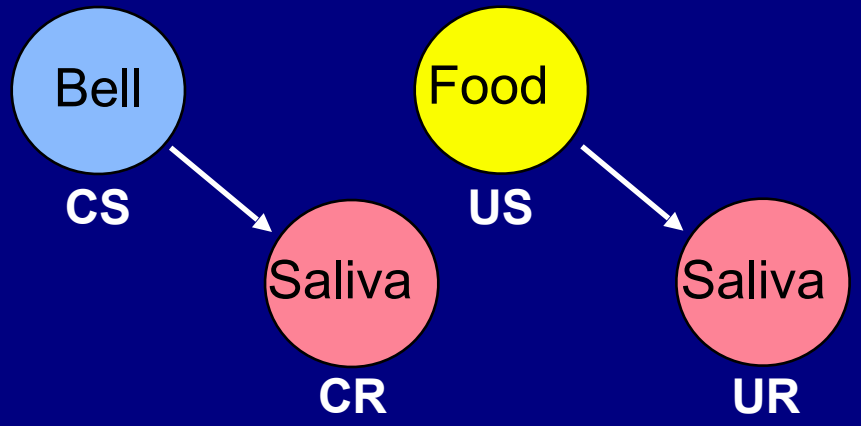
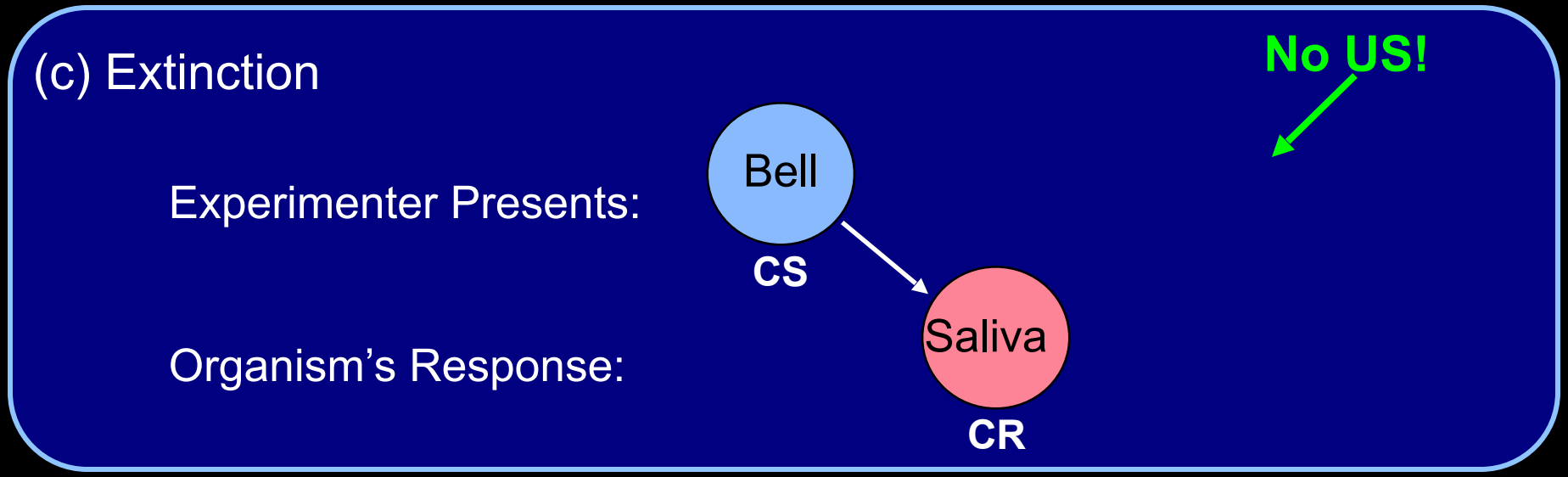
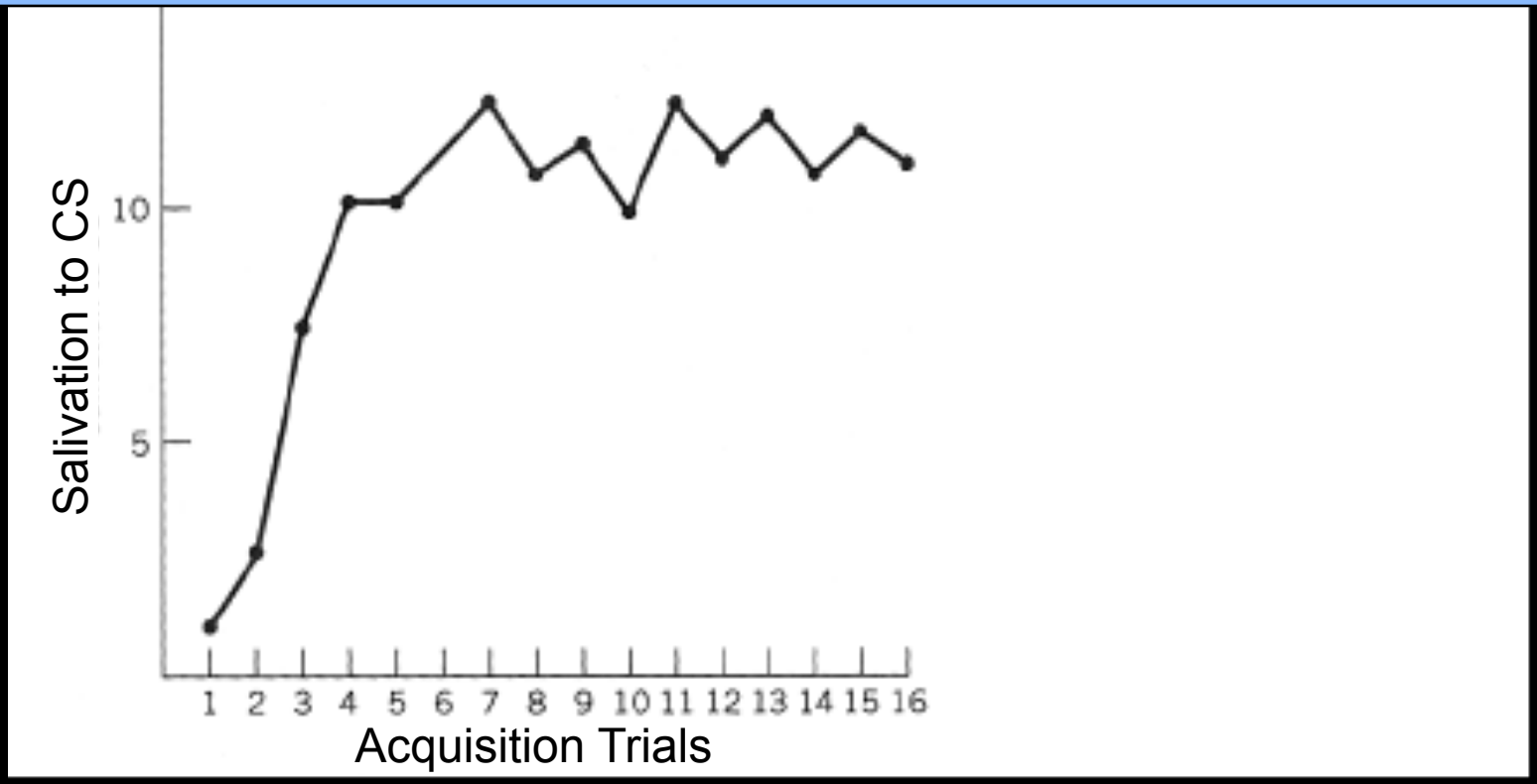


Stages of Classical Conditioning

(c) Extinction



Acquisition: The gradual increase in the CR with repetition (learning function: *law of diminishing returns*)



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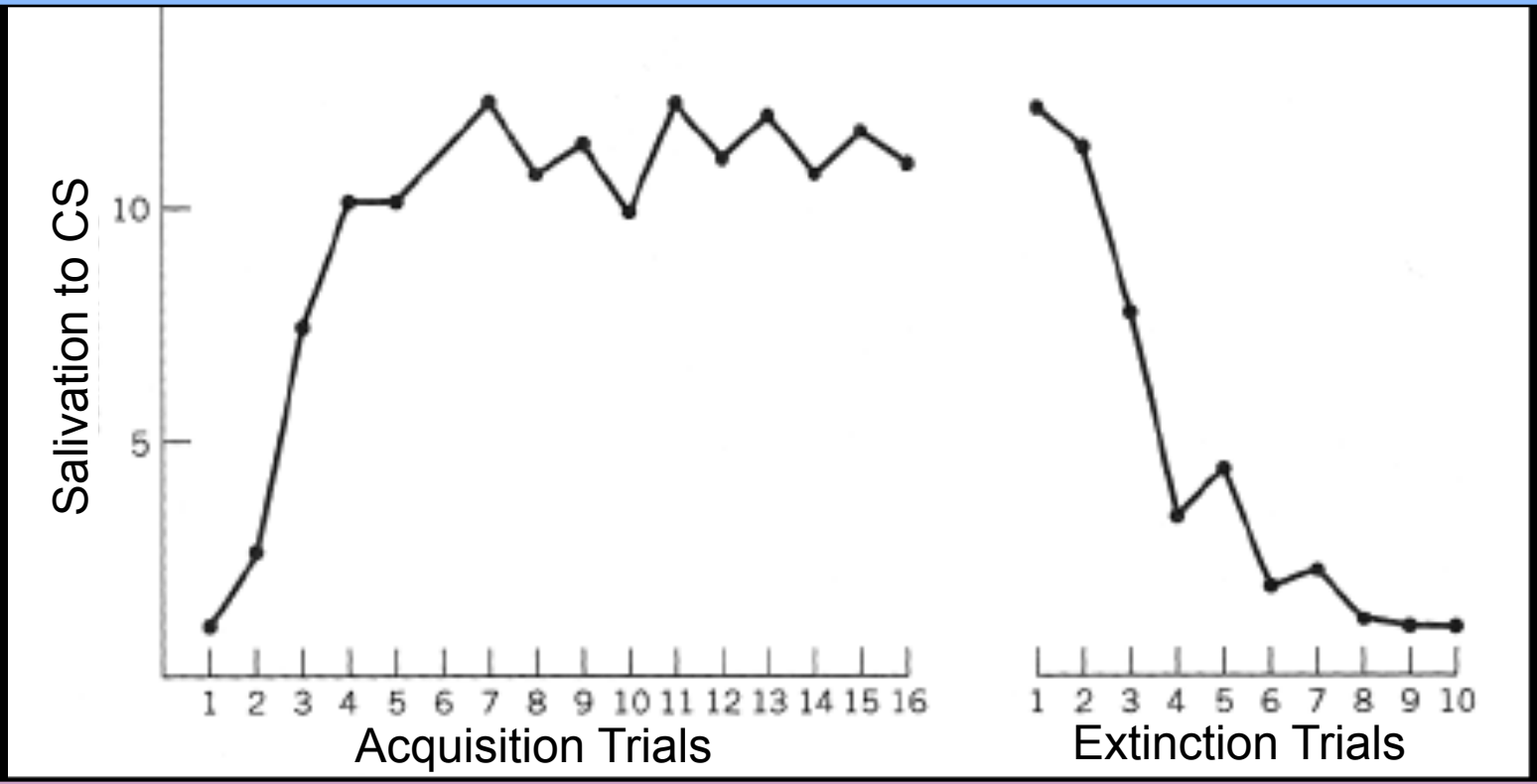
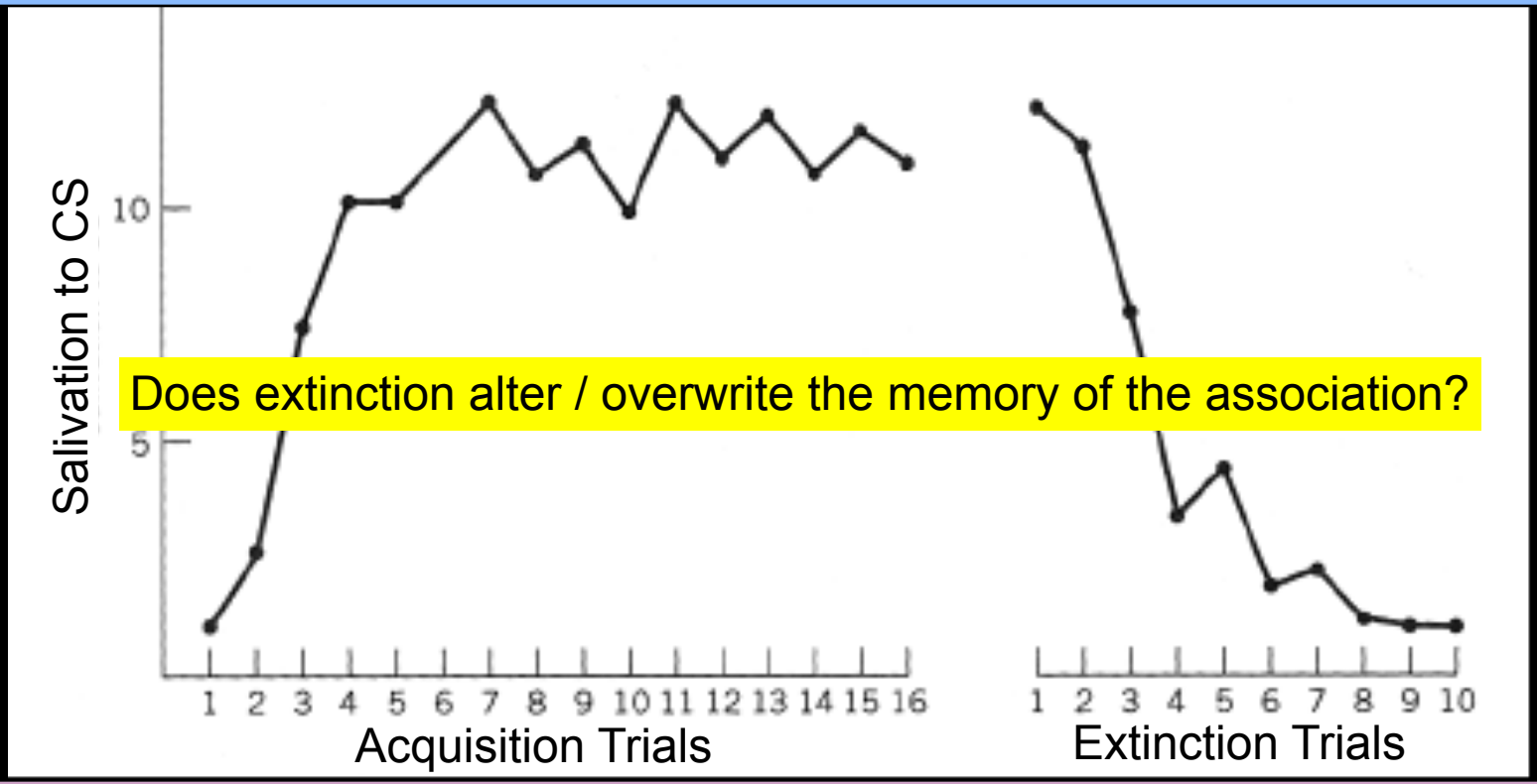


Extinction: The gradual reduction in the CR due to repeated presentation of the CS without the US (does not occur due to decay; requires presentation of CS without US)

Acquisition: The gradual increase in the CR with repetition (learning function: *law of diminishing returns*)



Does extinction alter / overwrite the memory of the association?

Extinction: The gradual reduction in the CR due to repeated presentation of the CS without the US (does not occur due to decay; requires presentation of CS without US)

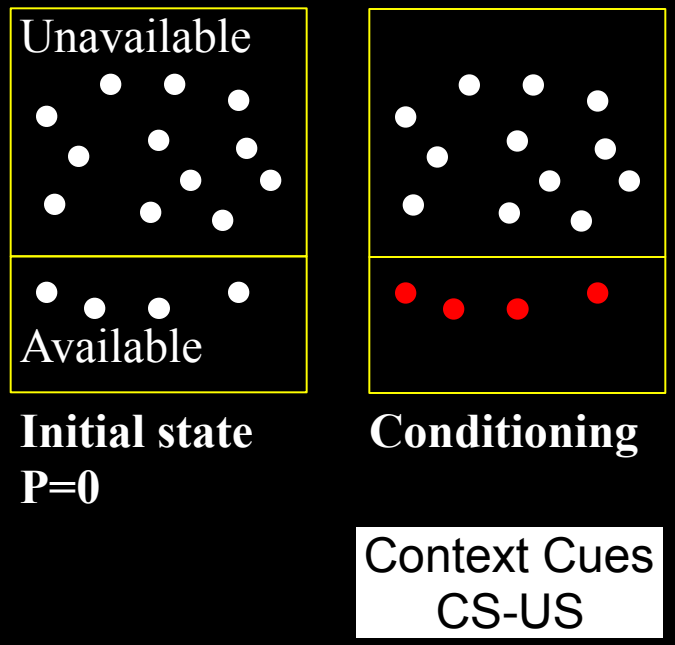
Stages & Principles of Classical Conditioning

Spontaneous Recovery: After extinction, wait a little while, present the CS alone, and the CR shows some recovery

Temporal Ordering:

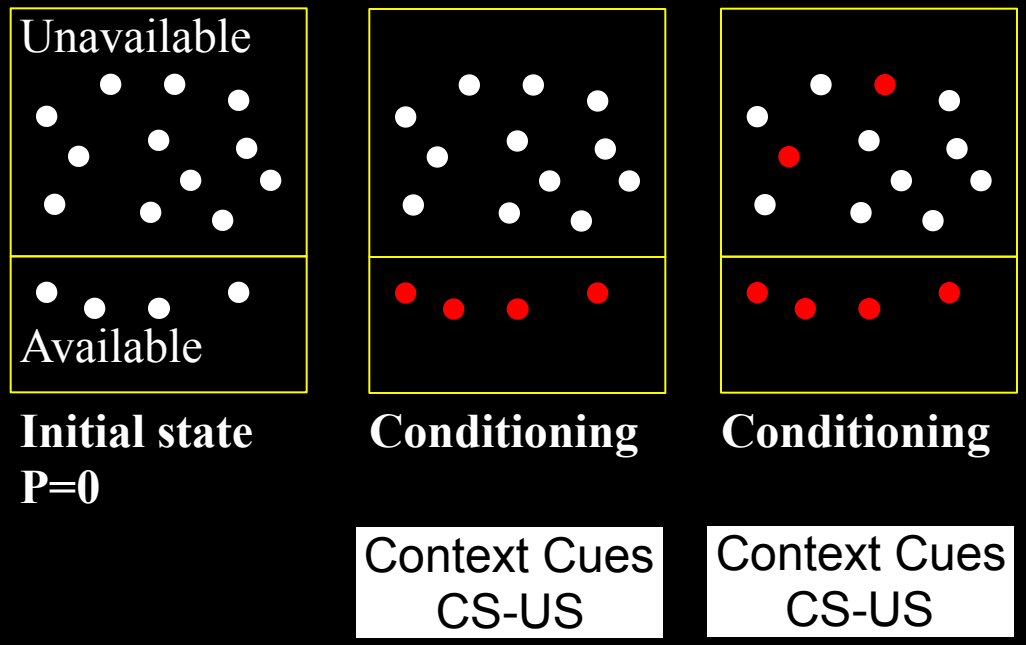
- Conditioning is strongest when the CS precedes the US
- The nature of what is learned during conditioning depends on temporal overlap of CS and US

Stimulus Sampling Theory & Spontaneous Recovery



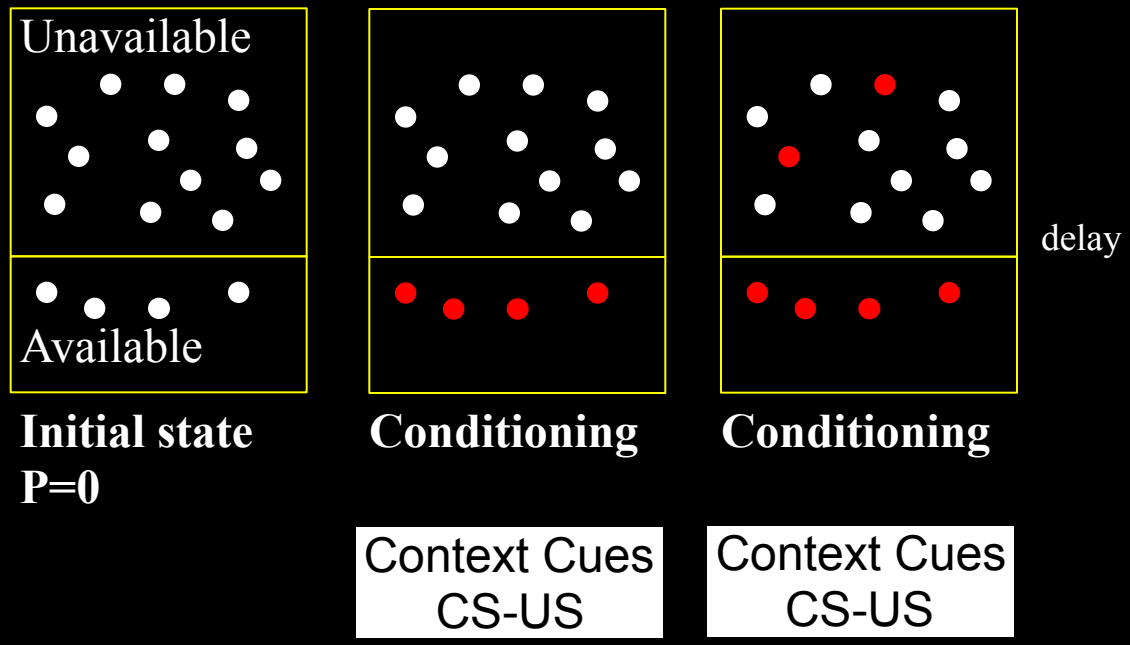
(Estes, 1955; SAM)

Stimulus Sampling Theory & Spontaneous Recovery



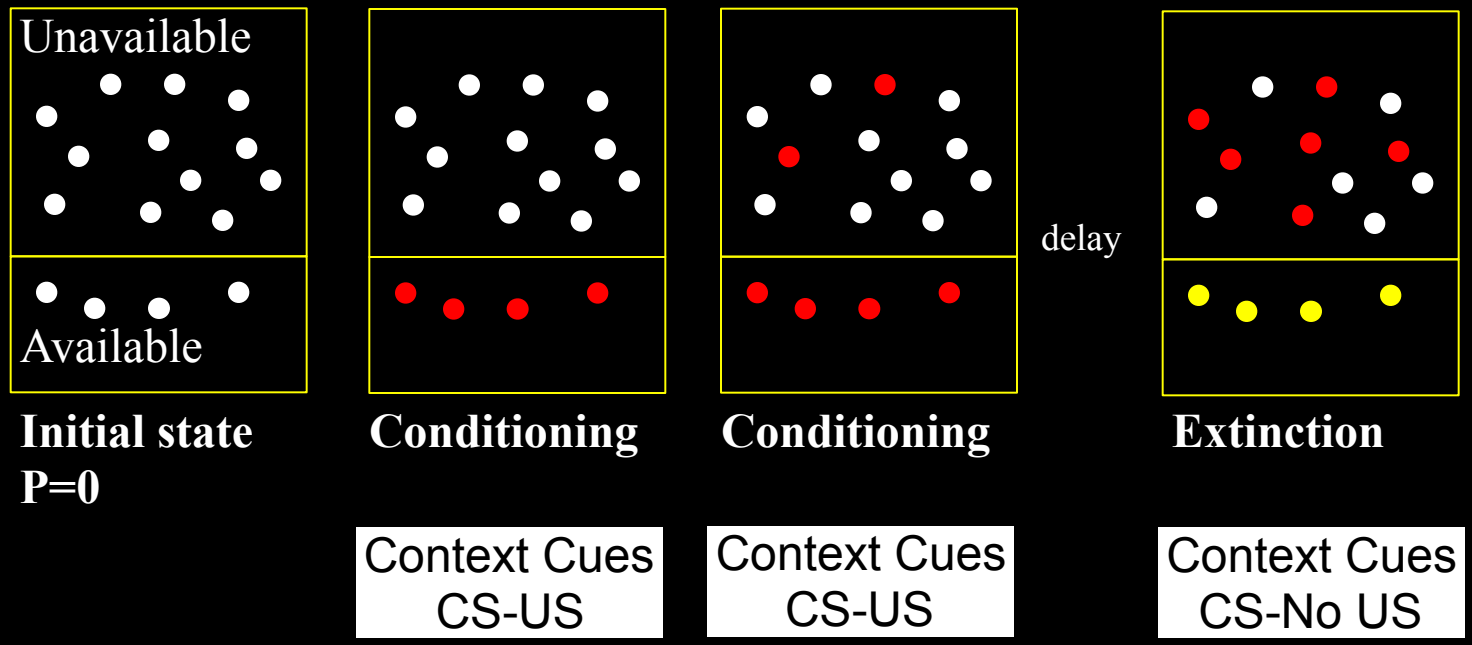
(Estes, 1955; SAM)

Stimulus Sampling Theory & Spontaneous Recovery



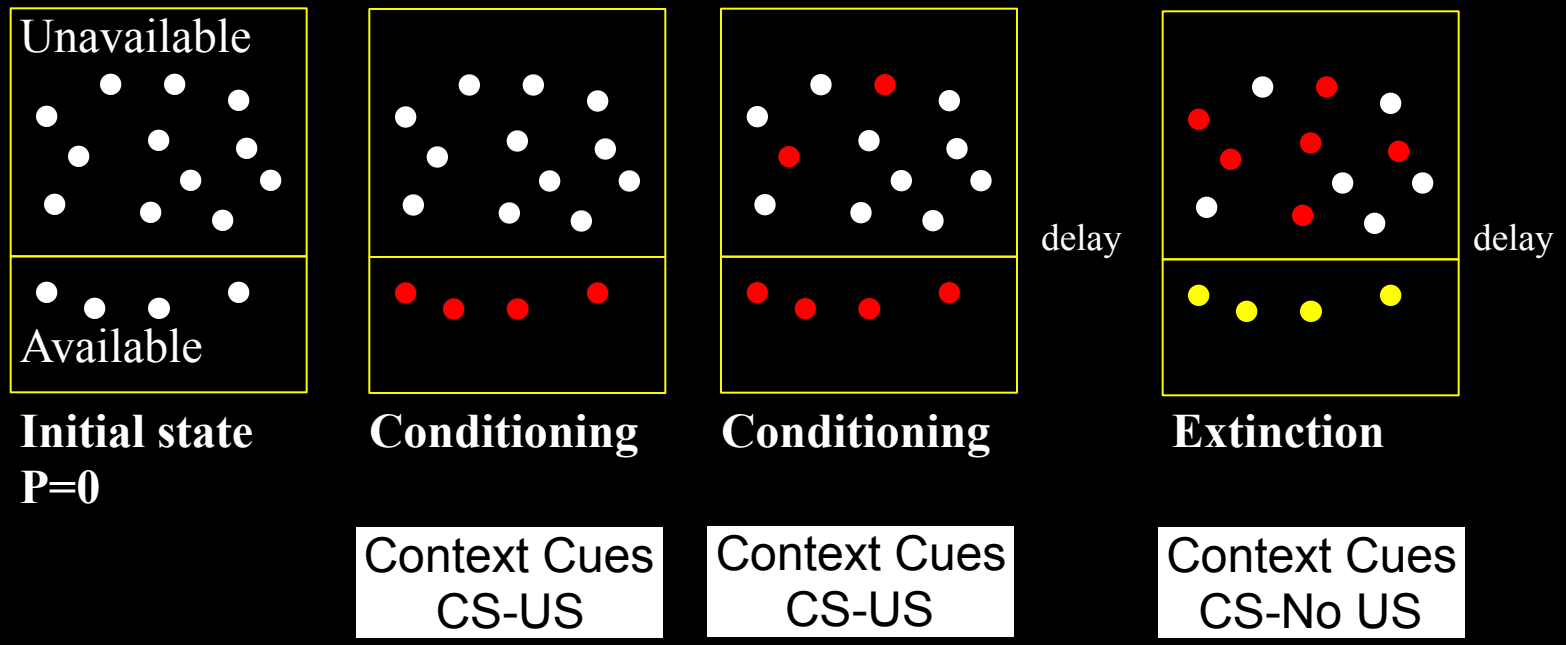
(Estes, 1955; SAM)

Stimulus Sampling Theory & Spontaneous Recovery



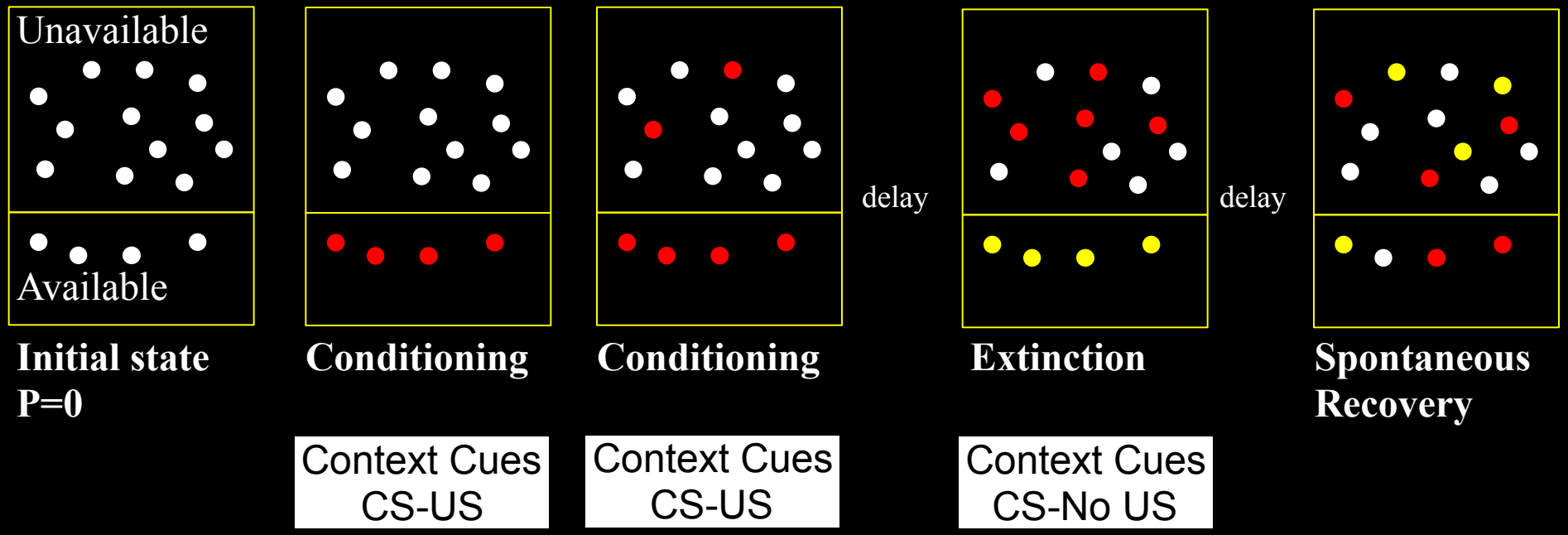
(Estes, 1955; SAM)

Stimulus Sampling Theory & Spontaneous Recovery



(Estes, 1955; SAM)

Stimulus Sampling Theory & Spontaneous Recovery



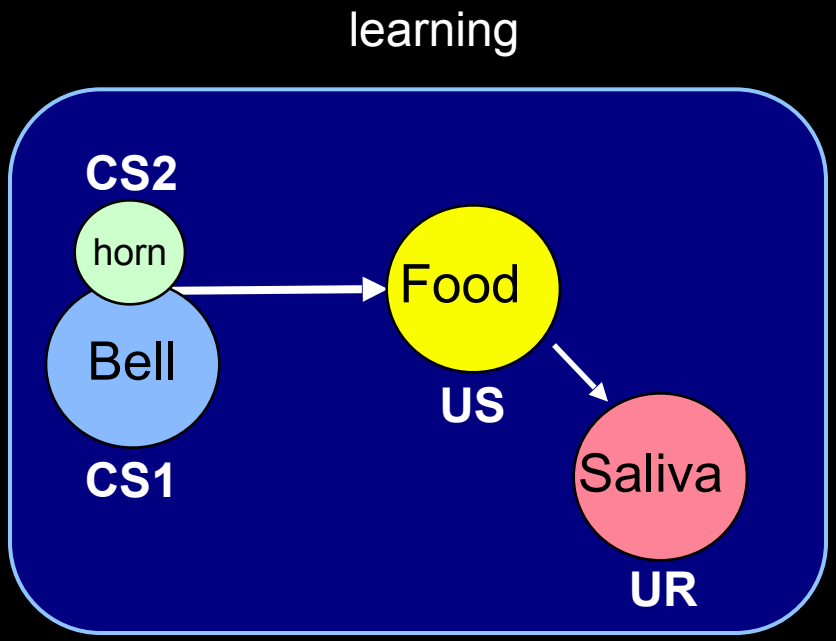
(Estes, 1955; SAM)

Temporal Ordering: Continguity & Contingency

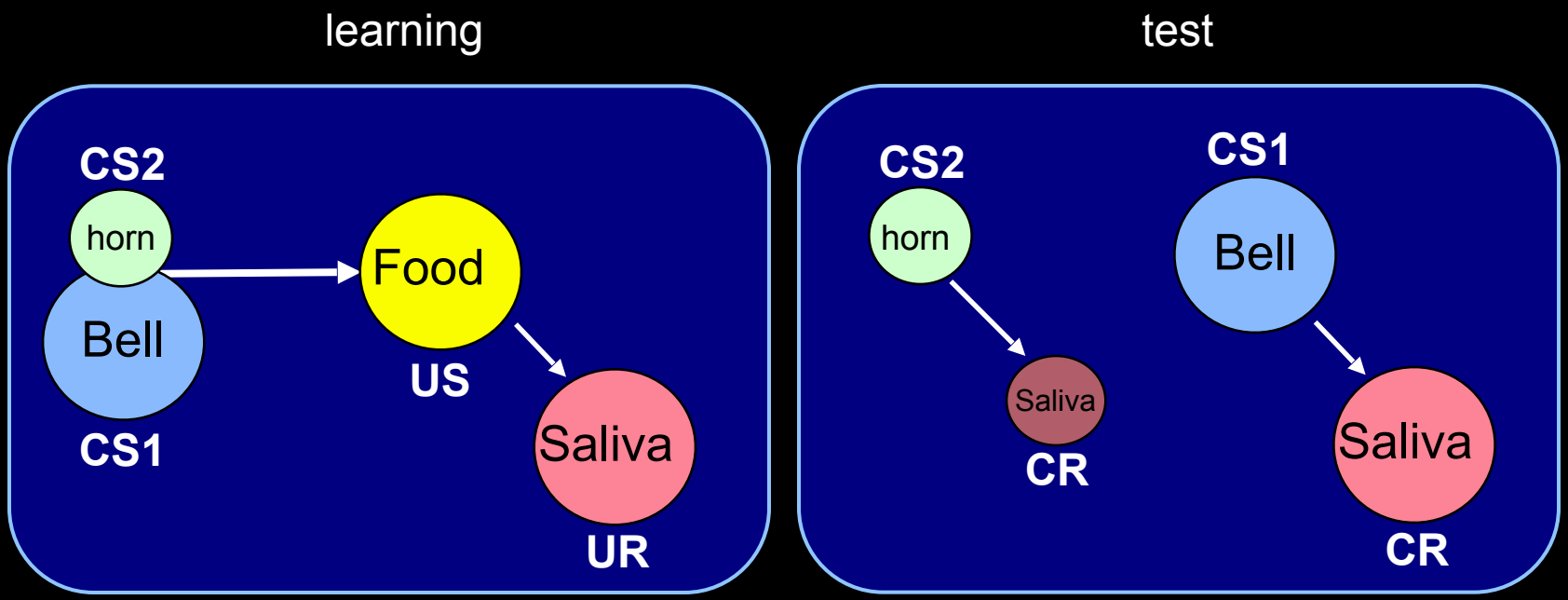
Law of Contiguity
- Two things become associated when they occur together in time

Law of Contingency
- Conditioning occurs if the **CS predicts the US**
- Co-occurrence is insufficient
- The CS must predict an increased probability that the US will occur

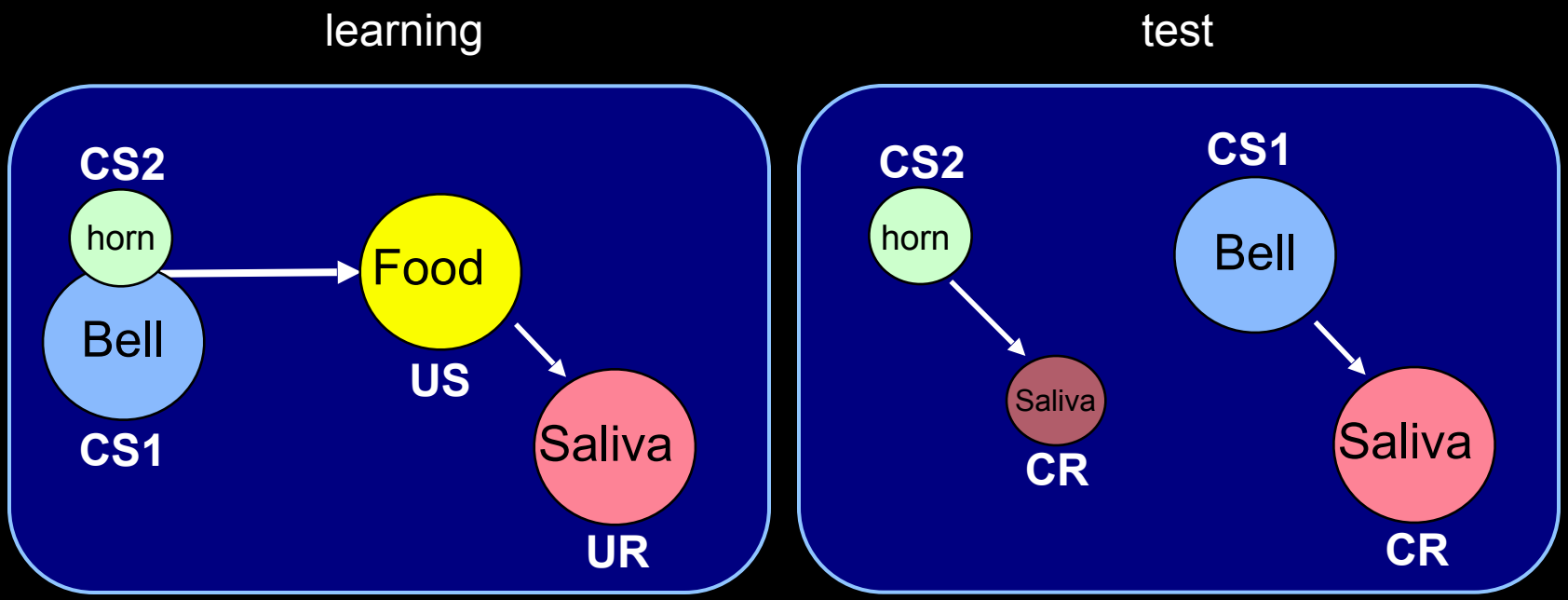
Overshadowing



Overshadowing



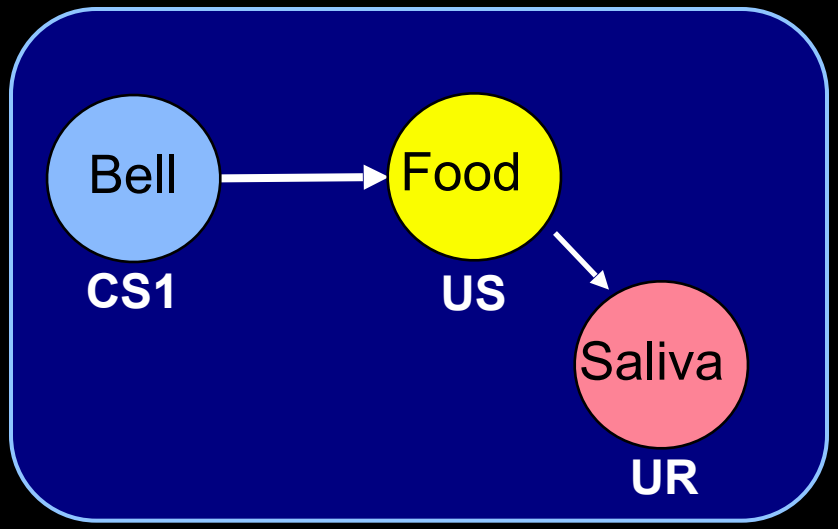
Overshadowing



When more than one CS is present, the strong CS ‘overshadows’ the weak CS

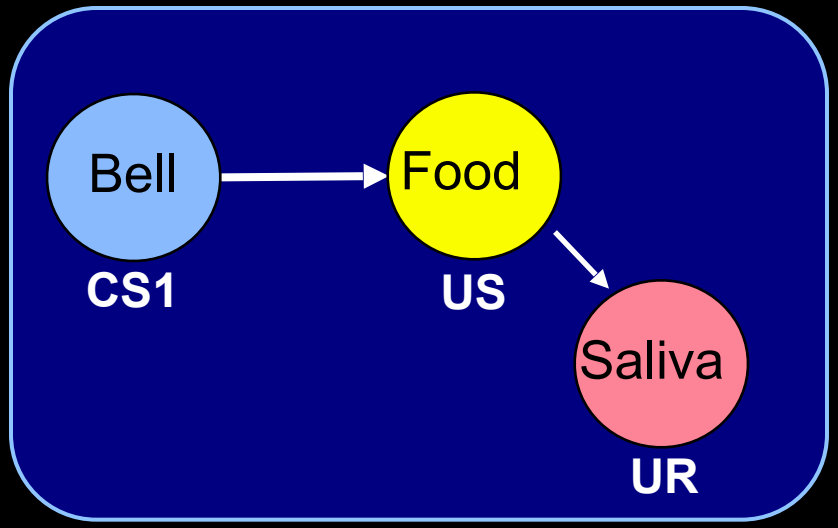
Blocking

learning 1

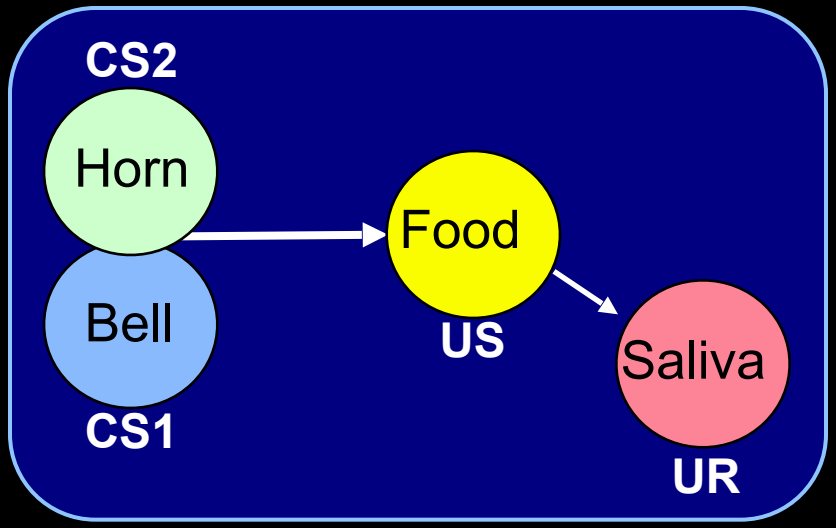


Blocking

learning 1

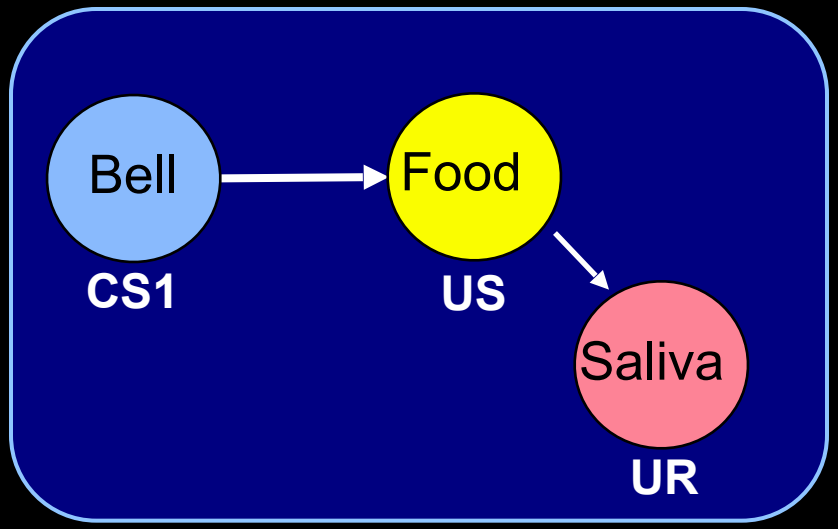


learning 2

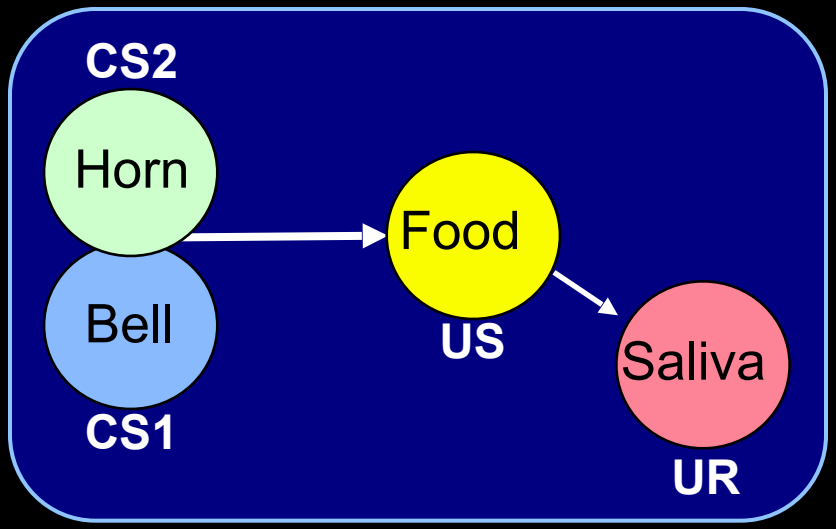


Blocking

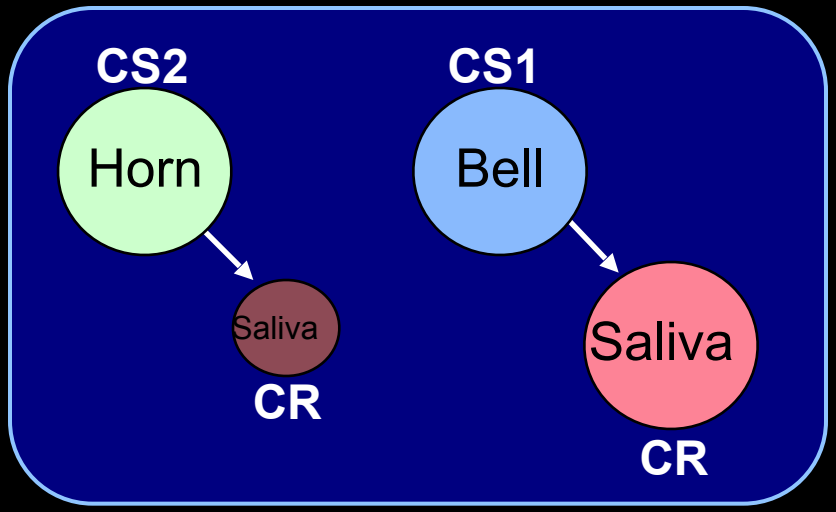
learning 1



learning 2



test



Once learned that CS1 predicts the US, a CR will not develop for CS2 presented with CS1.
CS1 blocks conditioning of other CS.

Predictability and Conditioning (informational value of cues)

Rescorla-Wagner Model Of Conditioning

Situation	CS:	US:	learning
1	Novel	yes	high (+)
2	Well learned	yes	low
3	Well learned	no	high (-)

The amount of learning that takes place is proportional to the surprise of the US outcome

Conditioning

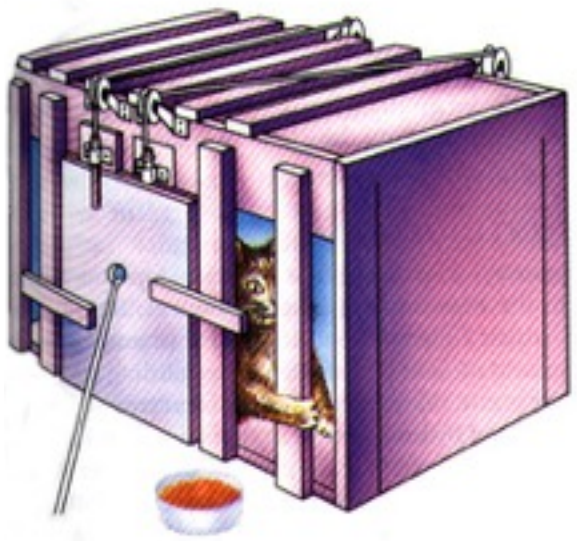
Classical Conditioning

- Principles and Stages of conditioning
- Model of Classical Conditioning

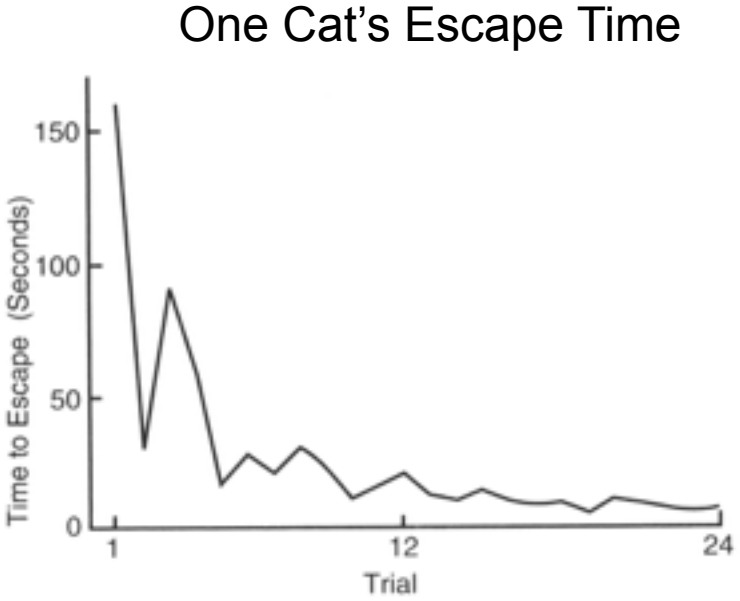
Operant Conditioning

- Schedule of Reinforcement

Instrumental / Operant Conditioning



Thordike Studied rate at which cats learned to press lever to escape box



CS = puzzle box; **CR** = press lever; **US** = escape + food (reward)

In **classical conditioning**, learn Stim1 (CS) predicts Stim2 (US)
In **operant conditioning**, learn CR elicits US (reward)

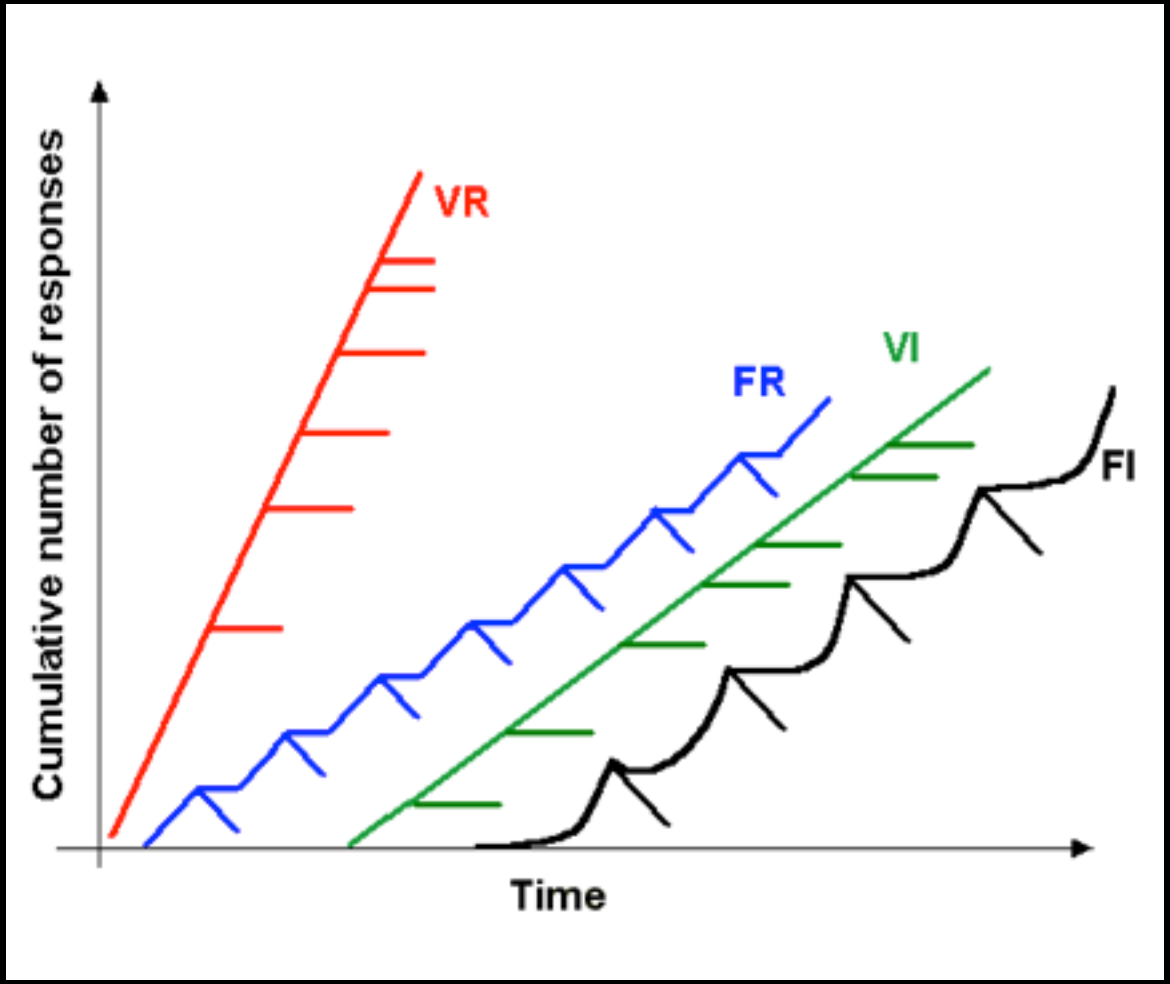
Operant Conditioning & Reward Schedules

VR = variable ratio; rewarded after variable # of responses

FR = fixed ratio; rewarded after fixed # of responses

VI = variable interval; rewarded after variable amount of time

FI = fixed interval; rewarded after fixed amount of time



Reward Schedules

Variable reinforcement schedule

Will yield greater rate of responding

Extinction occurs slowly

Fixed reinforcement schedule

Will yield lower rate of responding

Extinction occurs quickly

Conditioning Recap

Classical Conditioning

- Principles and Stages of conditioning
- Rescorla-Wagner model of Classical Conditioning: Prediction Error drives conditioning/learning

Operant Conditioning

- Response rate depends on reward schedule