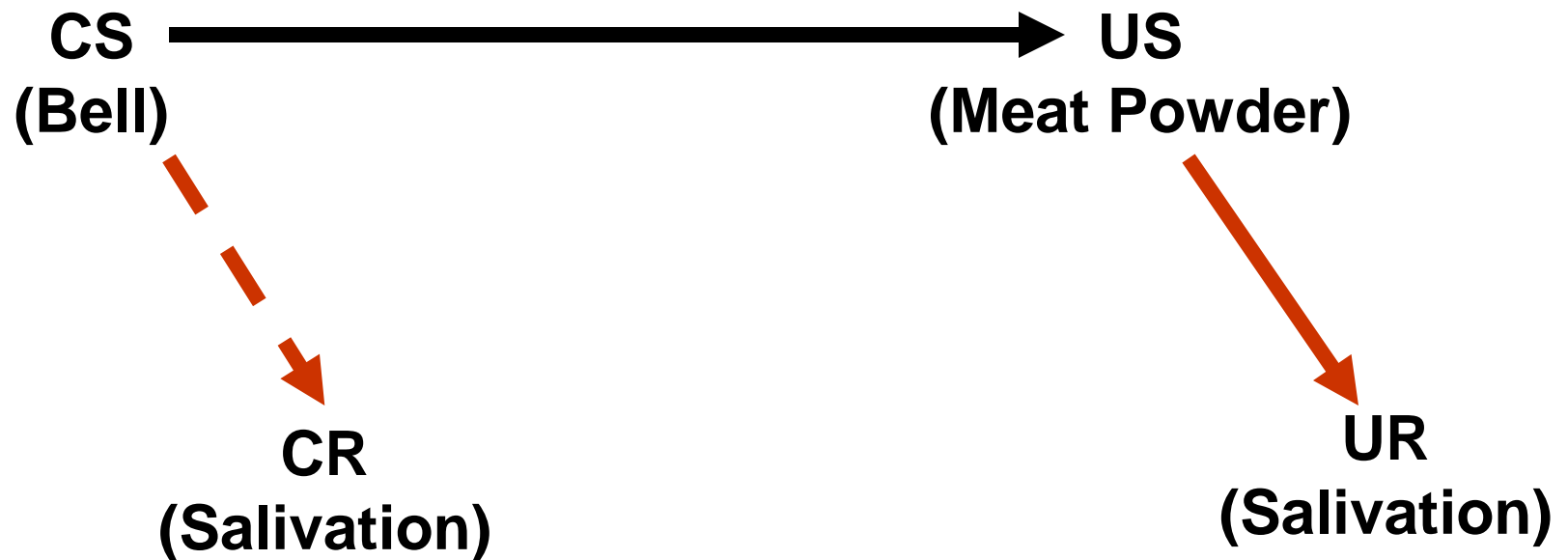


Classical and Instrumental Conditioning

Lecture 8

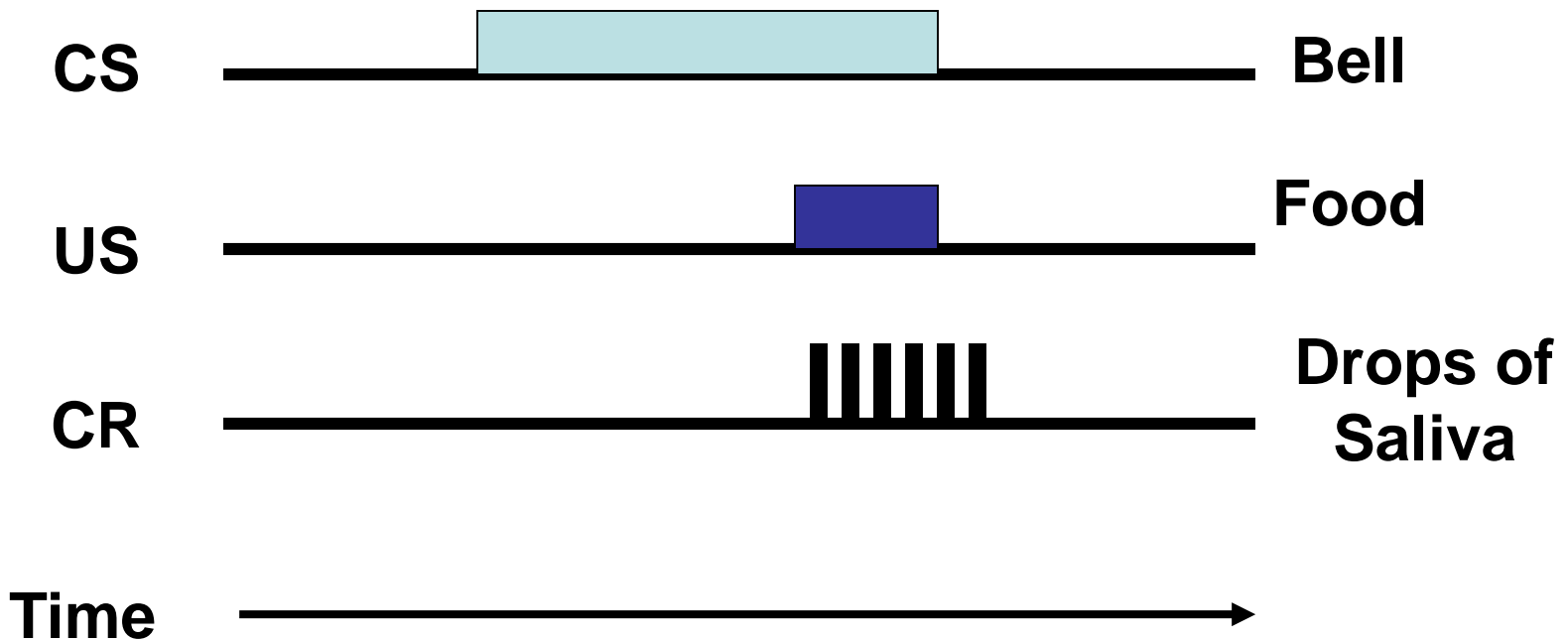
Basic Procedure for Classical Conditioning



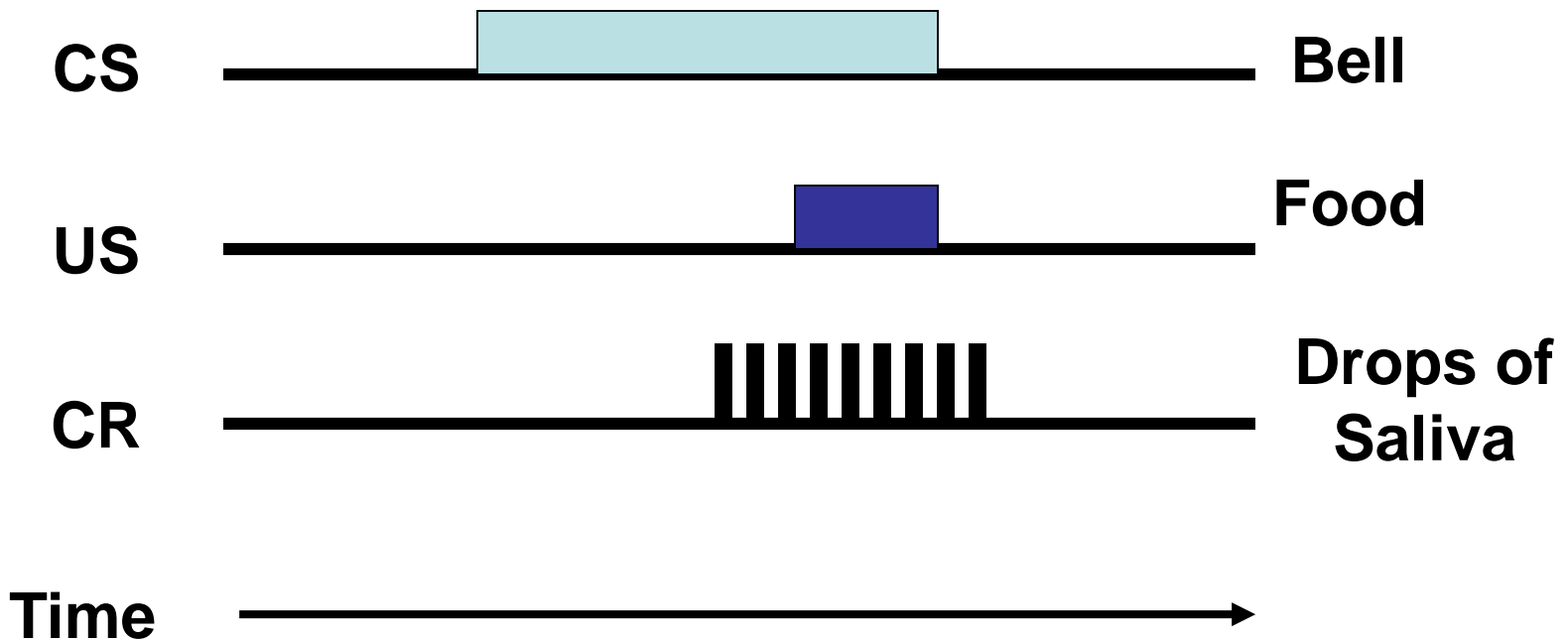
Major Phenomena of Classical Conditioning

- Acquisition
 - CR to CS Reinforced by US
 - Response Gains Strength
 - Magnitude of CR
 - Probability of CR

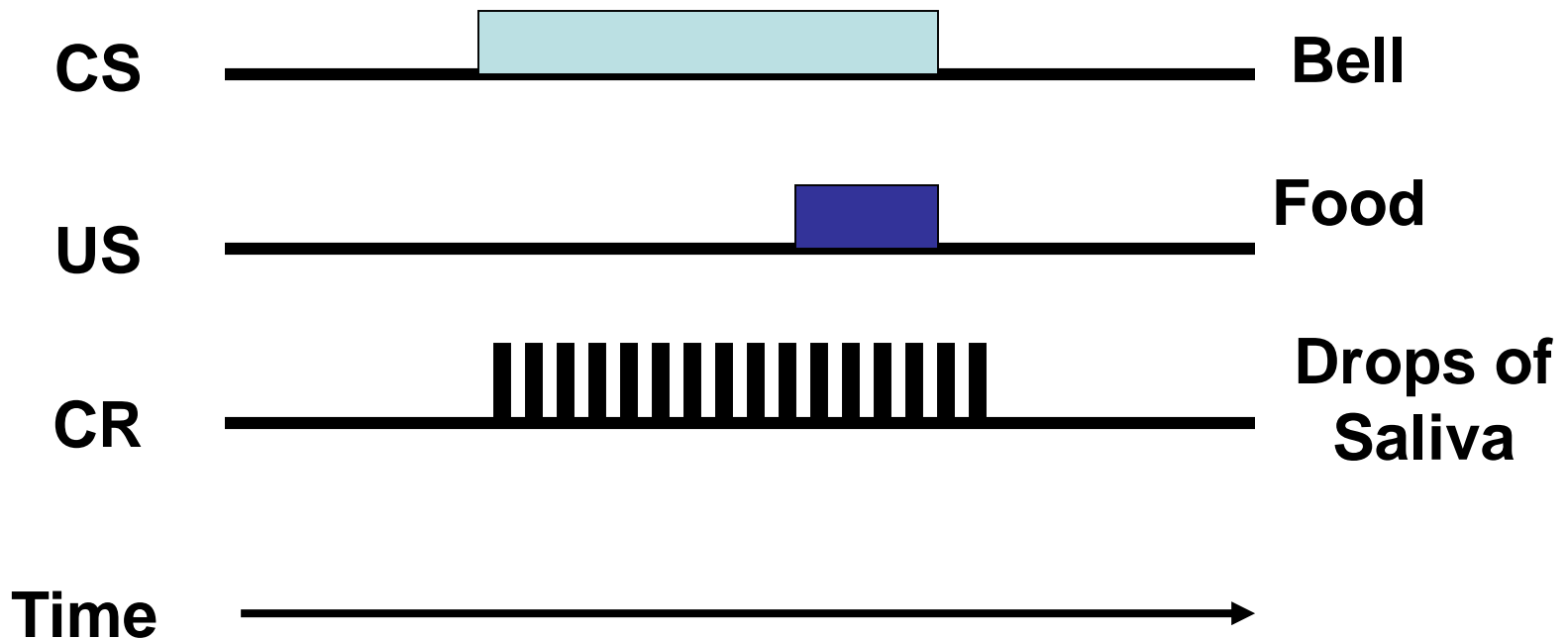
Acquisition: Trial 1



Acquisition: Trial 5

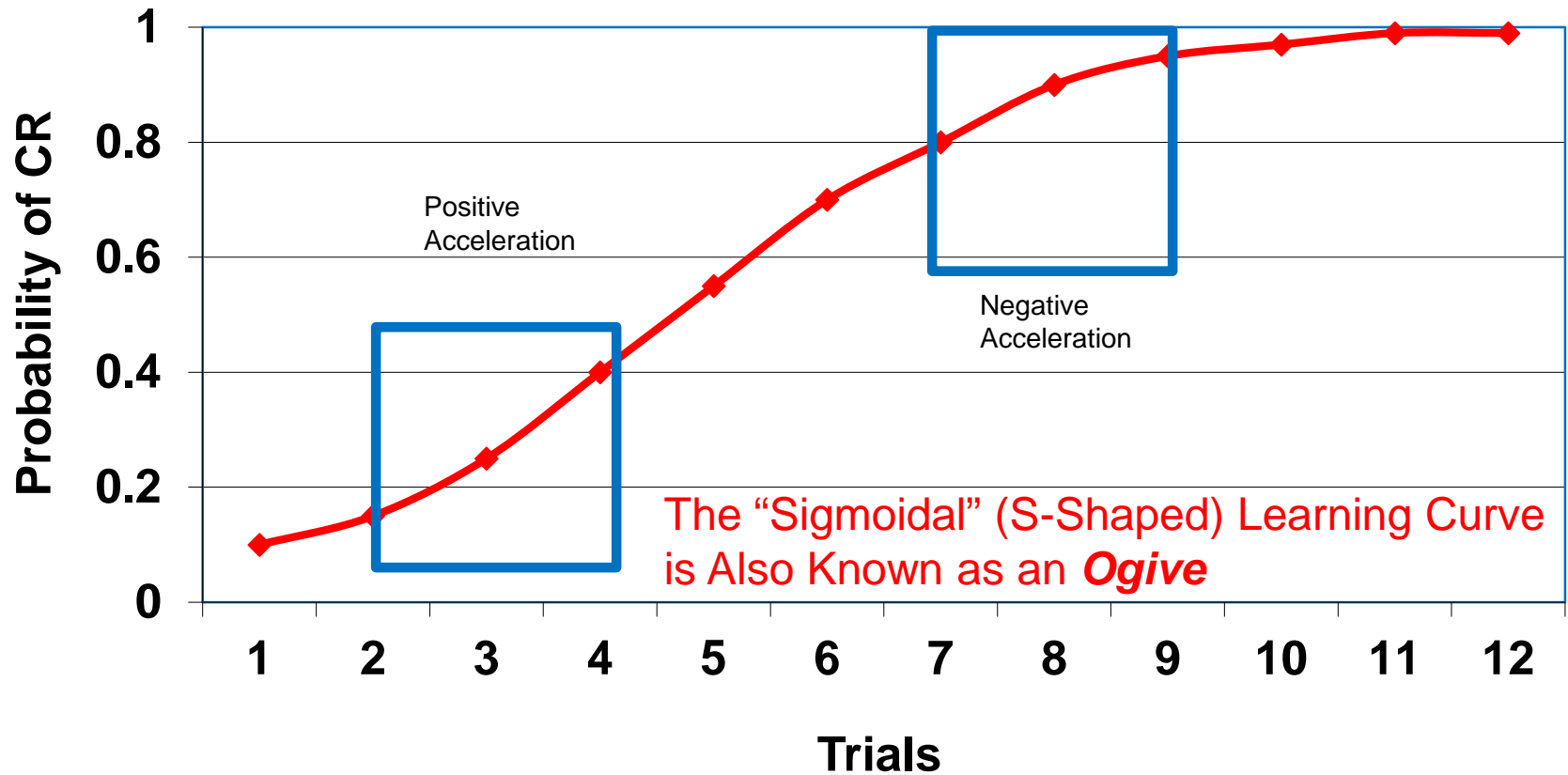


Acquisition: Trial 10



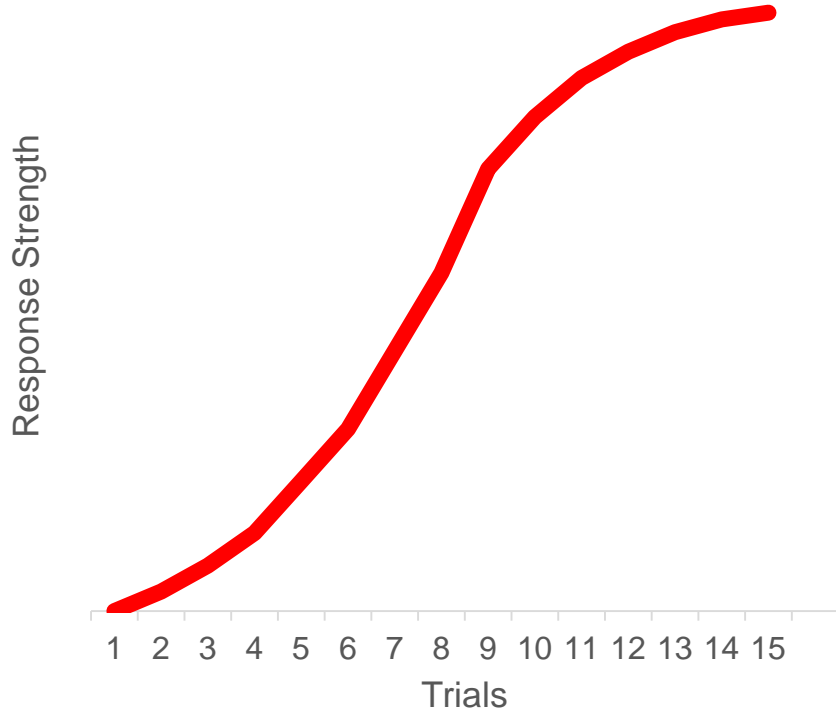
Acquisition of a Conditioned Response

CS ==> US

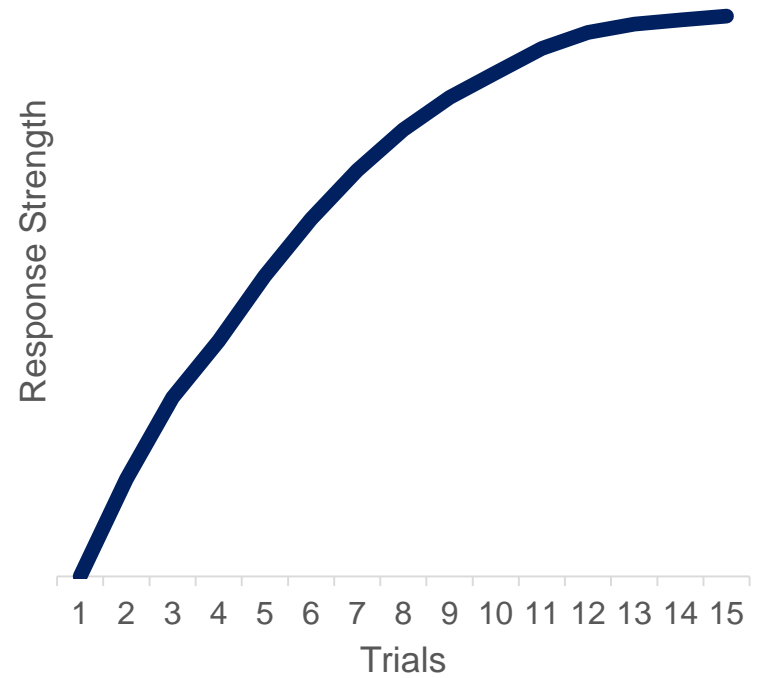


Two Shapes to the Learning Curve

Naïve Organism/
Complex Behavior



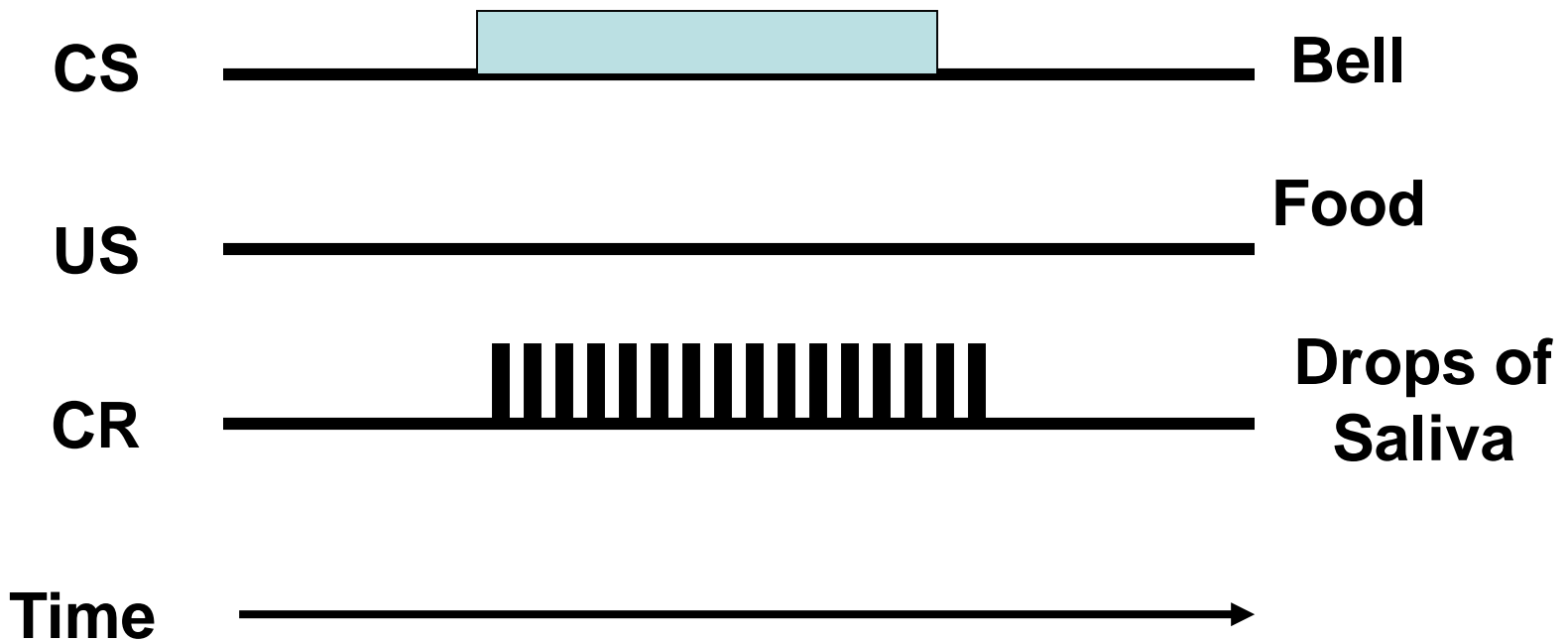
Experienced Organism/
Simple Behavior



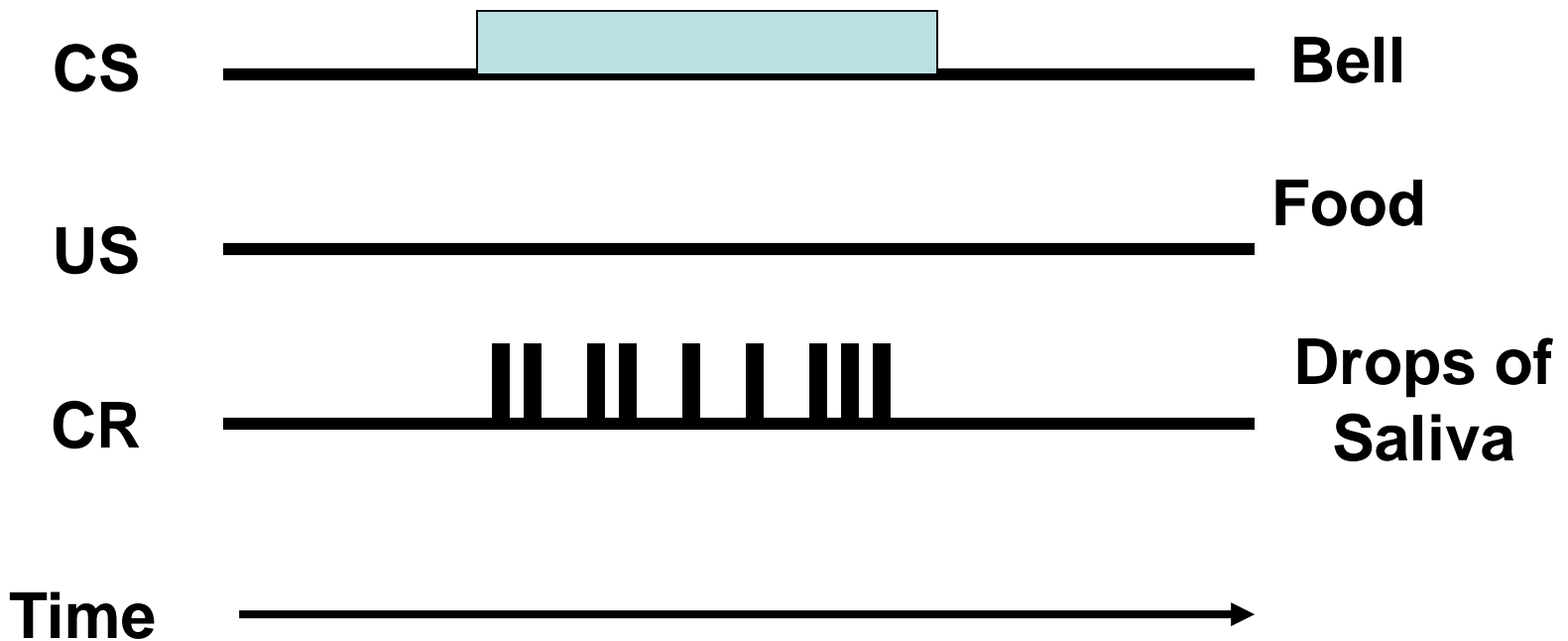
Major Phenomena of Classical Conditioning

- Acquisition
- Extinction
 - No Reinforcement
 - Response Loses Strength

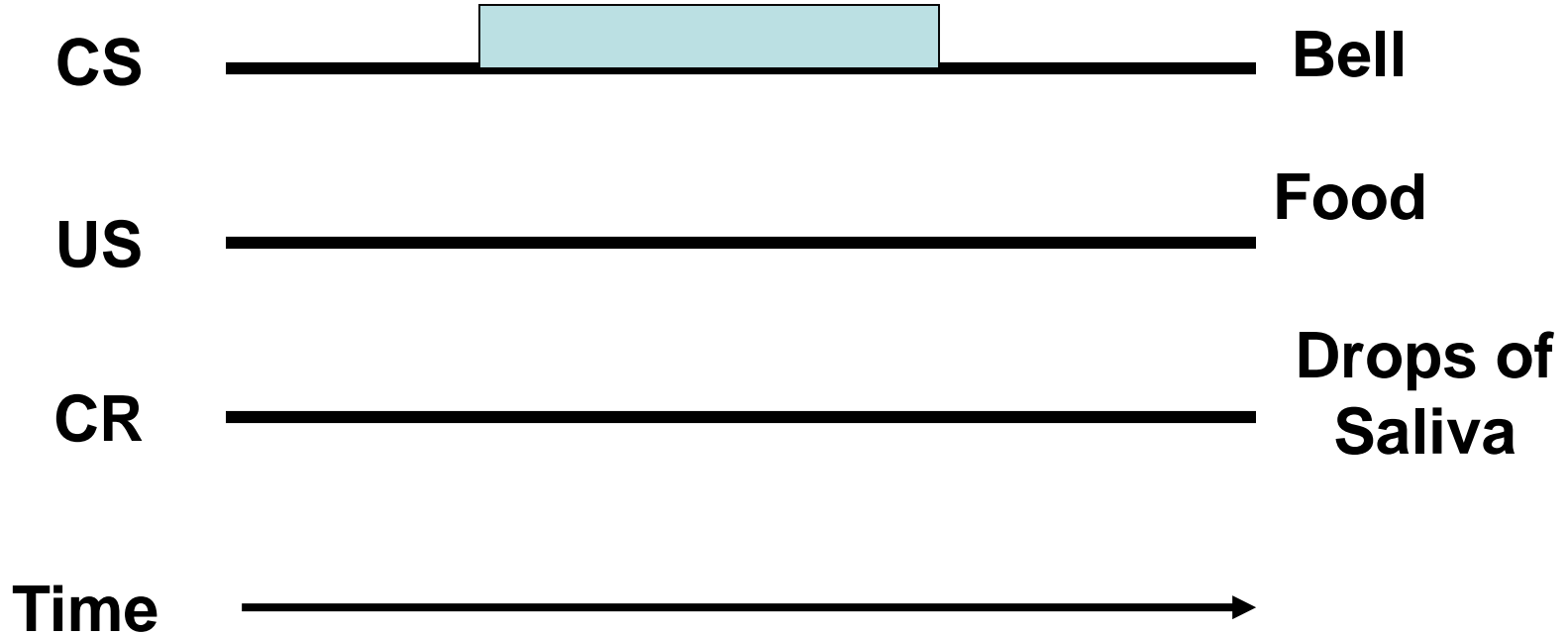
Extinction: Trial 1



Extinction: Trial 5

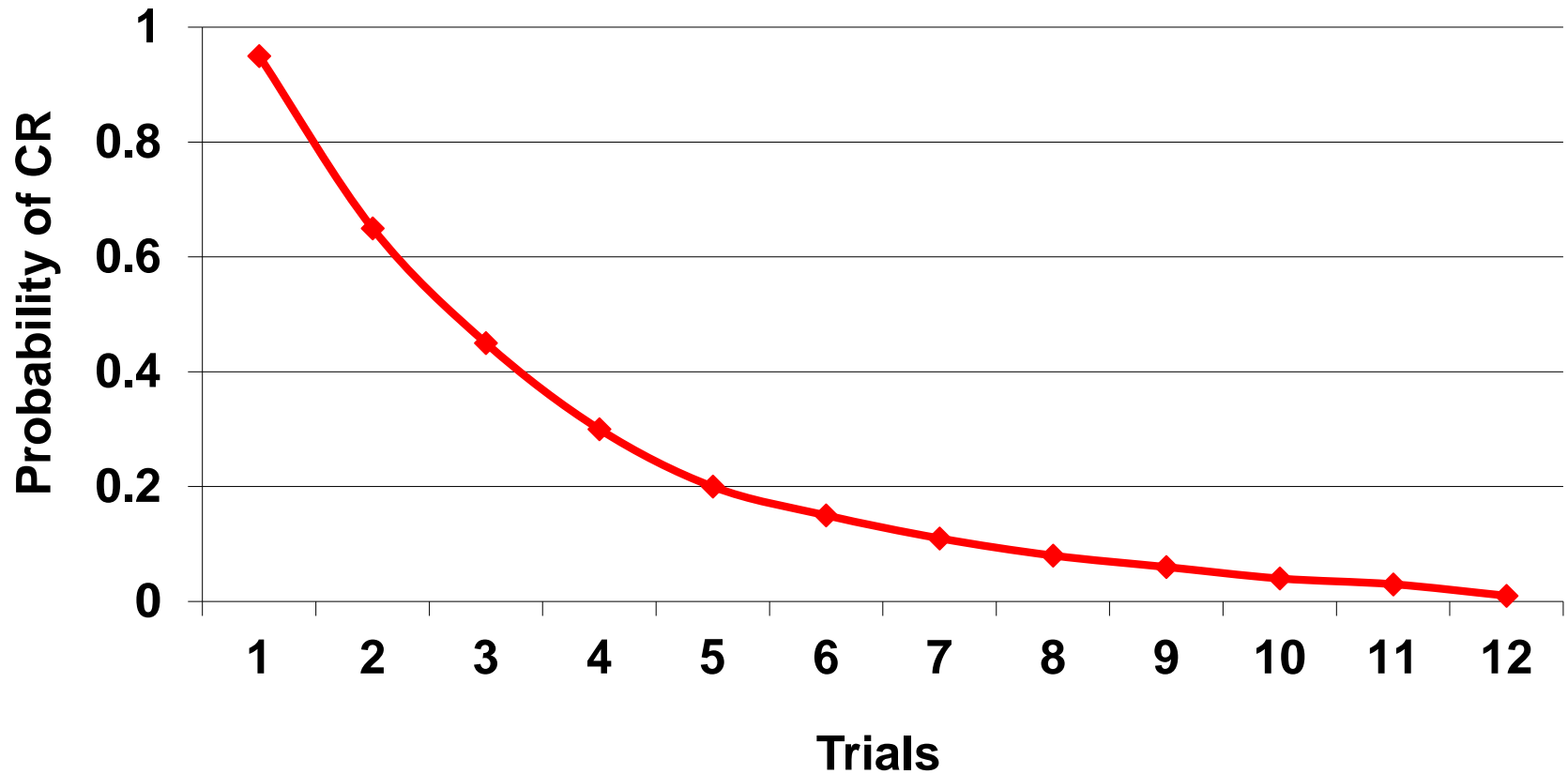


Extinction: Trial 10



Extinction of a Conditioned Response

CS ==> No US

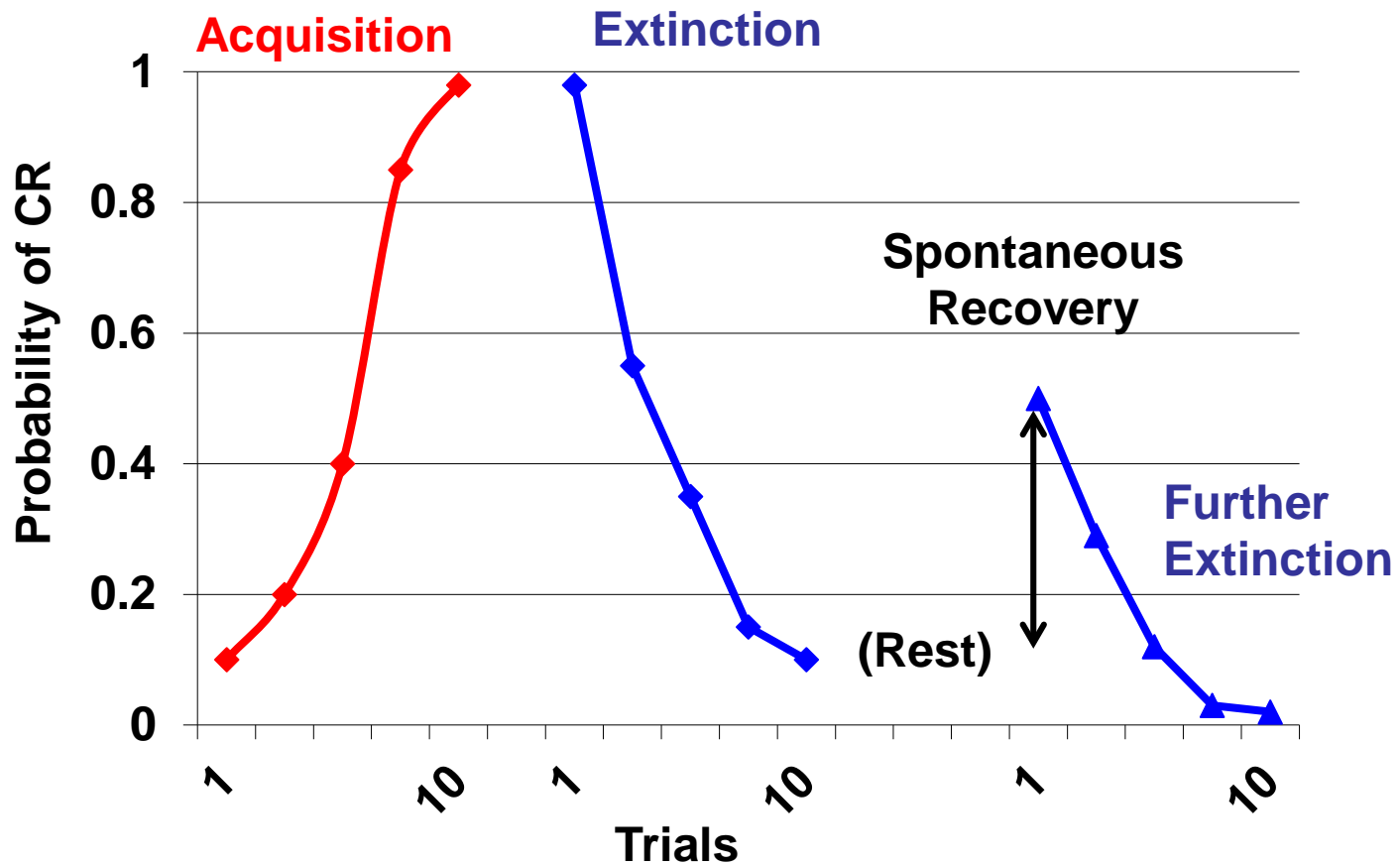


Major Phenomena of Classical Conditioning

- Acquisition
- Extinction
- Spontaneous Recovery
 - Rest After Extinction
 - Retest CS alone

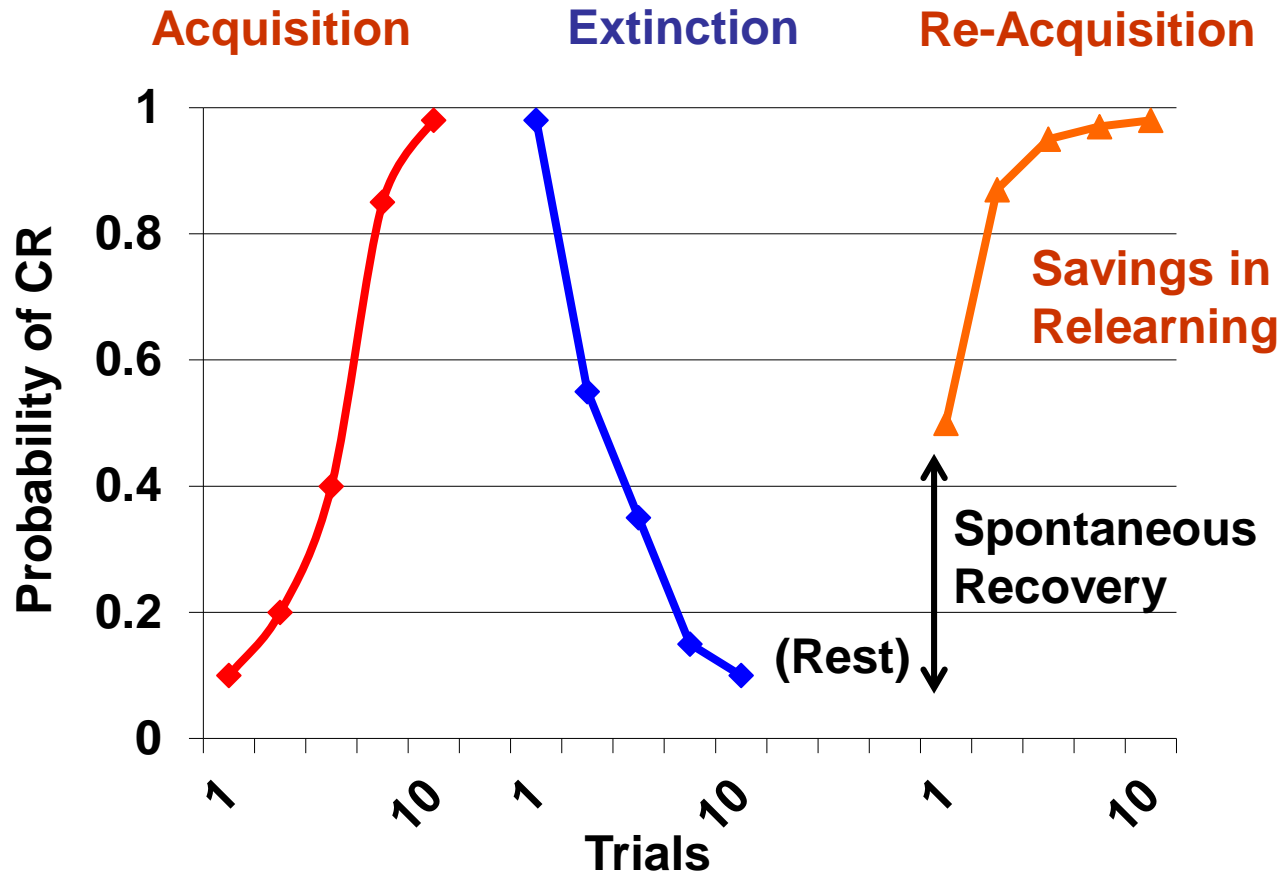
Spontaneous Recovery After Extinction

CS ==> No US



Re-Acquisition of Extinguished Response

CS ==> US



Extinction Below Zero

- Extinction Trials Continued After CR Disappears Entirely
- Reduced Spontaneous Recovery
- Less Savings in Relearning
 - Slower Reacquisition

Major Phenomena of Classical Conditioning

- Acquisition
- Extinction
 - Extinction Below Zero
- Spontaneous Recovery
- Re-Acquisition
 - CS Reinforced by US
 - Savings in Relearning

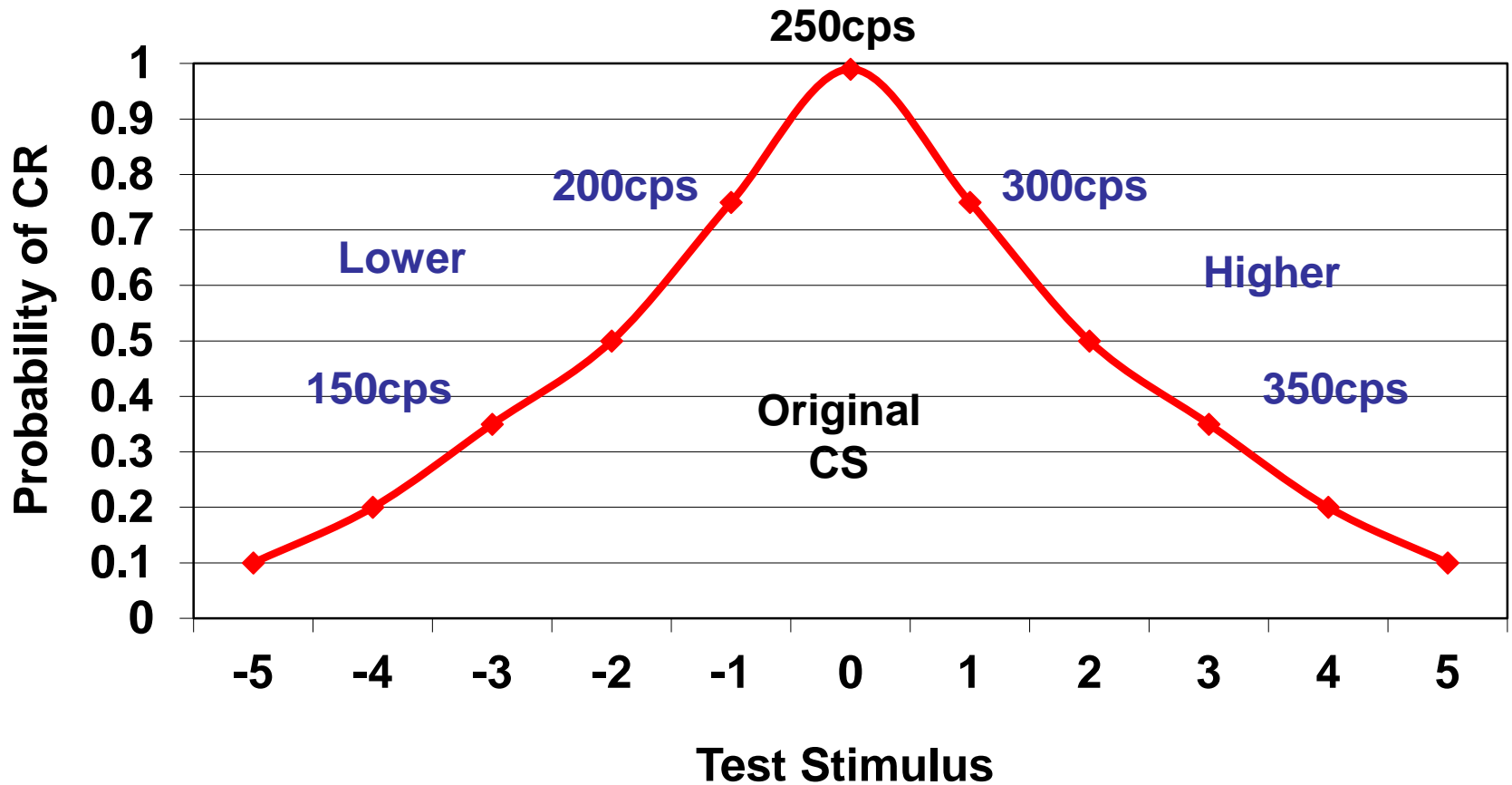
Implications of Savings and Spontaneous Recovery

- Conditioned Response Not “Lost”
- Rather, Inhibited or Suppressed
 - In Line with Changing Circumstances
 - Conditioned Stimulus No Longer Reinforced
- CR Can be Disinhibited
 - In Line with Changing Circumstances
 - CS Reinforced Once Again

Major Phenomena of Classical Conditioning

- Acquisition
- Extinction
- Spontaneous Recovery
- Re-Acquisition
- Generalization
 - CS_0 vs. $CS_1 \dots CS_n$
 - Generalization Gradient

The Generalization Gradient



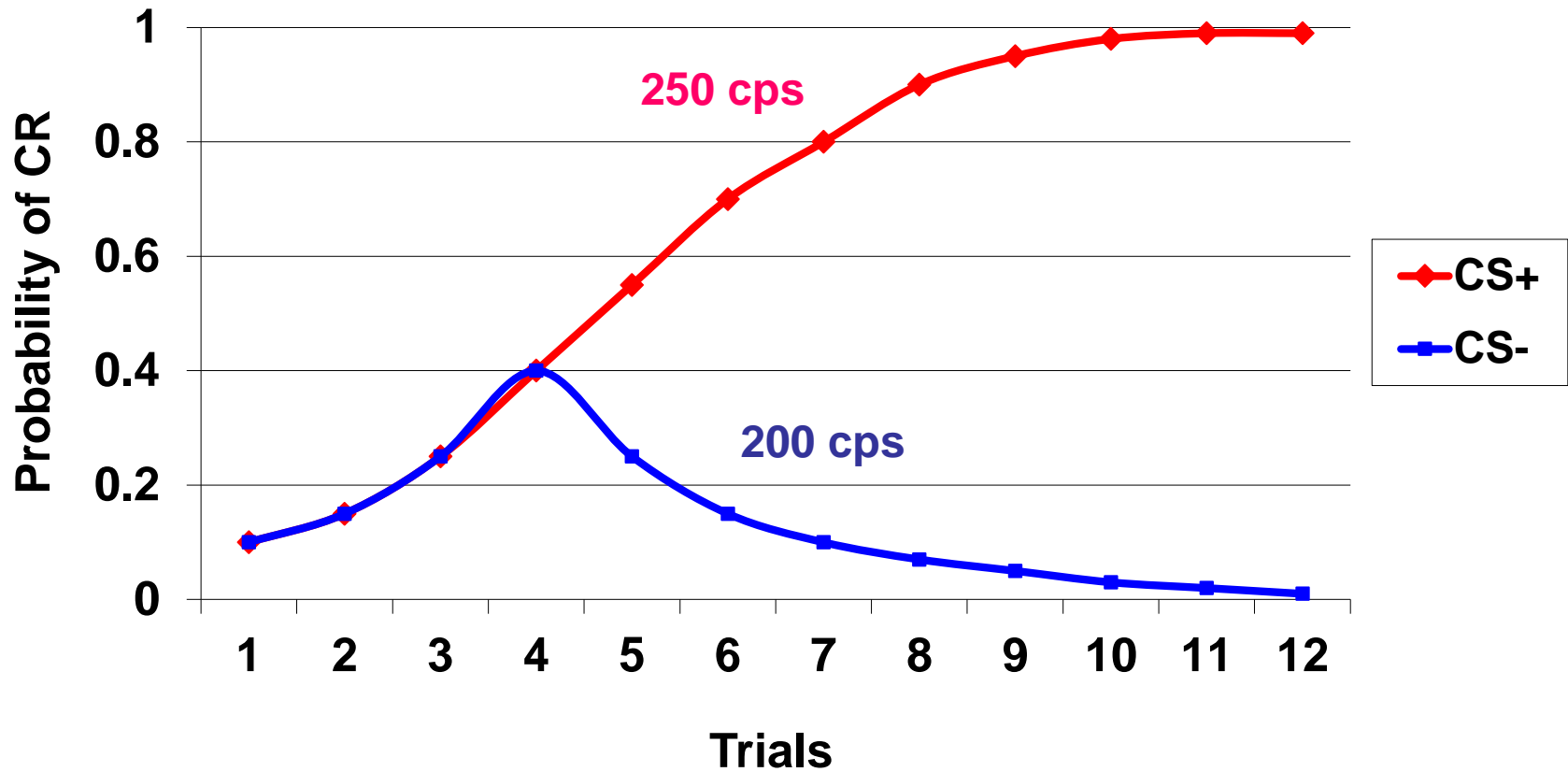
Major Phenomena of Classical Conditioning

- Acquisition
- Extinction
- Spontaneous Recovery
- Re-Acquisition
- Generalization
- Discrimination
 - CS+ (Reinforced)
 - CS- (Unreinforced)

Discrimination Learning

CS+ ==> US

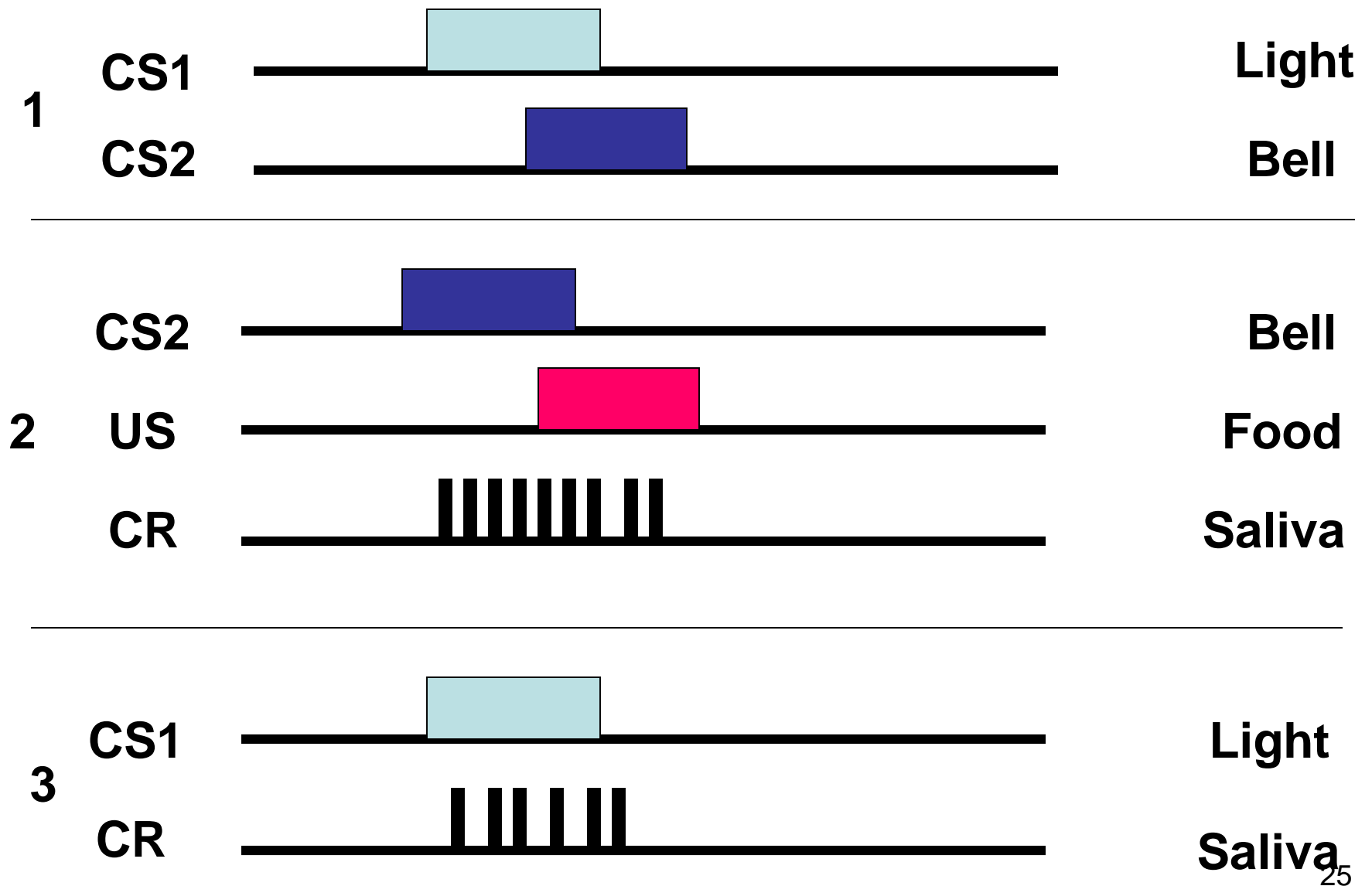
CS- ==> No US



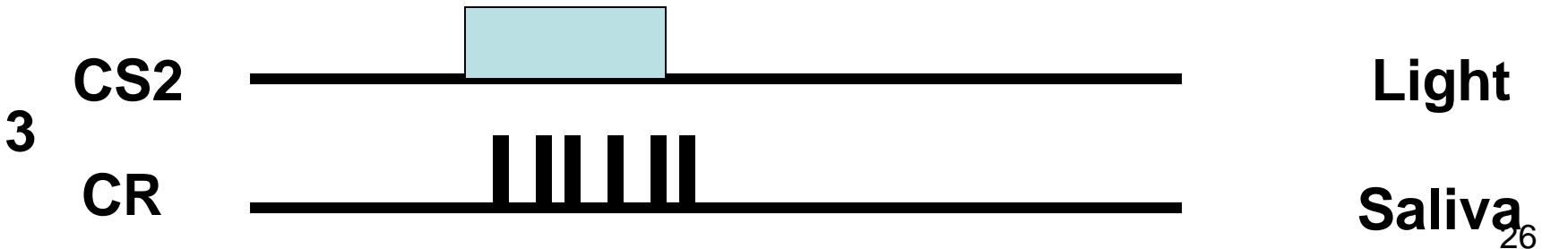
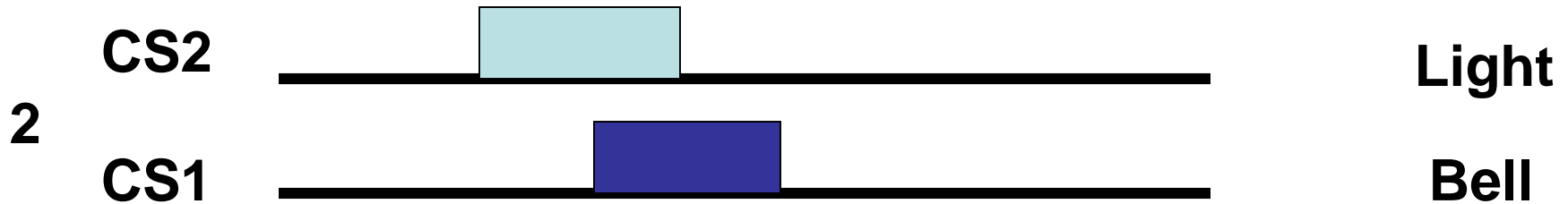
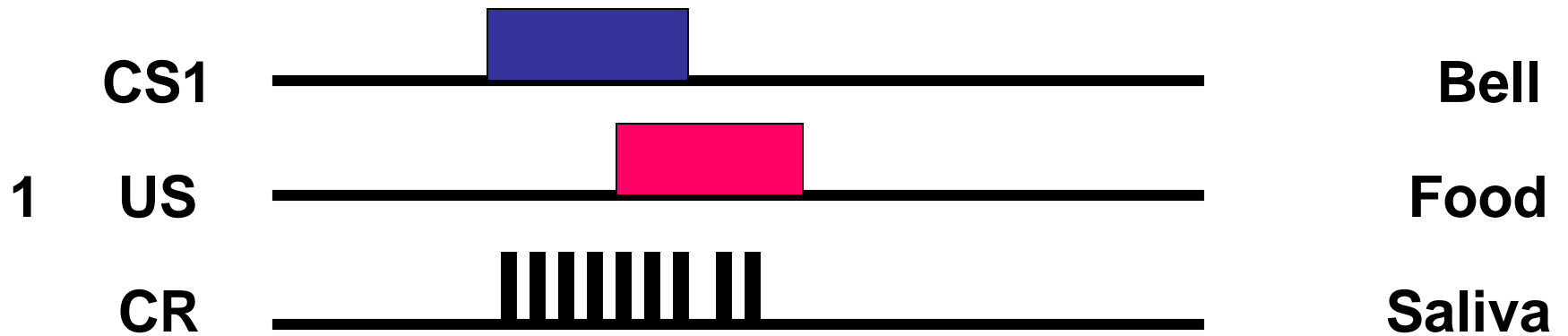
Review of Classical Conditioning

- Vocabulary
 - Unconditioned Stimulus
 - Unconditioned Response
 - Conditioned Stimulus
 - Conditioned Response
- Phenomena
 - Acquisition
 - Reinforcement
 - Extinction
 - Spontaneous Recovery
 - Savings in Relearning
 - Generalization
 - Generalization Gradient
 - Discrimination

Sensory Preconditioning



Higher-Order Conditioning

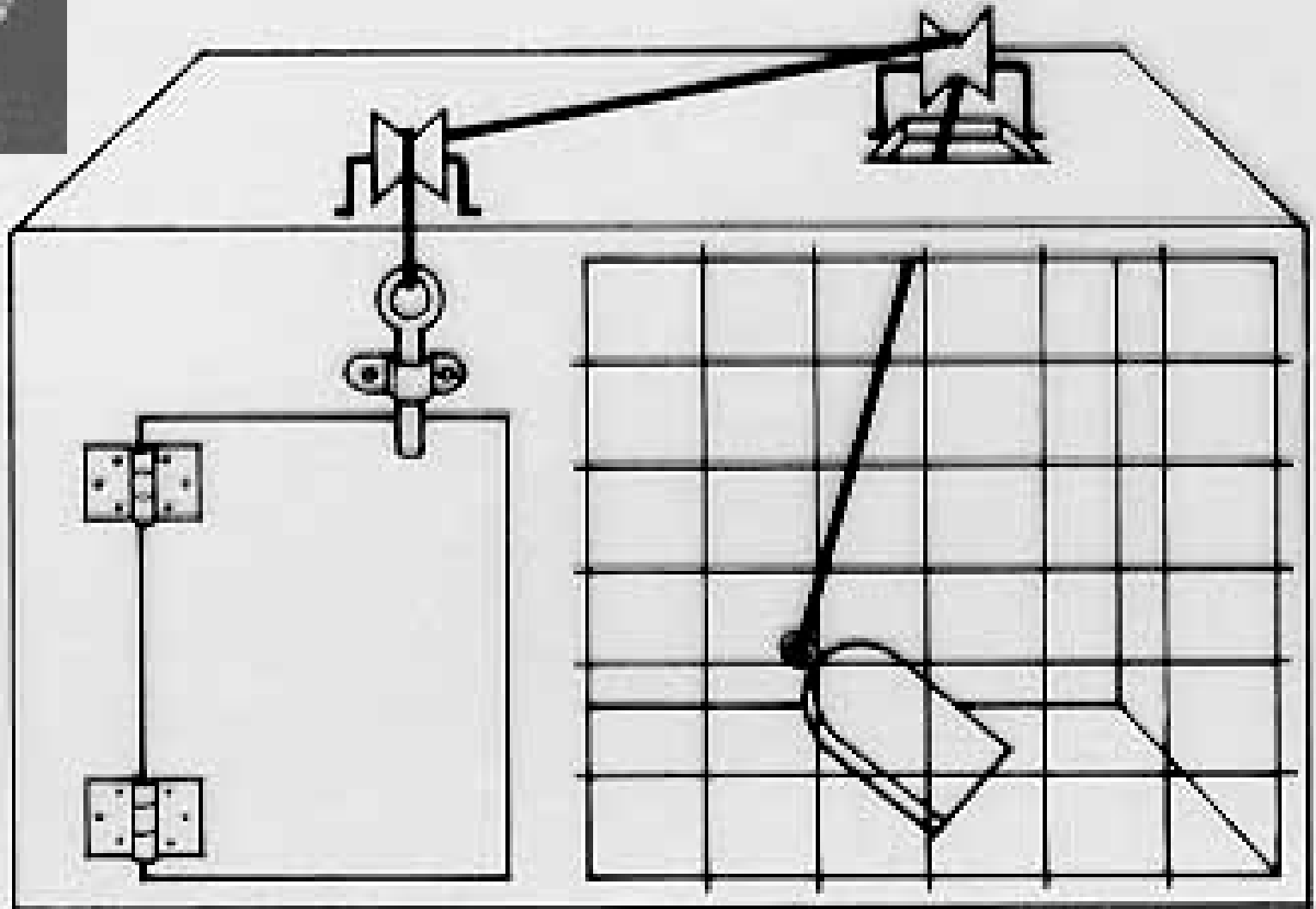


Significance of Classical Conditioning

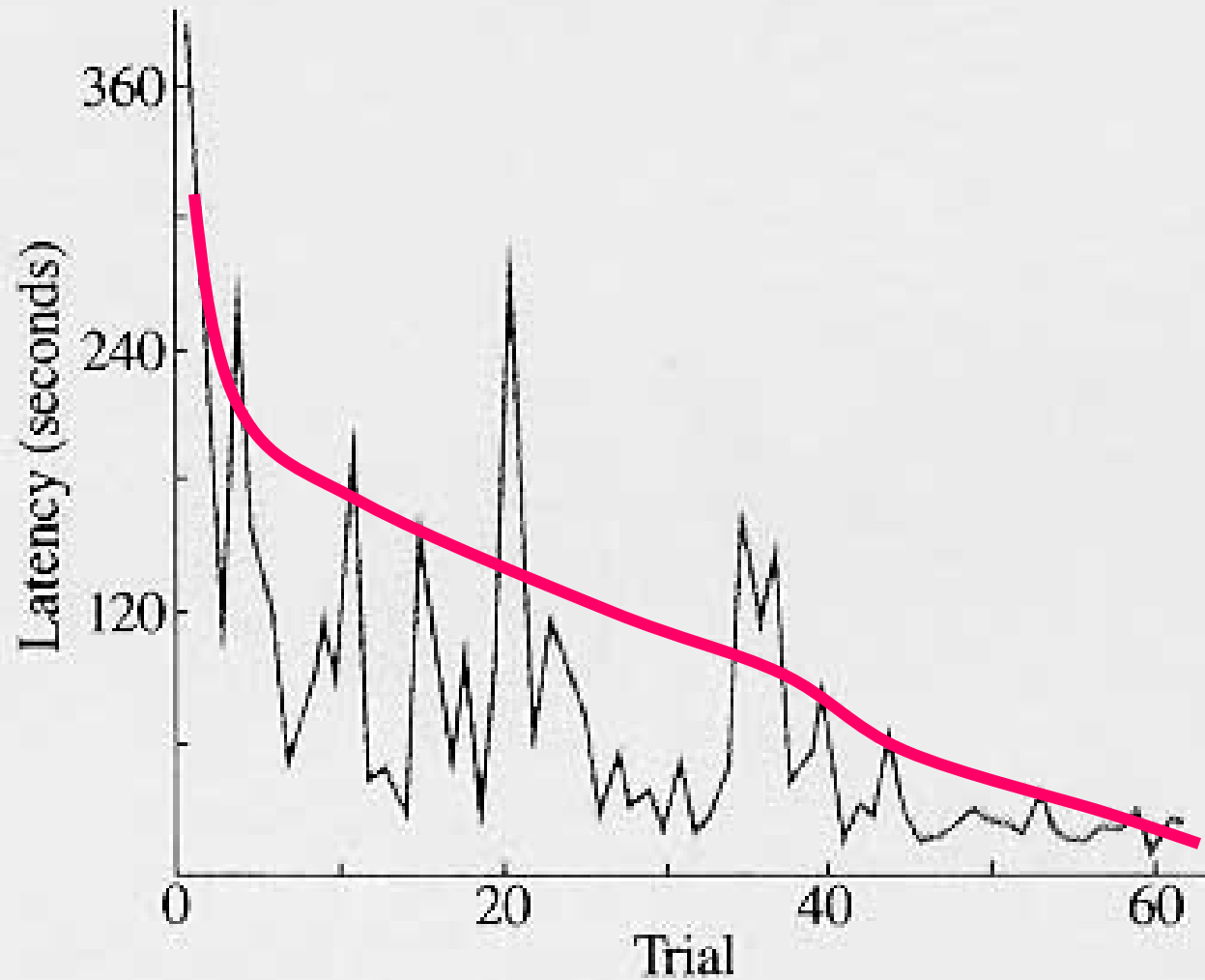
- Extends Control of Reflexes to Other Environmental Events
 - Associations between Events
- Ubiquitous (Nervous System)
- Pavlov: All Learning is Classical Conditioning (?)
- Laws of Classical Conditioning are the Laws of Emotional Life



Thorndike's Puzzle Box



Thorndike's Results



Thorndike's Laws of Learning

Law of Readiness

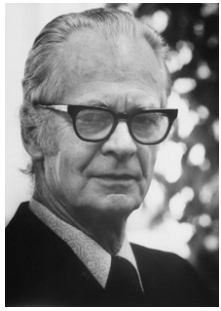
Law of Effect

Law of Exercise

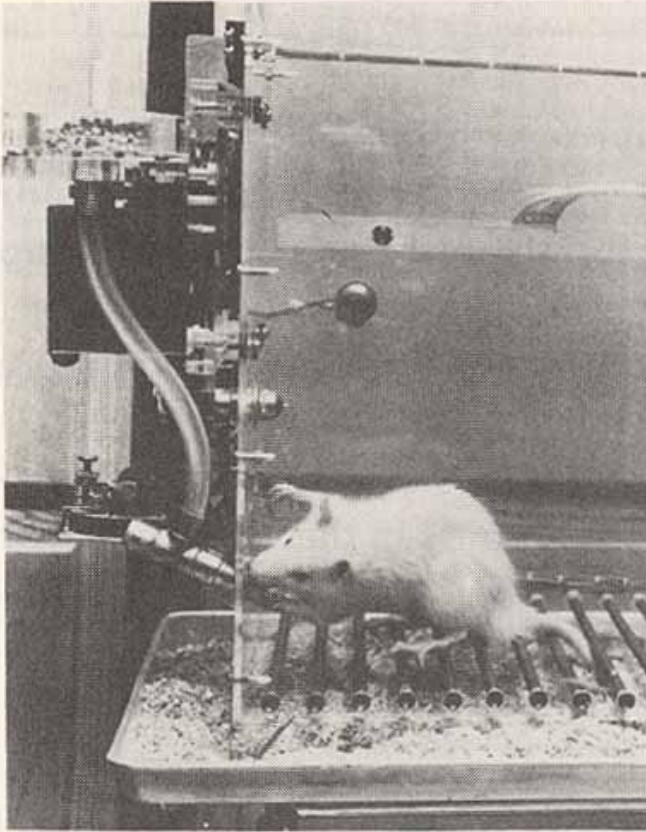
Instrumental Conditioning

(*Operant* Conditioning)

- Learn Adaptive Behavior
 - Through Experience of Success, Failure
- Organism *Operates* on Environment
 - Behavior Changes Environment
- Behavior *Instrumental*
 - Obtains Desired State of Affairs
- Associations between Behaviors and Outcomes



B.F. Skinner's Operant Chamber



A rat trained to press a lever for food reinforcement (courtesy of Pfizer Inc.) and a pigeon pecking a lit key for food reinforcement (photo by W. Rapport, courtesy of B. F. Skinner).

Instrumental Conditioning Procedure

- Phase 1: Baseline Behavior
- Phase 2: Acquisition Phase
- Phase 3: Discrimination Learning
- Phase 4: Extinction

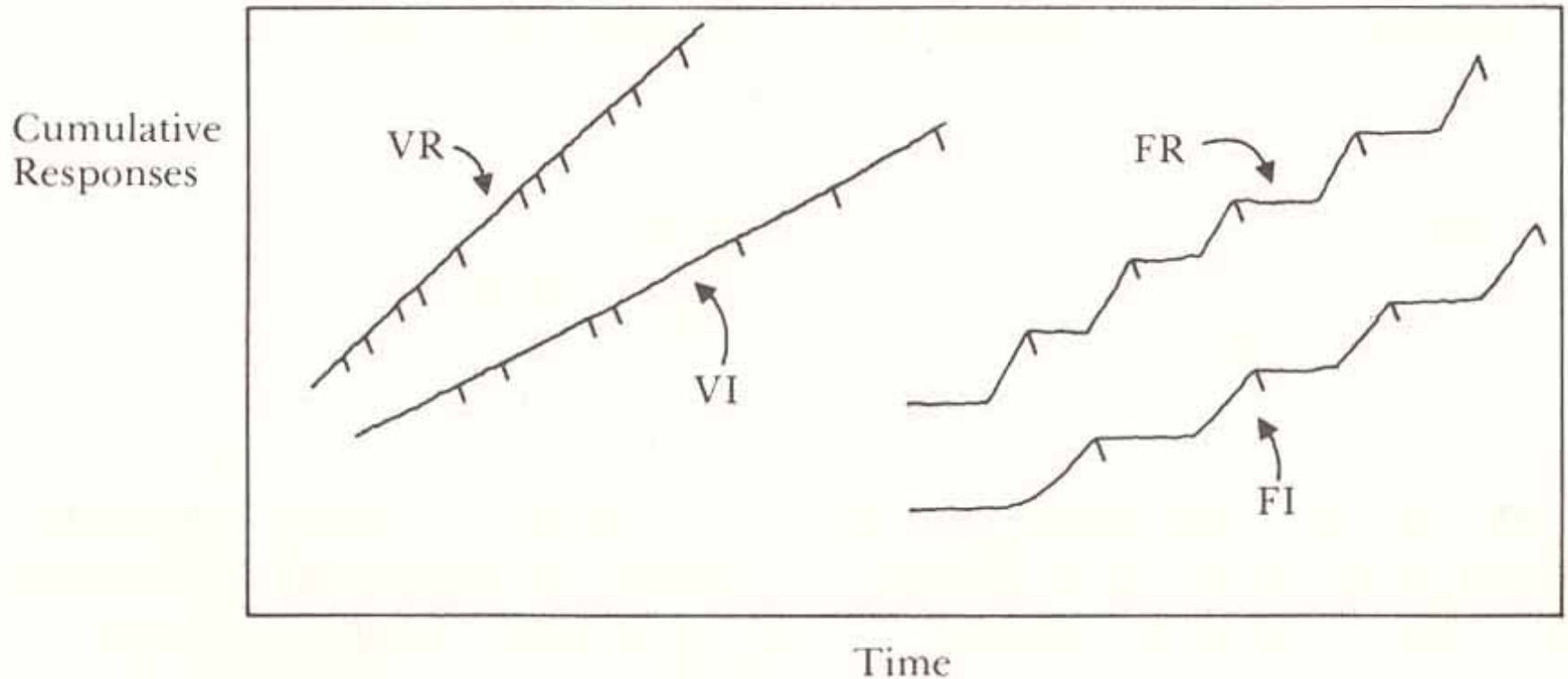
Vocabulary of Instrumental Conditioning

- Conditioned Response (No URs)
- Conditioned Stimulus (No USs)
- Reinforcement
 - Positive
 - Negative (Not Punishment)
- Acquisition
- Extinction
- Generalization
- Discrimination

Schedules of Reinforcement

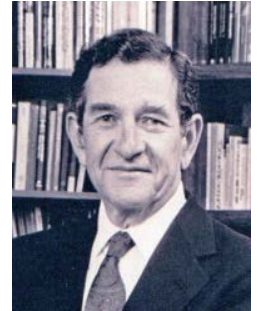
- Continuous
- Partial
- Intermittent
 - Fixed Ratio (FR)
 - Variable Ratio (VR)
 - Fixed Interval (FI)
 - Variable Interval (VI)
- Differential Reinforcement
 - Of Low Rates (DRL)
 - Of High Rates (DRH)

Intermittent Reinforcement



The Matching Law

Herrnstein (1970)



- Concurrent VI Schedules
 - Give Organism a Choice
 - Key A: VI3
 - Key B: VI1
- Response Rate is Proportional to the Frequency of Reinforcement
 - Also Magnitude, Delay of Reinforcement
- Basic Principle of Microeconomics
 - Supply and Demand
 - Relative Value of Reinforcers

Significance of Instrumental Conditioning

- Voluntary Behaviors Come Under Control of Environmental Events
 - Behavior-Outcome Associations
- Ubiquitous (Vertebrates)
- Thorndike, Skinner: All Learning is Instrumental/Operant Conditioning (?)
- Laws of Instrumental Conditioning Are the Laws of Adaptive Behavior
 - Habits
 - Incentives