

Memory: Storage and Retrieval

Lecture 19

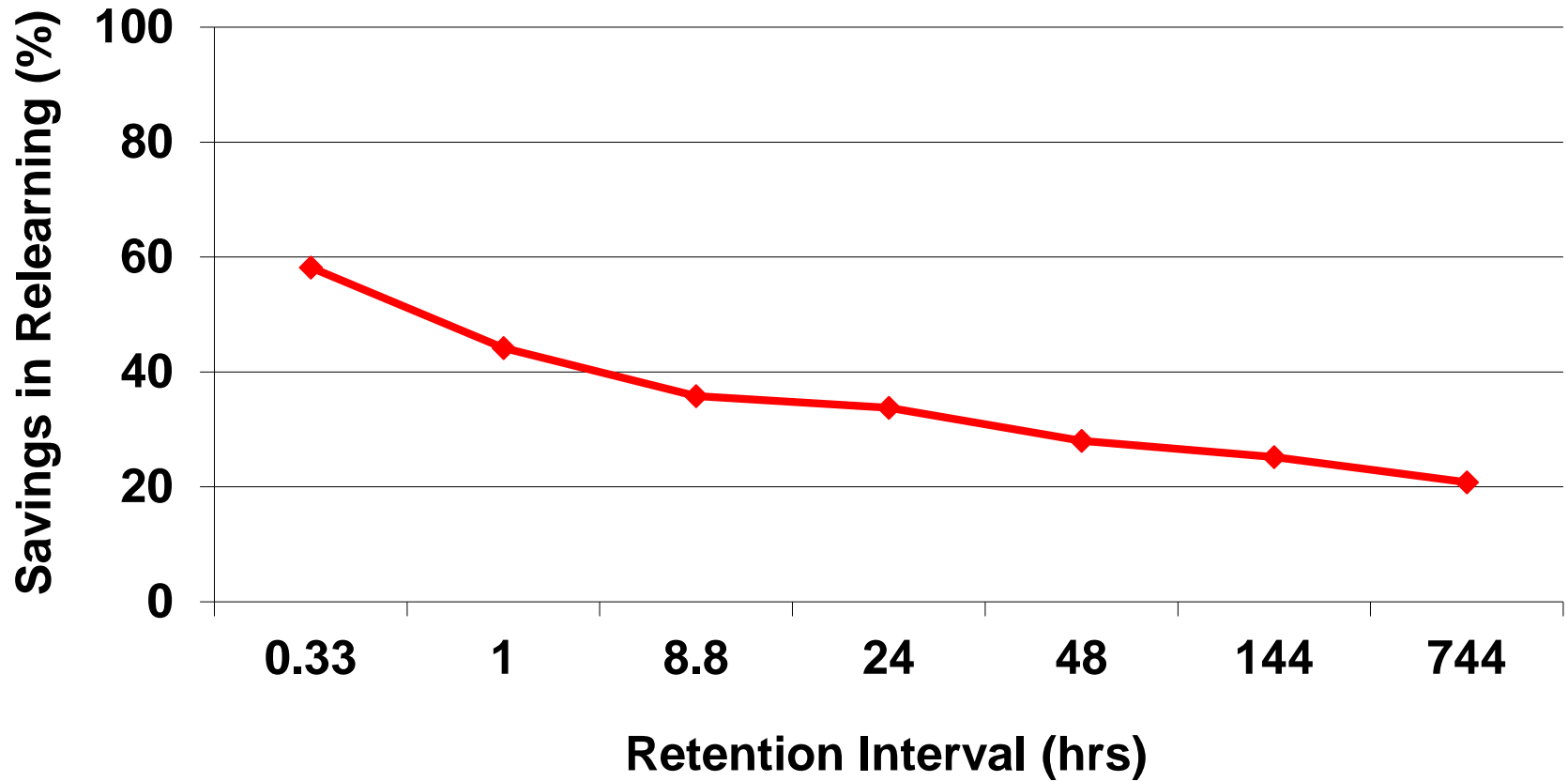
The Storage Phase of Memory Processing

- Assume that a Memory Trace has been Adequately Encoded
- What Happens over the Retention Interval?

Forgetting

Retention as a Function of Time

Ebbinghaus (1885)



The Time-Dependency Principle

Memory diminishes as a function of the length of the retention interval.

Setting Aside...

Reminiscence

Hypermnesia

Four Hypotheses Concerning Time-Dependency

- Decay
 - Memories “Fade” with Time
- Displacement
 - Loss from Storage
- Consolidation
 - Encoding Takes Time
- Interference
 - Failure of Retrieval

Four Factors in Time-Dependency

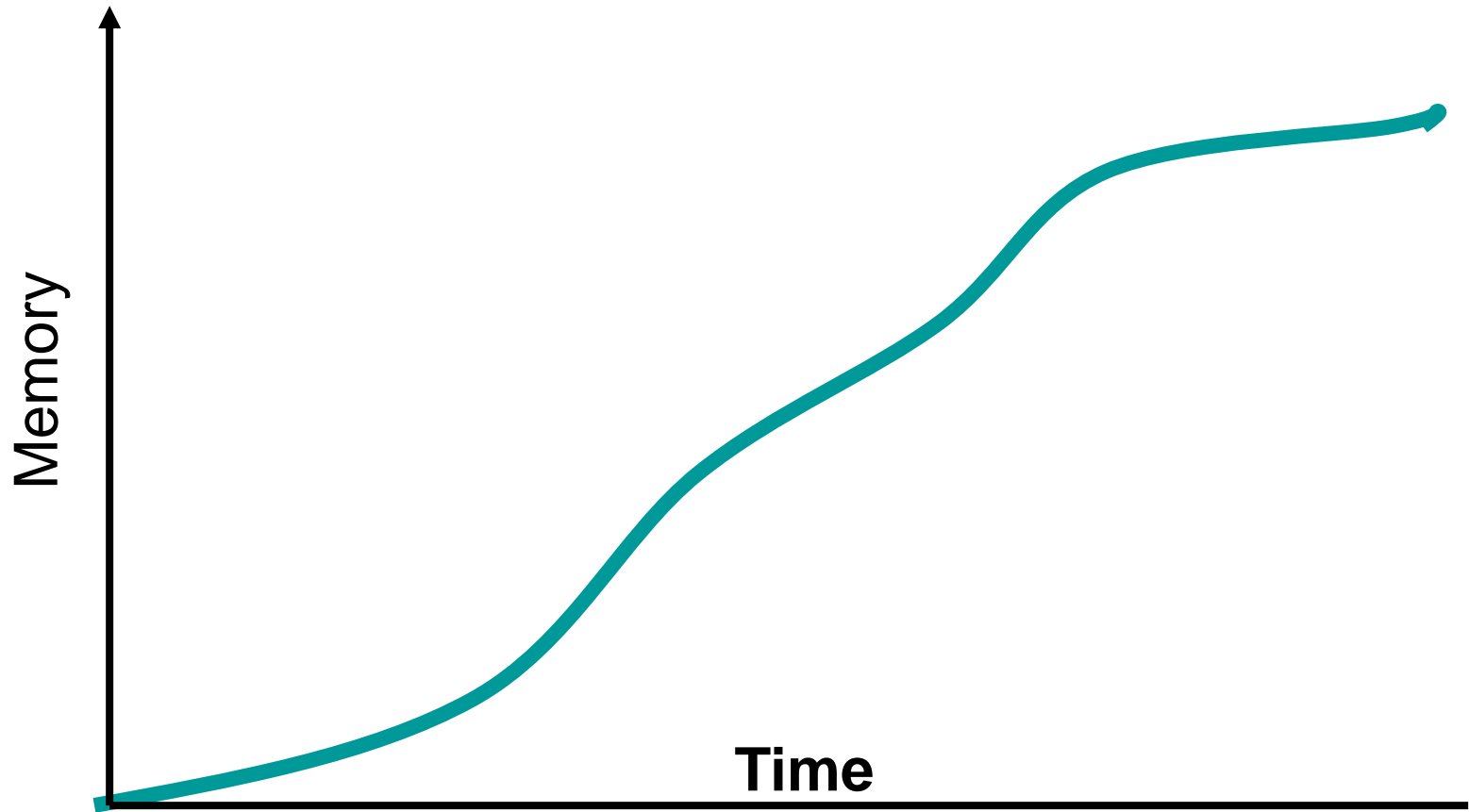
- Decay
 - Sensory Registers
- Displacement
 - Sensory Registers
 - Masking in “Subliminal” Perception
 - Short-Term Memory
- Consolidation
 - Traumatic Retrograde Amnesia
- Interference
 - Long-Term Memory (Episodic or Semantic)

Law of Regression

Ribot (1882)

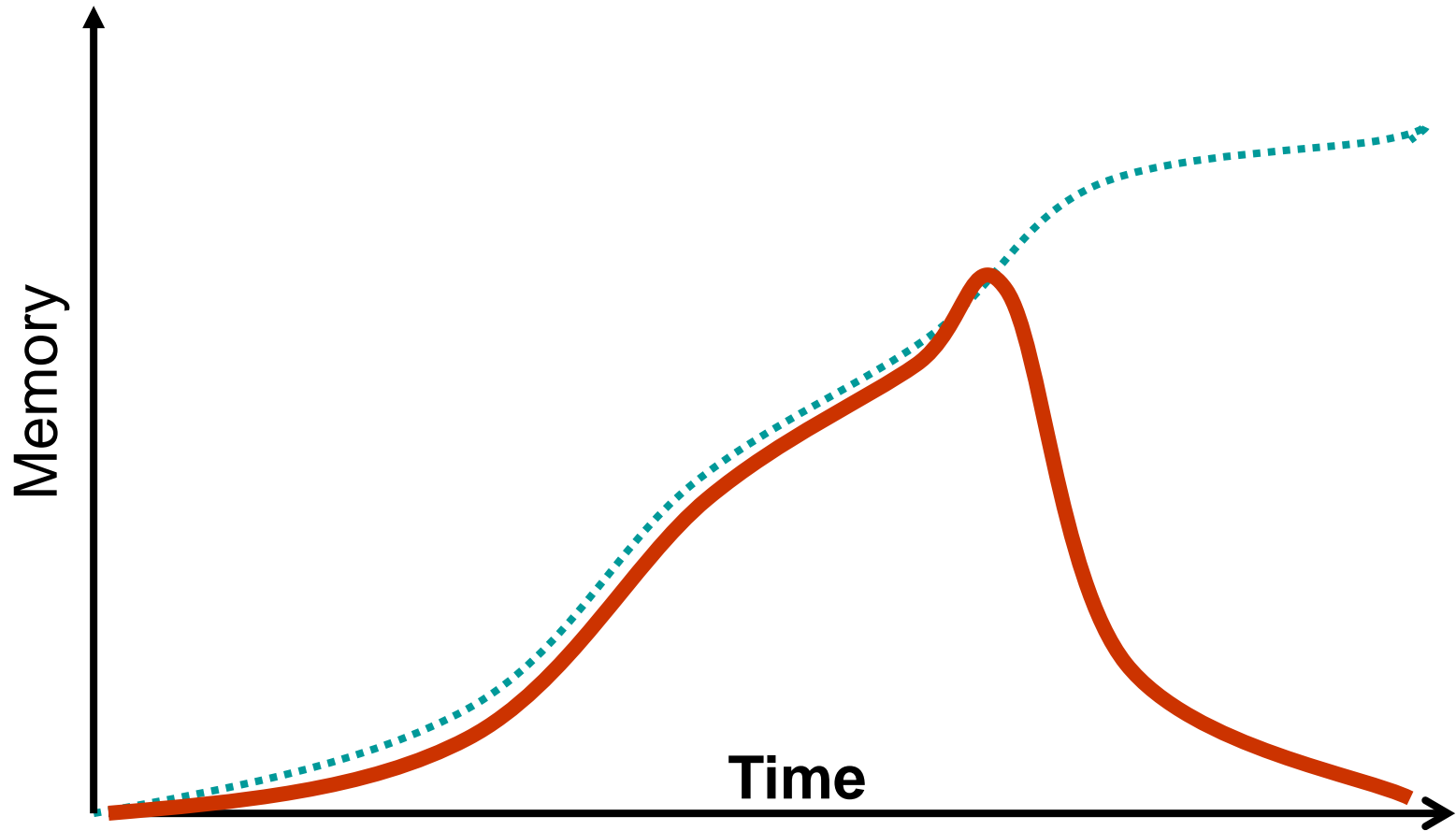
- Path of Dissolution of Memory
 - Recent Events
 - General Ideas
 - Feelings
 - Acts

Temporal Gradient in Memory



Traumatic Retrograde Amnesia

Following “Cerebral Shock”



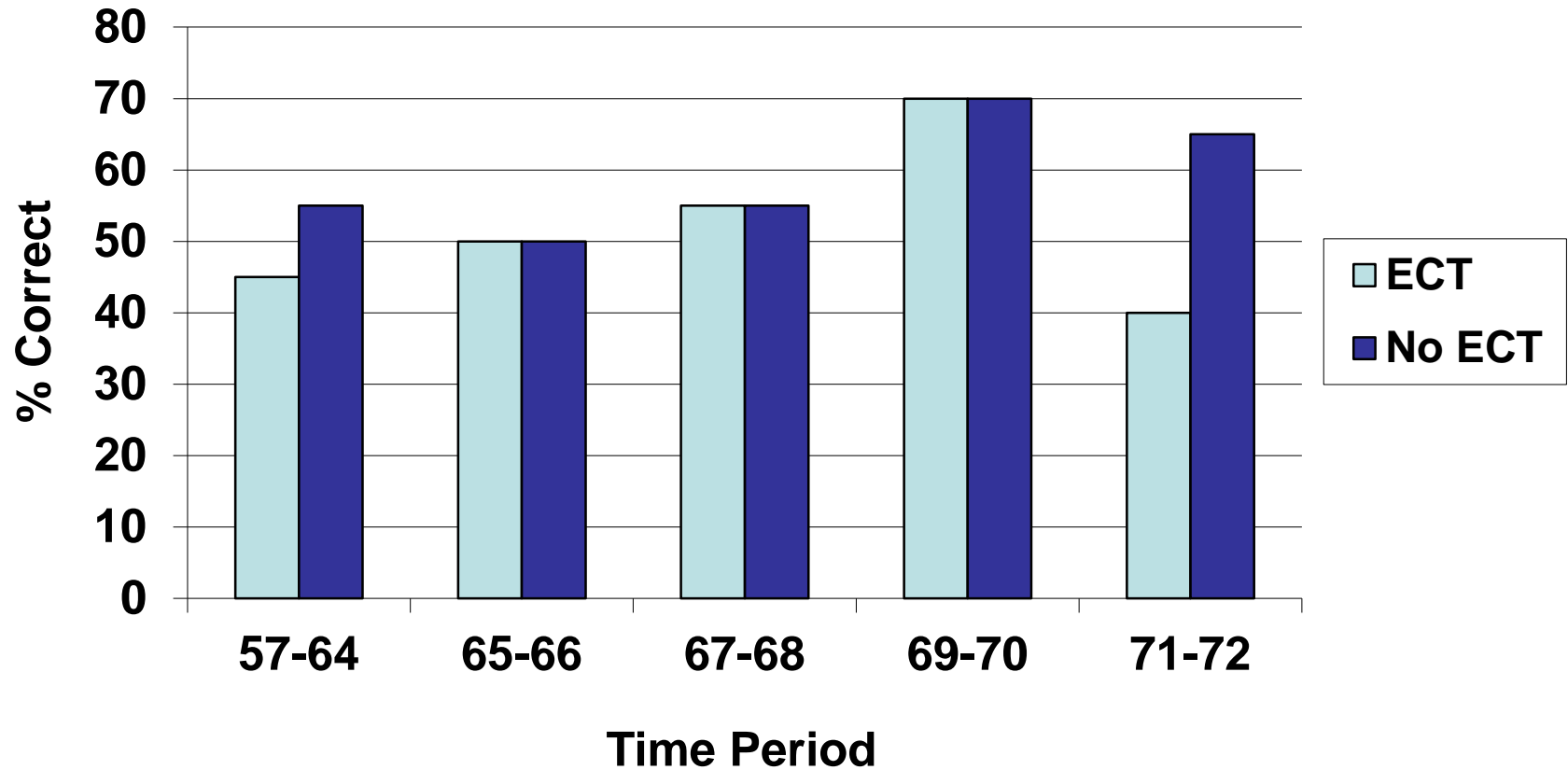
ECT and Retrograde Amnesia

Squire & Chase (1975)

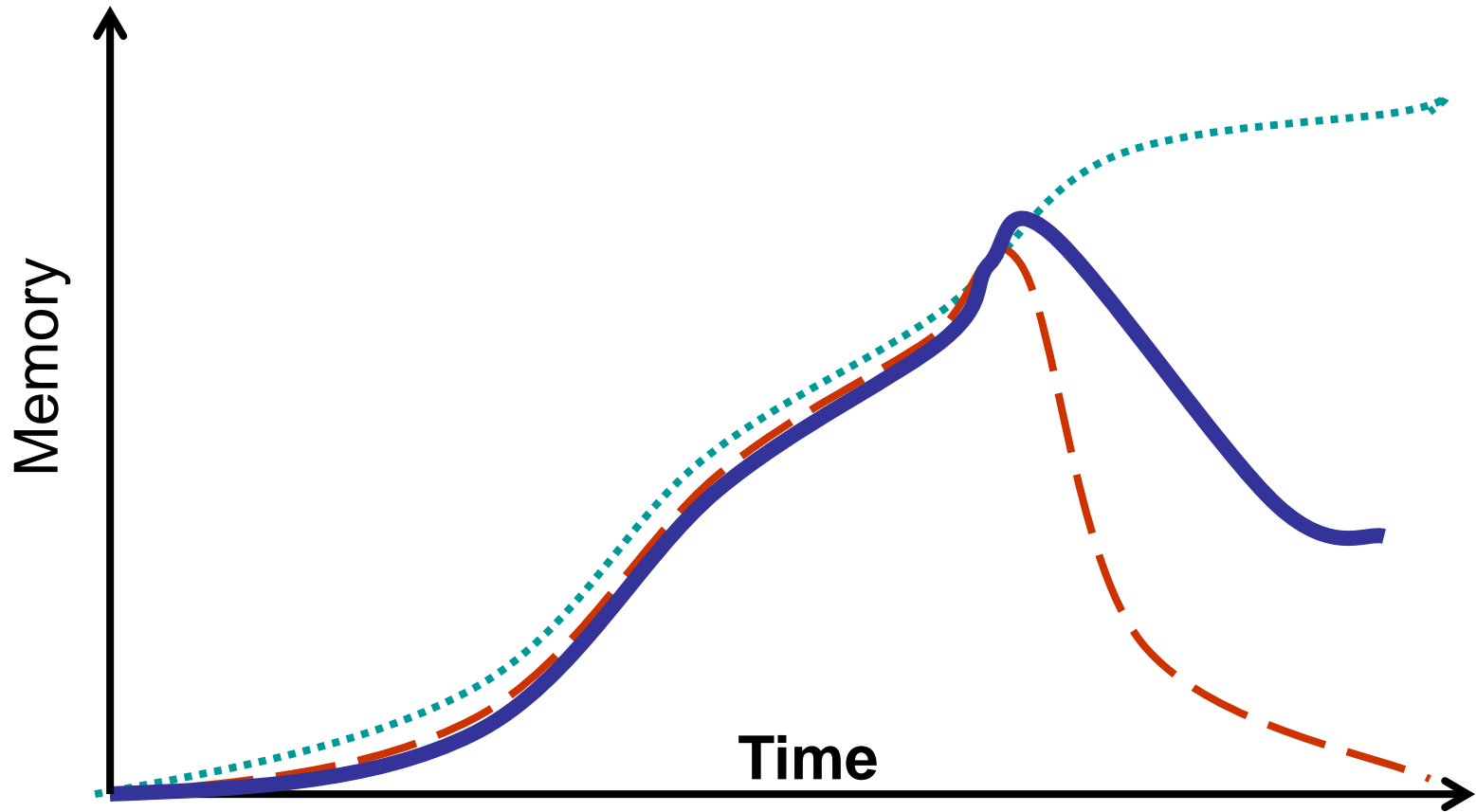
- **Electroconvulsive Therapy for Depression**
 - Electrodes Placed on Scalp
 - Right and Left Temples; or Temple and Vertex
 - Brief Electrical Current
 - Convulsive Seizure
- **Between-Subjects Design**
 - Patients Receiving ECT
 - Tested 6 Hrs. After Last ECT
 - Controls
 - No ECT

ECT and Retrograde Amnesia

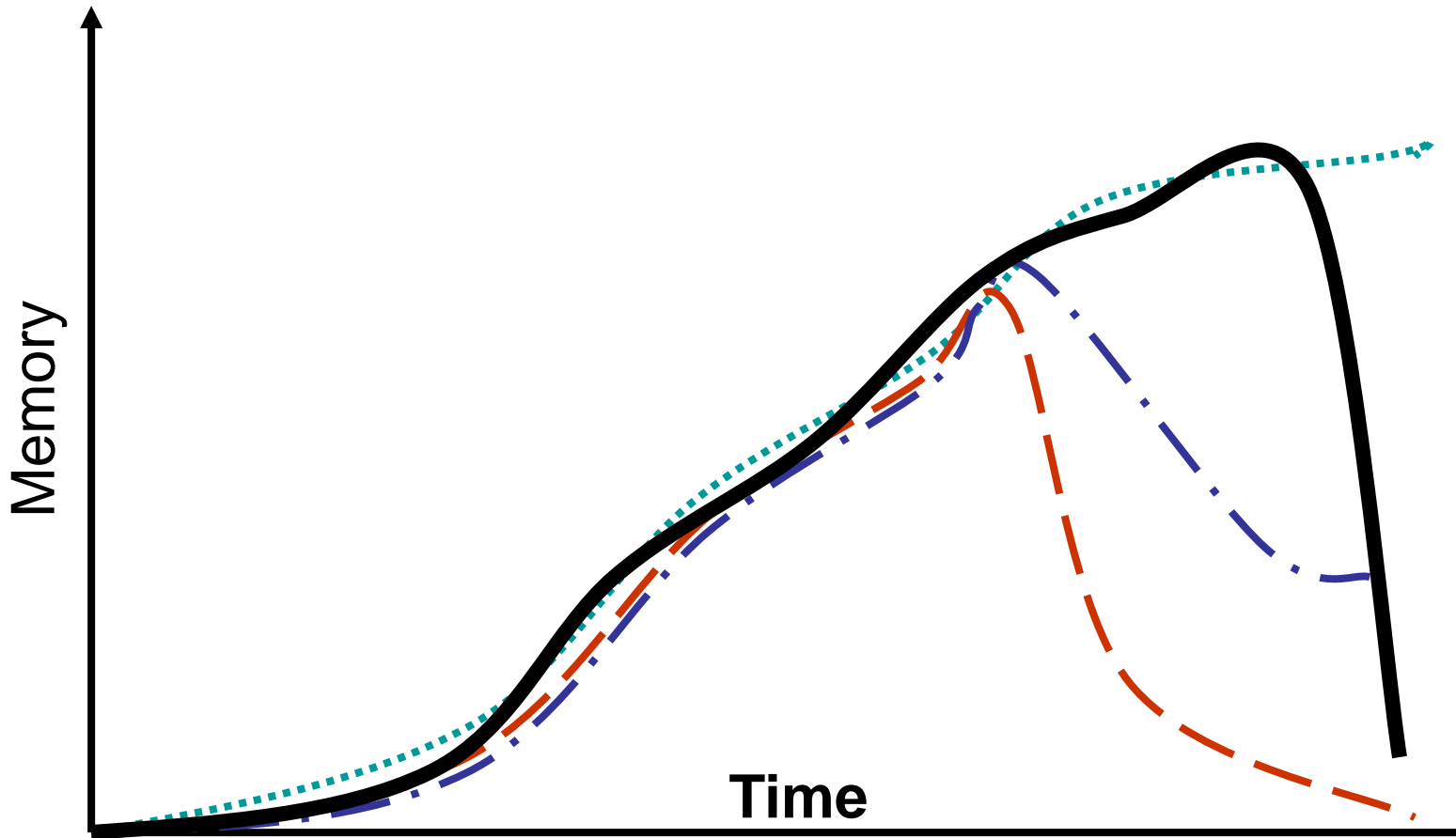
Squire & Chase (1975)



Recovery from Traumatic Retrograde Amnesia



“Final” Residual Amnesia Following Recovery



Two Kinds of Consolidation?

- Short-Term
 - Byproduct of Encoding
 - Occurs within Seconds of Event
 - Disruption Causes Anterograde Amnesia
- Long-Term
 - Persists After Initial Encoding
 - Transpires Over Longer Periods of Time
 - Facilitated by Sleep
 - Disruption Causes Retrograde Amnesia

Interference

Storage is Essentially Permanent

Forgetting over Time Occurs by Virtue of Interference by Accumulated Memories

The Paradox of Interference:

The More You Know, the Harder it is to Remember to any Particular Item of Information.

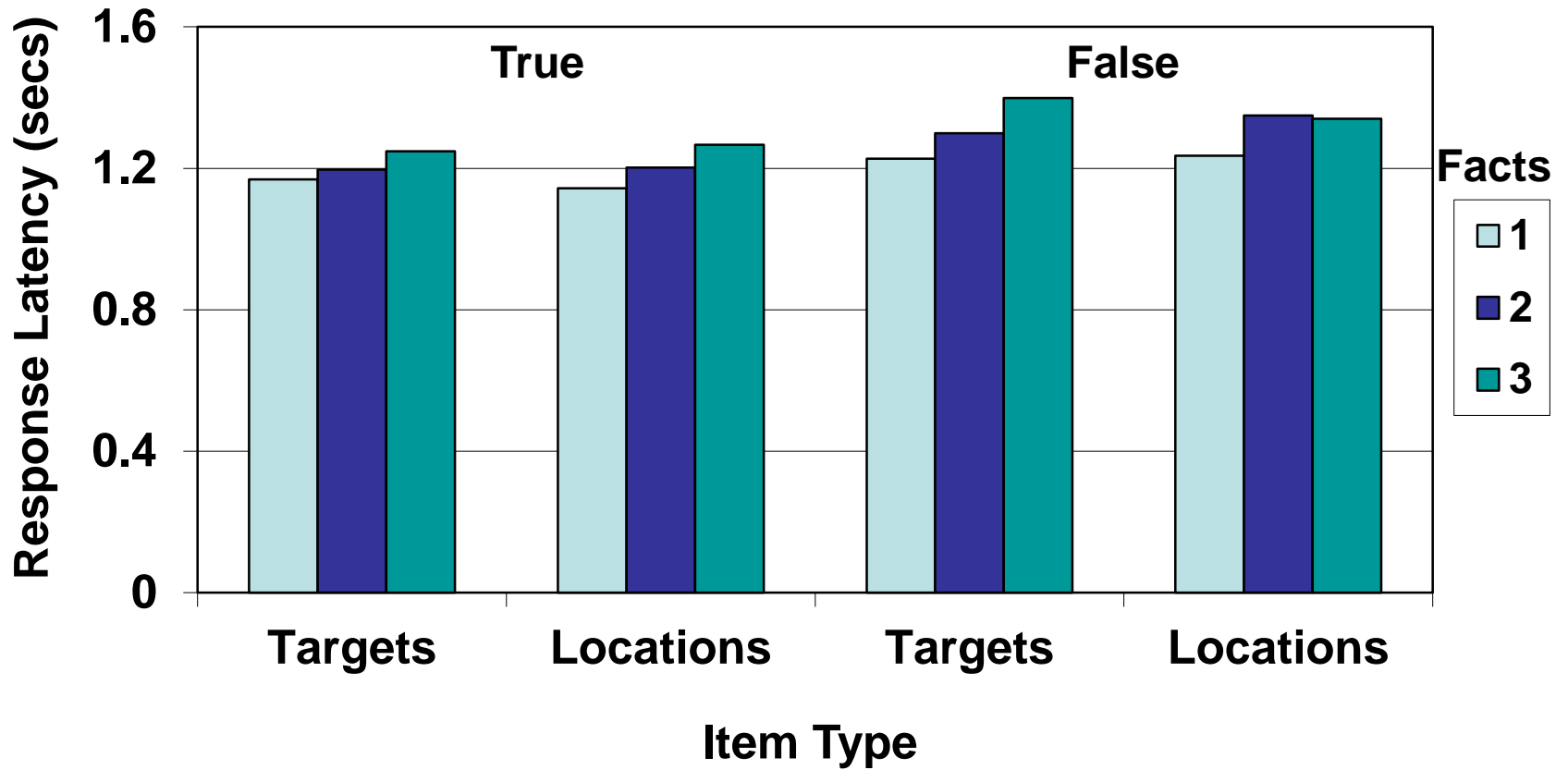
Retrieval from Episodic Memory

Anderson (1974)

- Learn Facts about People, Locations
 - The doctor is in the bank (1-1)
 - The fireman is in the park (1-2)
 - The lawyer is in the church (2-1)
 - The lawyer is in the park (2-2)
- Memorize to Criterion of Perfect Recall
- Recognition
 - Studied targets
 - The doctor is in the bank
 - Unstudied lures
 - The doctor is in the park

The Fan Effect

Anderson (1974)



The Time-Dependency Principle Restated

Memory diminishes with time,
mostly by virtue of interference
among competing memories.

Retroactive
Proactive

Availability vs. Accessibility

- Availability of memory
 - In Storage
 - Impaired by Decay, Displacement, Consolidation Failure
- Accessibility of memory
 - At Retrieval Attempt
 - Impaired by Interference

Availability vs. Accessibility

Encoded memories, available in storage,
may not be accessible
when retrieval is attempted.

The Retrieval Phase of Memory Processing

- Assume that a Memory Trace has been Adequately Encoded...
- ...and Remains Available in Storage Over the Retention Interval...
- How Do We Gain Access to Available Memories?

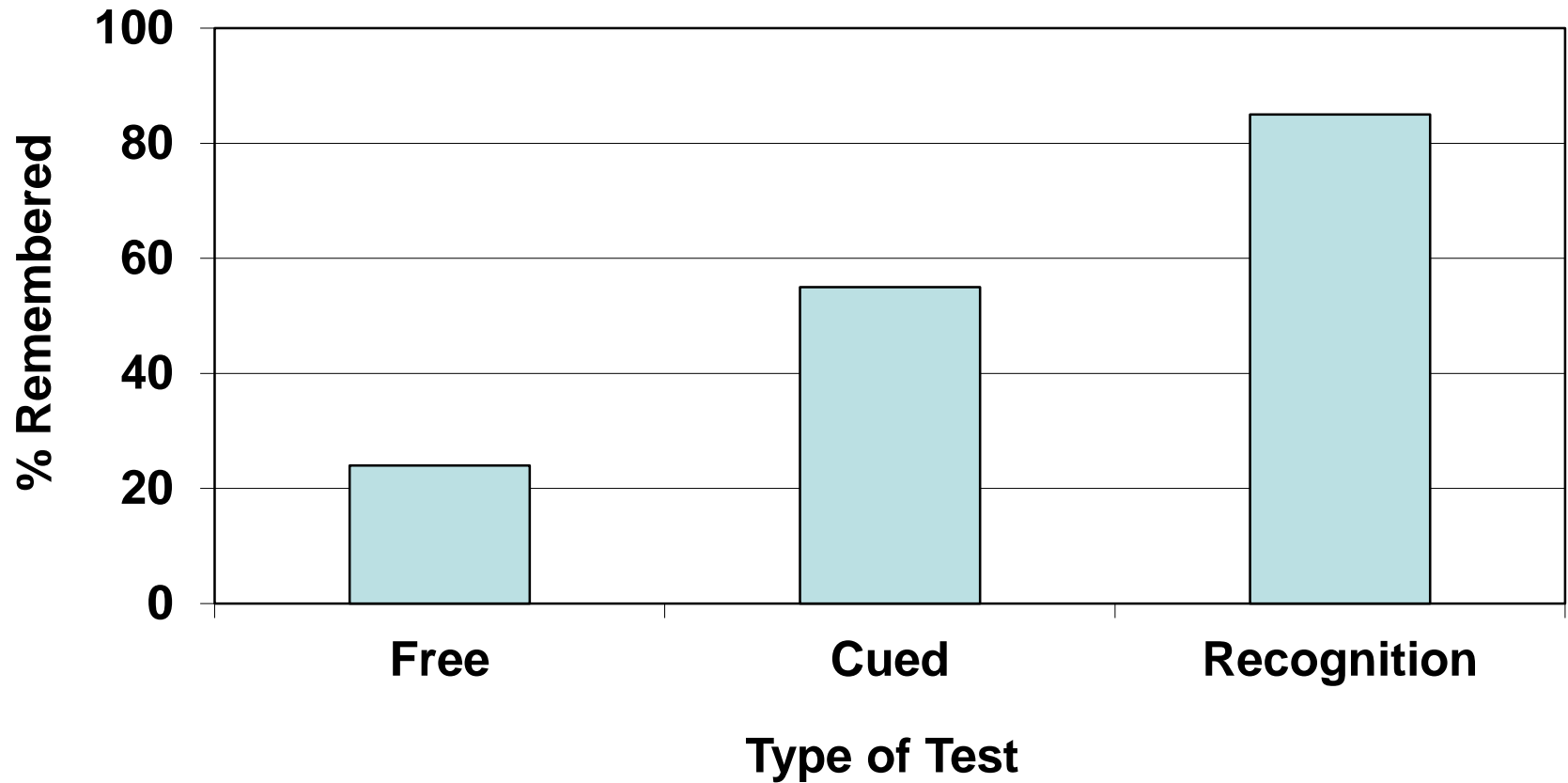
Queries and Cues

Memory Tests

- Free Recall
 - Query Specifies Spatiotemporal Context
 - What were the words on the last list studied in class?
- Cued Recall
 - Query Adds Information About Target
 - What were the *color words* on that list?
- Recognition
 - Query Contains a Copy of the Target
 - Was *orange* one of the words on that list ?

Free Recall, Cued Recall, and Recognition

Tulving & Watkins (1975)



The Cue-Dependency Principle

Memory depends on the informational value of the cues provided at the time of retrieval.

Interactions Between Encoding and Retrieval Processes

- Retrieval Cues Can Compensate for Poor Encoding
 - Cued Recall, Recognition
- “Deep” Encoding Can Compensate for Impoverished Retrieval Cues
 - Elaboration, Organization
- Encoding Sets the Stage for Retrieval
 - Encoding Constrains Retrieval

Study List from Last Lecture

Foot		Elephant
Lion	→	Amber
Blouse		Mouth
Orange		Rat
Finger		Tie
Coat		Purple

The Encoding Specificity Principle

Memory is best when
the cue information
processed at the time of retrieval
matches the cue information
processed at the time of encoding.

Transfer-Appropriate Processing

State-Dependent Memory

Overton (1964)

Memory Depends on the Match Between
the Organism's Physiological State
at the Time of Encoding
and Its Physiological State
at the Time of Retrieval

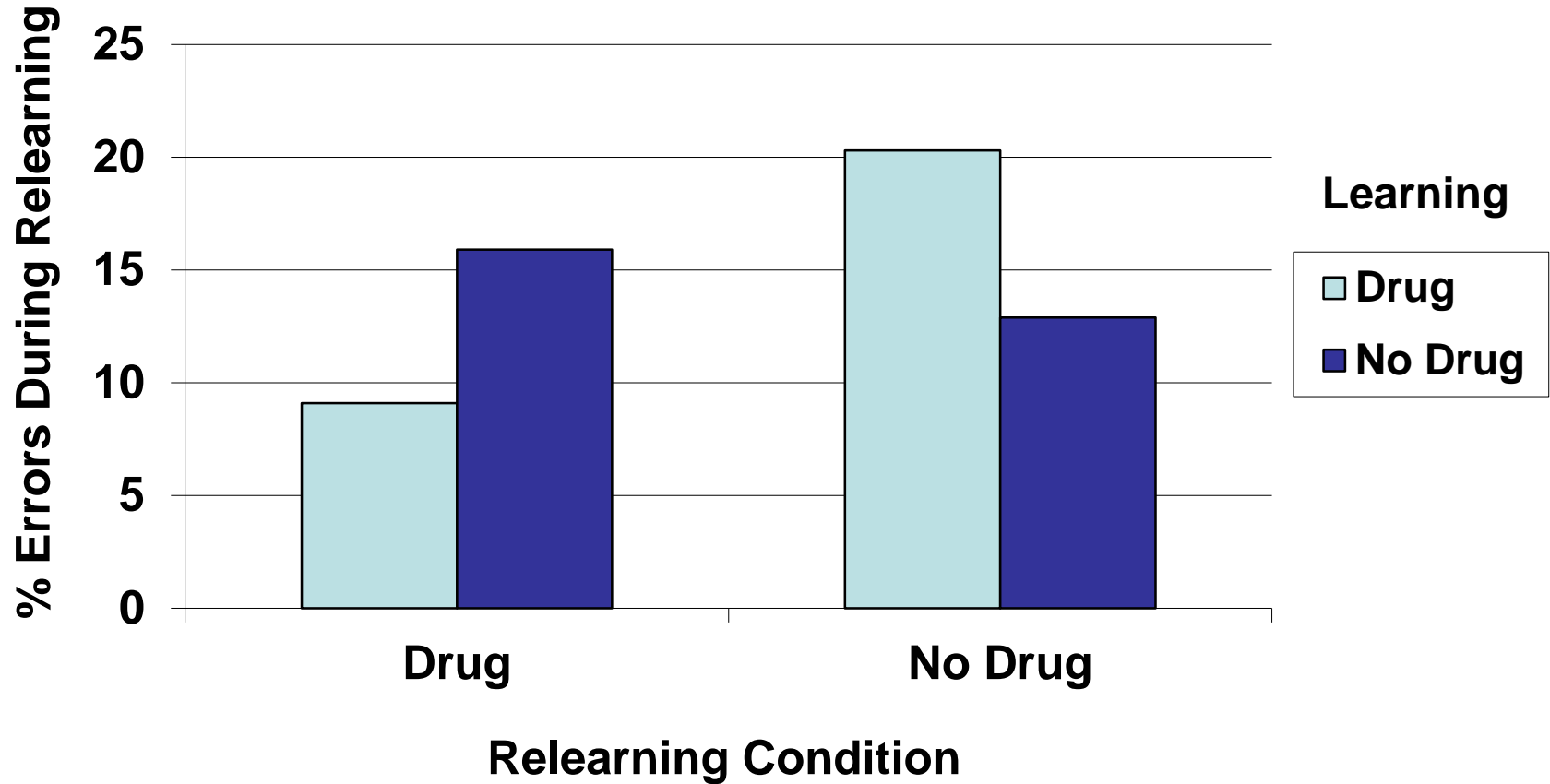
State-Dependent Memory Paradigm

After Overton (1964)

<i>Encoding Condition</i>	<i>Retrieval Condition</i>	
	No Drug	Drug
No Drug	+++	-
Drug	-	+

Ritalin Drug-Dependent Memory in Children with ADHD

Swanson & Kinsbourne (1976)



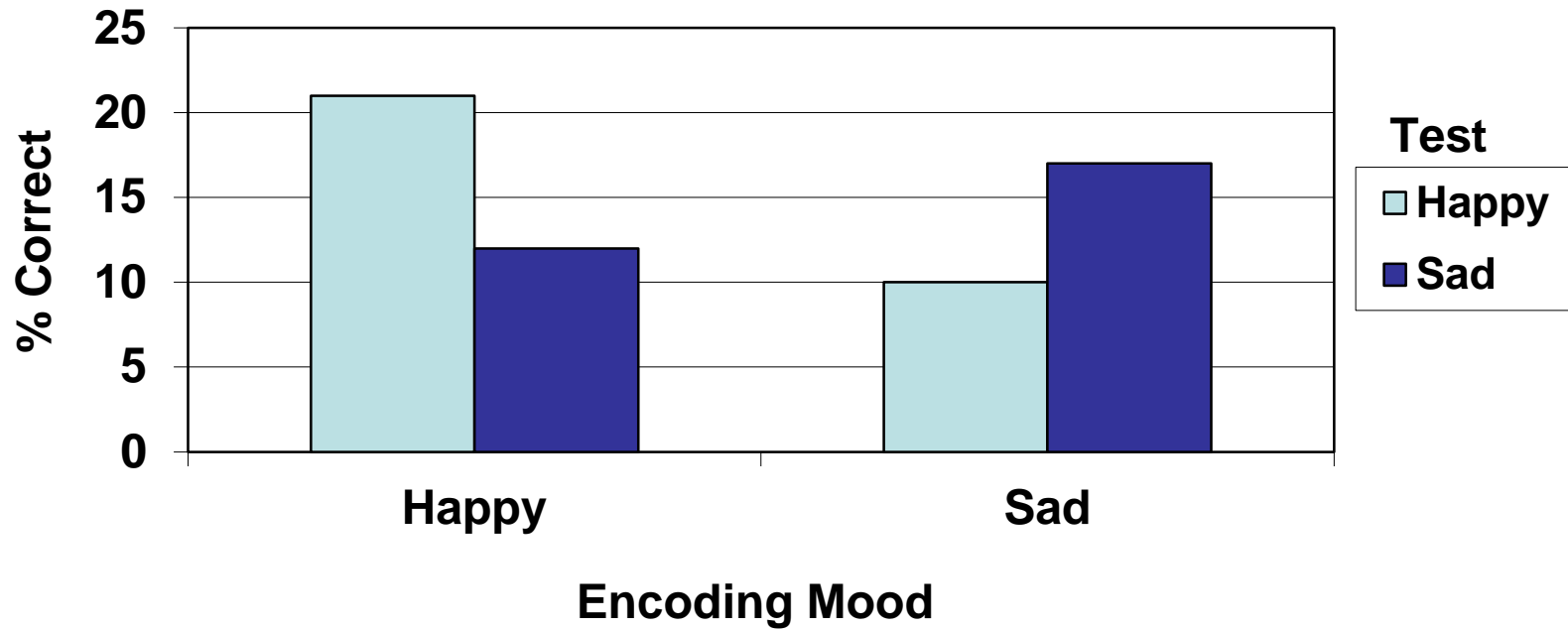
Magnitude of Drug-Induced State-Dependent Memory in Humans

Eich (1980)

- ***Strong Effects***
 - *Anesthetics*
 - *Barbiturates*
 - *Ethyl Alcohol*
 - *Chloral Hydrate*
 - *Ether*
 - *Nitrous Oxide*
 - *Librium*
 - *Nicotine*
- ***Moderate Effects***
 - *Marijuana*
 - *Narcotics*
 - *Hallucinogens*
- ***Weak Effects***
 - *Physostygmine*
 - *Chlorpromazine*
 - *Imipramine*
- ***No Effects***
 - *Caffeine*
 - *Aspirin*
 - *Lithium*

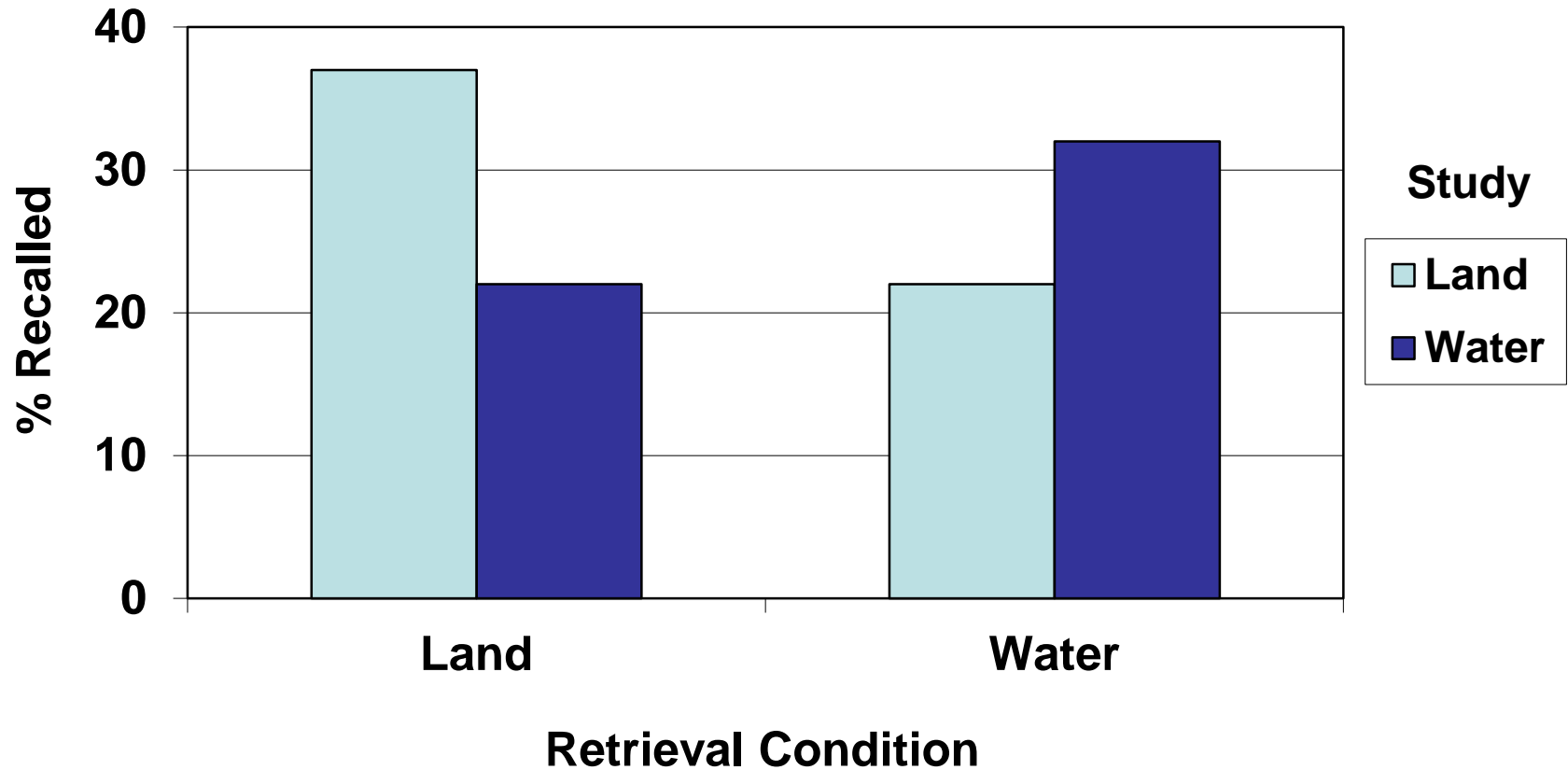
Mood-Dependent Memory

Eich & Metcalfe (1989)



Environment-Dependent Memory

Godden & Baddeley (1975)



Context-Dependent Memory

- Episodic Context
 - Time, Place
 - Features of External Environment
 - Features of Internal Environment
 - Physiological State
 - Emotional State
 - Motivational State?
- Psychoactive Drugs Impair Cognition
- Context Effects are Cue-Dependent
 - Overshadowed by Other Cues

Context-Dependency and Encoding Specificity

- Encoding
 - Sets the Stage for Retrieval
- Retrieval
 - Recapitulates Encoding Processes
- Congruent Conditions
 - Facilitates Match with Trace
- Incongruent Conditions
 - Cue Information Mismatches Trace
 - Forgetting as Failure of Access