

## INSTRUMENTAL or OPERANT CONDITIONING

cats in puzzle box (Thorndike, 1898)

- trial and error; incremental learning

Law of Effect - response is automatically strengthened when followed by reinforcement ("satisfying state of affairs"); automatically weakened when followed by punishment ("annoying state of affairs")

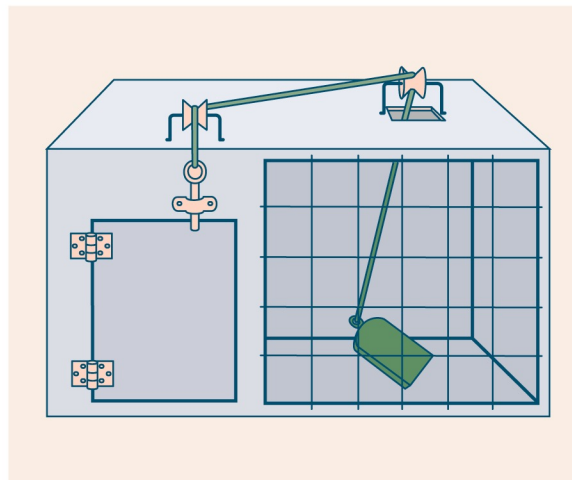


Figure 4.7: Puzzle box

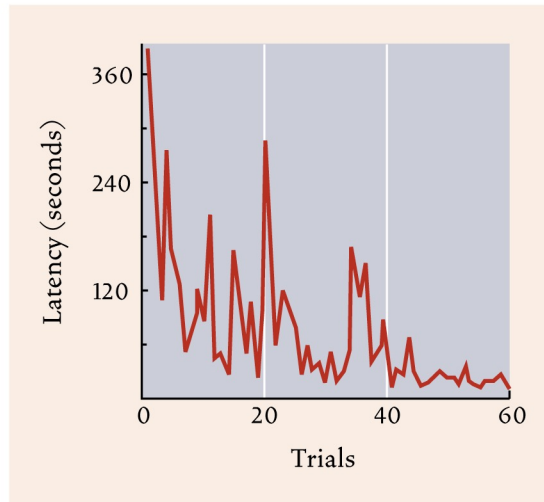


Figure 4.8: Learning curve of one of Thorndike's cats

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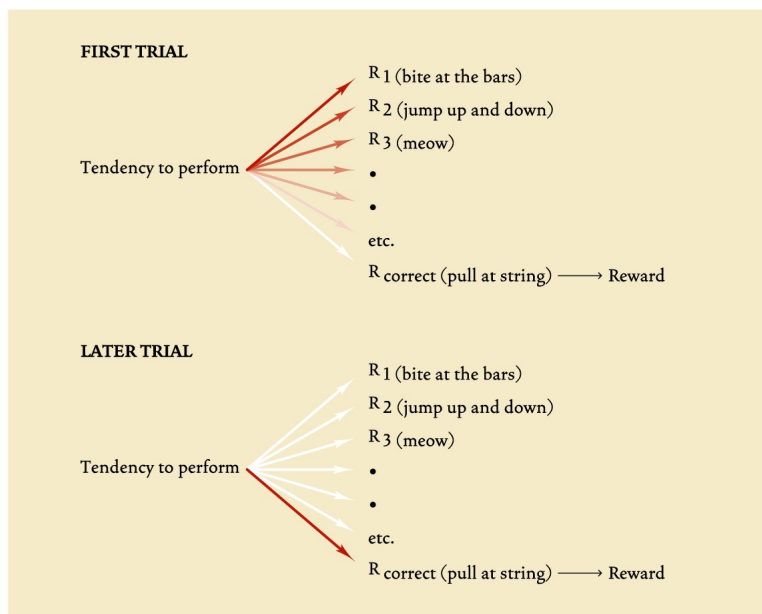


Figure 4.9: The law of effect

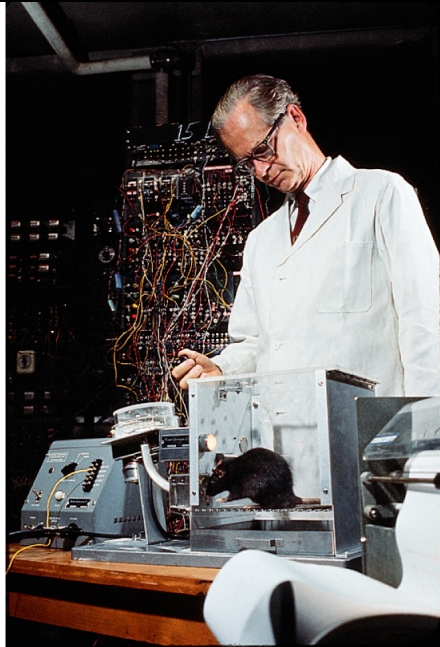
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### Operant conditioning vs. classical conditioning:

- operant cond. - reinforcement depends on response;
- class. cond. - reinforcement (US) comes regardless
- operant response is emitted and voluntary;
- classical cond. response is elicited and involuntary
- What is learned?  
in operant cond. - a BEHAVIOR  
in classical cond. - a SIGNAL (CS-->US)
- Through what mechanism?  
operant: Law of Effect: CONSEQUENCES  
(but delay of reinforcement weakens response!)  
classical: CONTIGUITY... so far!
- "conditioning", because changing the conditions  
changes response frequency; not under conscious  
control even though voluntary!

### B.F. SKINNER - "Skinner box":

- many responses
- little time and effort
- easily recorded
- RESPONSE RATE is the Dependent Variable



Page 135: B. F. Skinner

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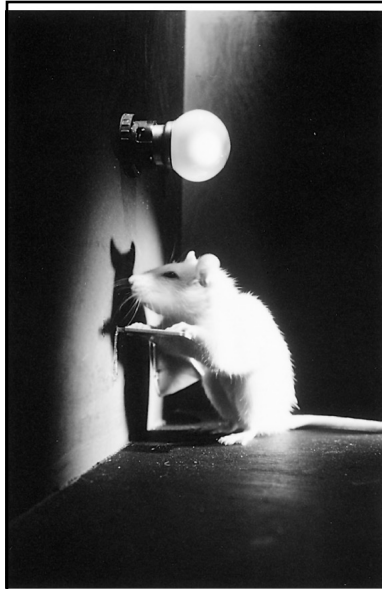


Figure 4.10: Animals in operant chambers

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## REINFORCEMENT AND PUNISHMENT

REINFORCEMENT (both pos. and neg.) always increases rate of responding

- **positive** reinforcement delivers appetitive stimulus (food, approval);
- **negative** reinforcement removes aversive stimulus (shock, alarm clock noise)

PUNISHMENT decreases rate of responding

w/ NO reinforcement: extinction and spontaneous recovery happen just as in classical conditioning

|                  | Increases Behavior            | Decreases Behavior         |
|------------------|-------------------------------|----------------------------|
| Present Stimulus | <b>Positive Reinforcement</b> | <b>Positive Punishment</b> |
| Remove Stimulus  | <b>Negative Reinforcement</b> | <b>Negative Punishment</b> |

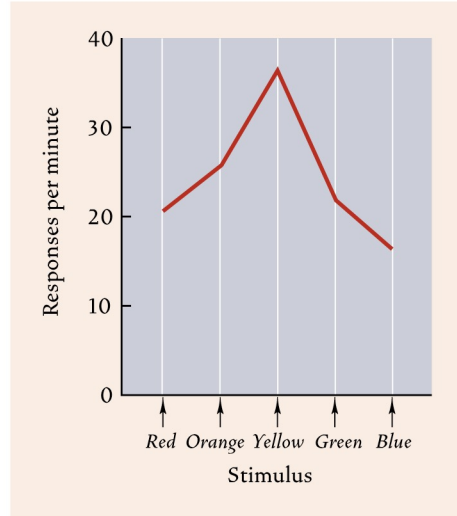


Figure 4.11: Stimulus generalization of an instrumental response

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**DISCRIMINATIVE STIMULUS:** indicates under what circumstances response will be reinforced

ex: rat presses bar, but only gets food when light in box is on; eventually doesn't press unless light is on

stimulus does **NOT CAUSE** response, or **SIGNAL** reinforcement; it **SETS OCCASION** for response

parallel to classical:

instead of CR there's operant response  
instead of US, reinforcement  
instead of CS, discriminative stimulus

but order changes:

- CLASSICAL: stim (CS)      reinf (US)      resp (CR)
- OPERANT:    stim                      resp!                      reinf!

conditioned (secondary) reinforcer:

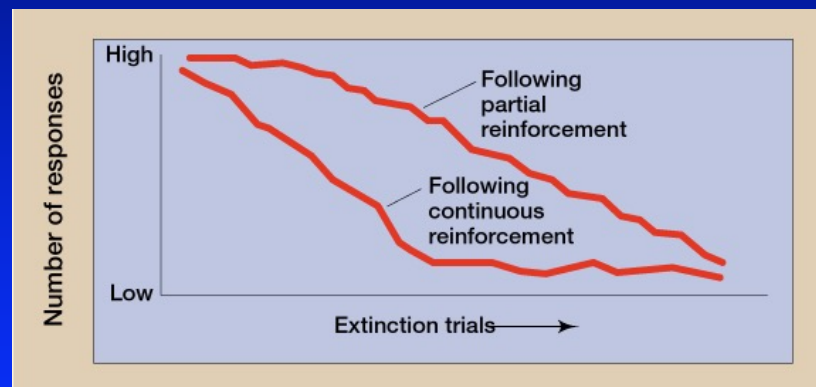
stimulus paired with reinforcer acquires reinforcing properties

- how does something get to be a conditioned reinf?  
through classical conditioning!
- ex.: in higher order classical conditioning - once bell is  
connected with food, it's used like a US

partial reinforcement effect:  
reinforcing **ONLY SOME TRIALS** produces even  
**STRONGER** response than reinforcing **ALL TRIALS**;  
but what does some mean?..

**SCHEDULES OF REINFORCEMENT:**

- describe as interval, ratio, fixed, variable
- continuous reinforcement (CR) = all responses get reinforced





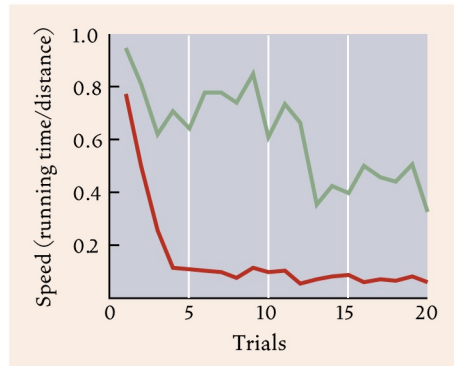


Figure 4.14: The partial-reinforcement effect

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interval schedule - reinforce next response after some **time interval**

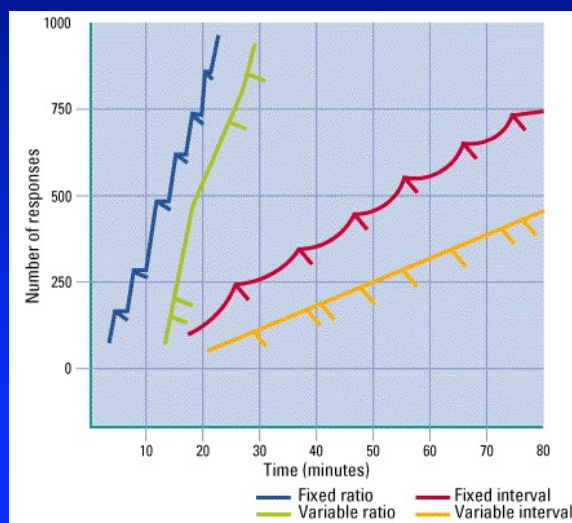
- "fixed interval" (FI) - time is fixed; rat gets food pellet for next bar press, say, 30 seconds after last pellet (ex: checking mail, delivered daily)

- "variable interval" (VI) - time is average; rat gets food pellet for next bar press 20, 40, 25, 35 seconds after last pellet, etc. - 30 seconds on average (ex: checking e-mail, delivered whenever)

ratio schedule - reinforcement after some **number of responses** (ratio of responses to reinforcements)

- "fixed ratio" (FR) - ratio is fixed; rat gets food pellet for every 10th bar press (ex: factory piecework)

- "variable ratio" (VR) - ratio is average; rat gets food pellet after 8, 12, 5, 15 responses - 10th response on average (ex: gambling)



shaping - differential reinforcement of successive approximations to desired response

- can produce a response the animal would never have made spontaneously on its own

chaining - linking responses into long sequence allows training of very complex behaviors