The ABCs of Behavior Analysis

A REVIEW OF THE BASICS

National Autism Conference
Workshop
The Pennsylvania State University
August 2017

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Topics

- Reinforcement, Extinction, and Their Side-Effects
- Contingencies, Contiguities, and Pairings
- Motivation: Establishing Operations
- Positive vs Negative Reinforcement
- Punishment
- Reinforcement as Selection - Shaping
- Operant Classes
- Stimulus Control and Attention

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- Popular assumptions about reinforcement and about getting rid of problem behavior
- These assumptions probably originated in superficial treatments, as in intro psych courses taught by those without a background in behavior analysis
- Ignoring (extinction) is not the procedure of choice

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- Reinforcement and its misrepresentations
- Reinforcement differs from bribery
- The so-called Hidden Costs of Reward mainly occur (if they occur at all) when reinforcers are delivered noncontingently

7

- Reinforcement: Reinforcing responses or reinforcing organisms?
- Where is the response in self-reinforcement?

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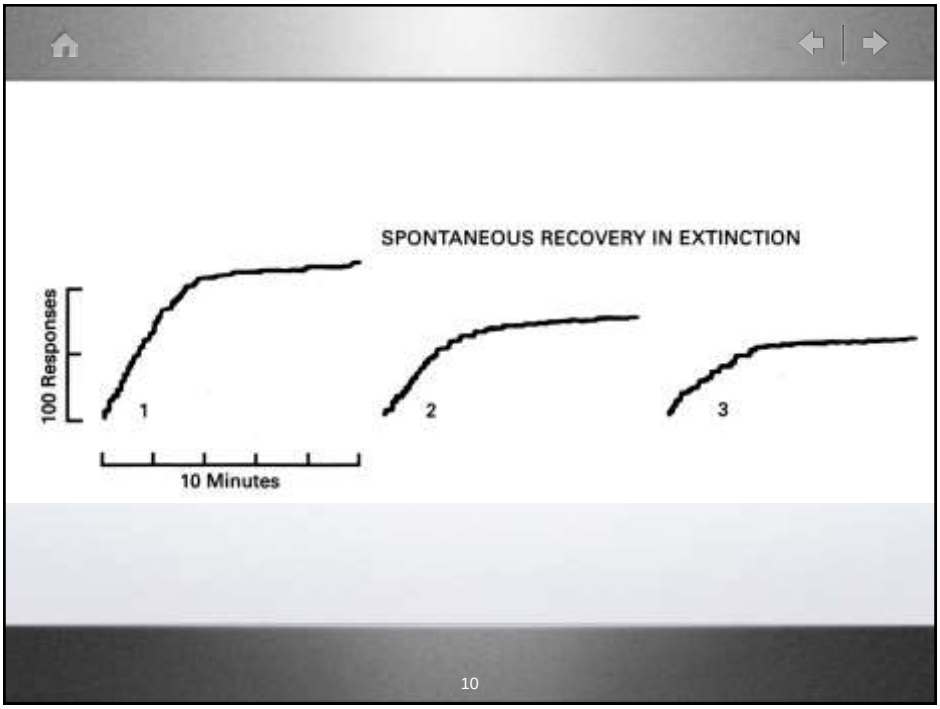
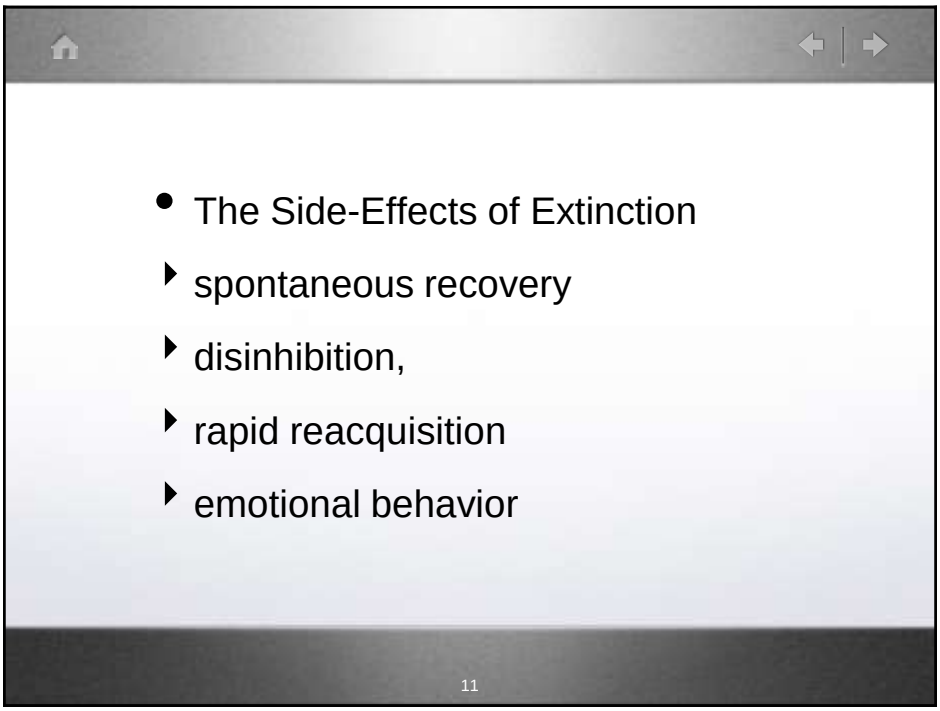
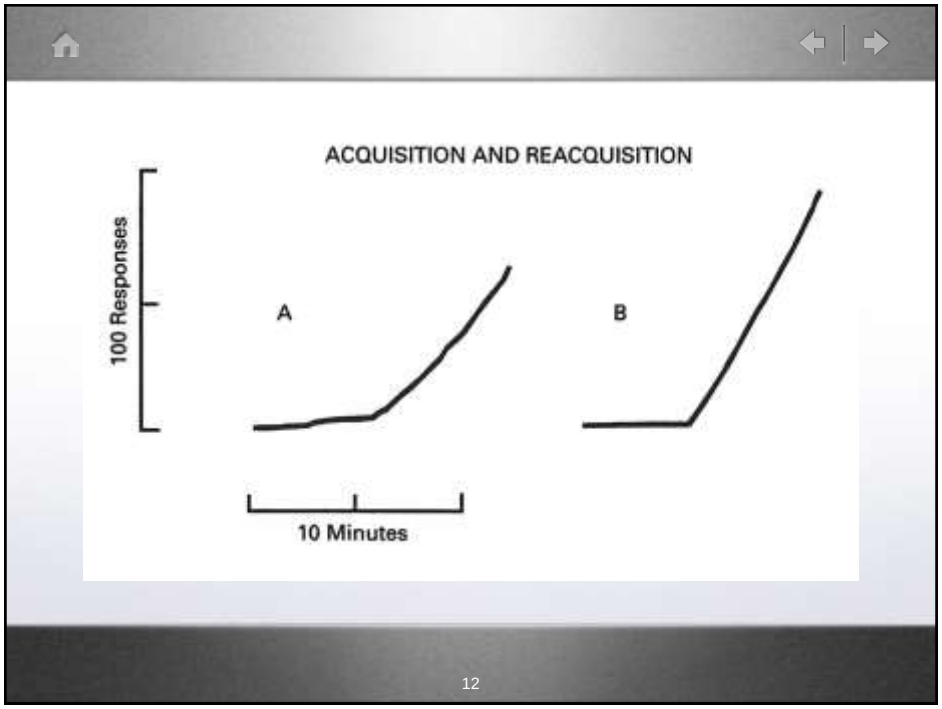
The Vocabulary of Reinforcement

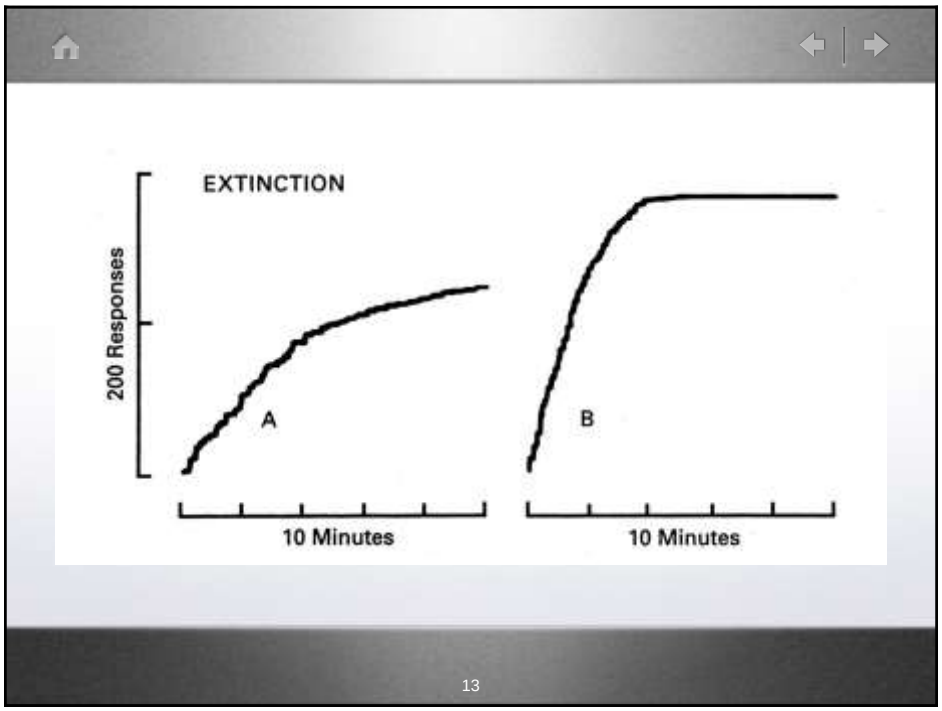
Term	*Restrictions*	*Examples*
reinforcer (noun)	A stimulus	Food pellets were used as reinforcers for the rat's lever presses
reinforcing (adjective)	A property of a stimulus	The reinforcing stimulus was presented more often than other stimuli
reinforcement (noun)	As procedure: the delivery of consequences when a response occurs	The fixed-ratio reinforcement schedule delivered food after every tenth key peck
	As outcome: the increase in responding following from the reinforcement	The experiment demonstrated reinforcement produced by social consequences
to reinforce (verb)	As procedure: to deliver consequences when a response occurs (responses are reinforced, not organisms)	When a period of free play was used to reinforce the child's completion of school work, the child's grades improved
	As outcome: to increase responding through a reinforcement procedure	The experiment showed that gold stars did not reinforce cooperative play among first-graders

9


SPONTANEOUS RECOVERY IN EXTINCTION
100 Responses
1
2
3
10 Minutes
10


The Side-Effects of Extinction
spontaneous recovery
disinhibition,
rapid reacquisition
emotional behavior
11


ACQUISITION AND REACQUISITION
100 Responses
A
B
10 Minutes
12


EXTINCTION
200 Responses
A
B
10 Minutes
10 Minutes
13

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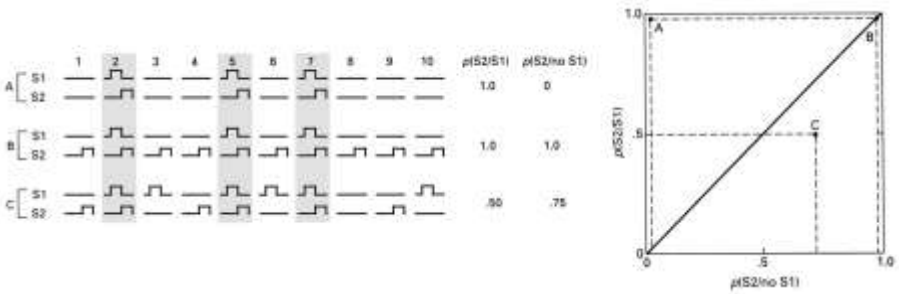
The distinction between contingencies and pairings



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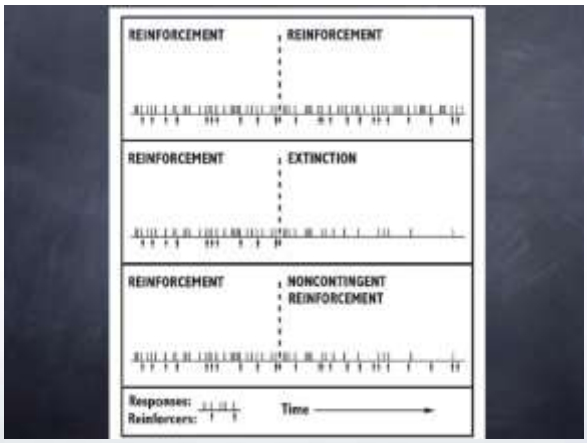
- The distinction between contingencies and pairings
  - Reinforcement
  - Extinction
  - Free or noncontingent reinforcement (NCR)

18



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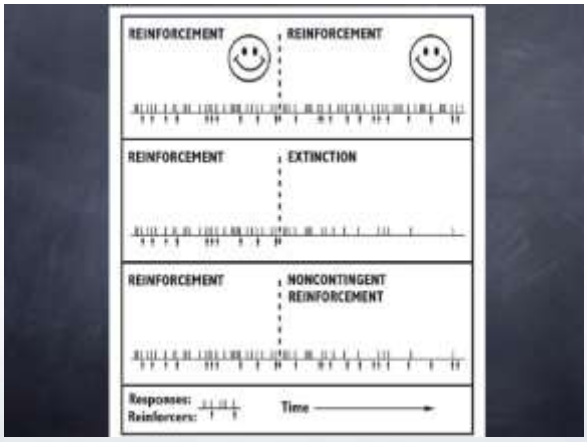
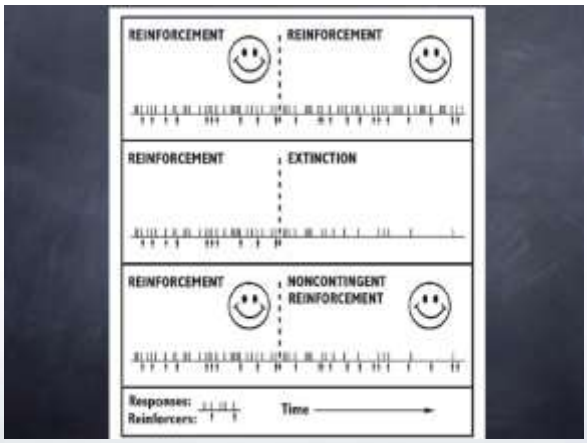

REINFORCEMENT
REINFORCEMENT
REINFORCEMENT
EXTINCTION
REINFORCEMENT
NONCONTINGENT
REINFORCEMENT
Responses:
Reinforcers:
Time

20


REINFORCEMENT
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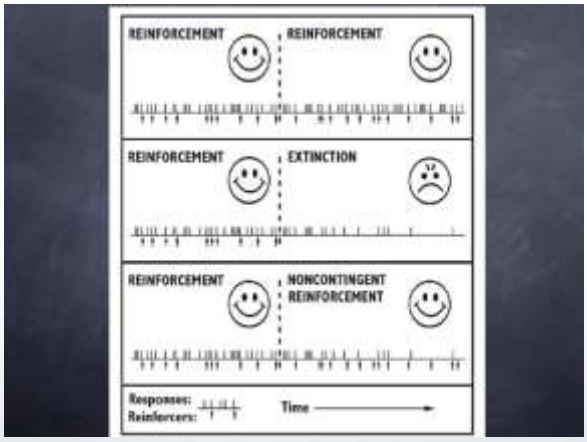
EXTINCTION
REINFORCEMENT
NONCONTINGENT
REINFORCEMENT
Responses:
Reinforcers:
Time

21


REINFORCEMENT
REINFORCEMENT
REINFORCEMENT
EXTINCTION
REINFORCEMENT
NONCONTINGENT
REINFORCEMENT
Responses:
Reinforcers:
Time

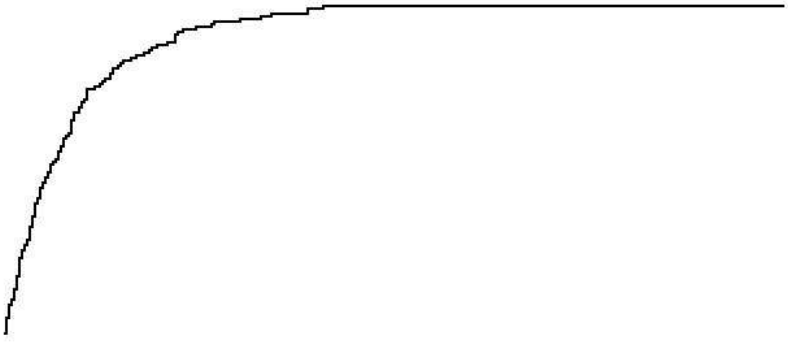
22

WINNING MAY NOT
BE EVERYTHING,
BUT LOSING
ISN'T ANYTHING!

23

EXT (a)

24



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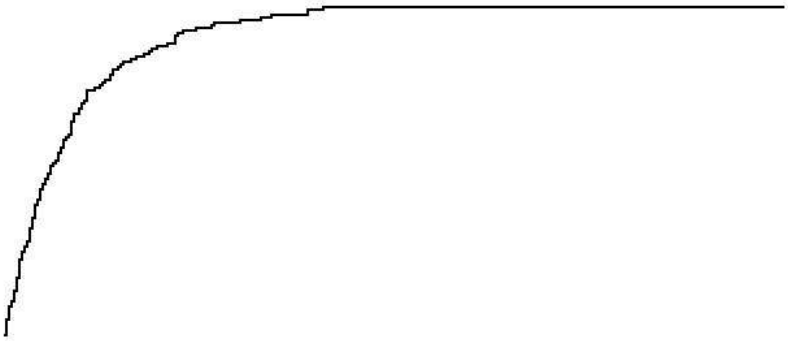

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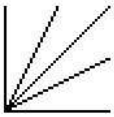
Responses: 126 0
Time (sec): 300 177
Reinforcers: 0 Reserve (max/now): 250 -1
rpm/2: 87 24 9 5 1 0 0 0 0 0



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EXT (b)

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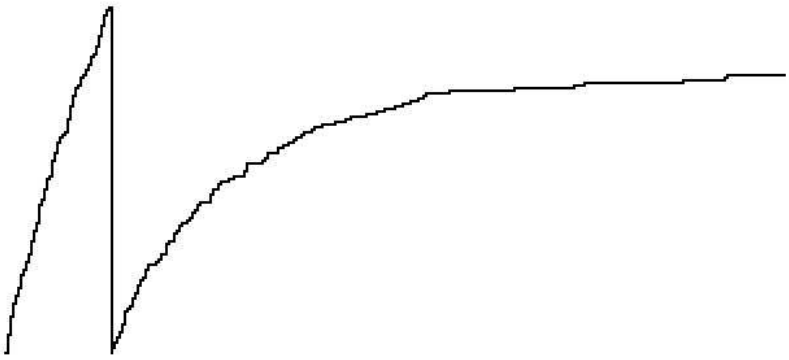

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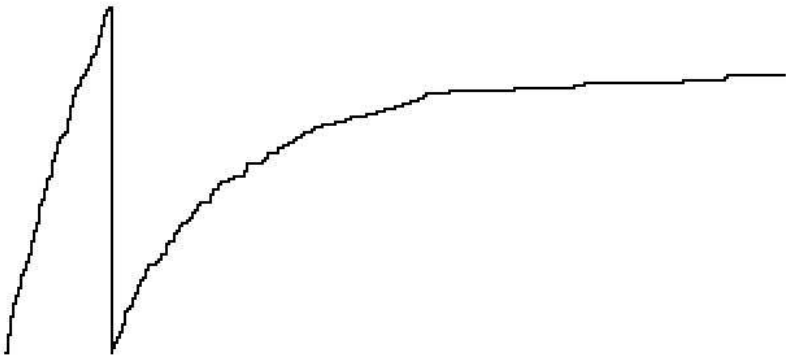

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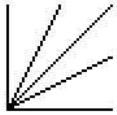
Responses: 241
Time (sec): 300
Reinforcers: 0 Reserve (max/now): 482 0
rpm/2: 106 64 32 19 7 7 1 2 1 2



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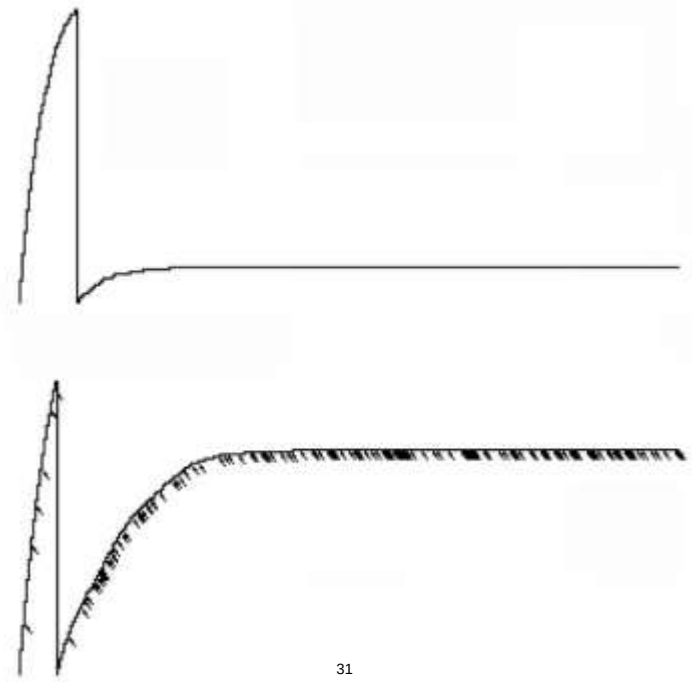
EXT / RT 20-s

30



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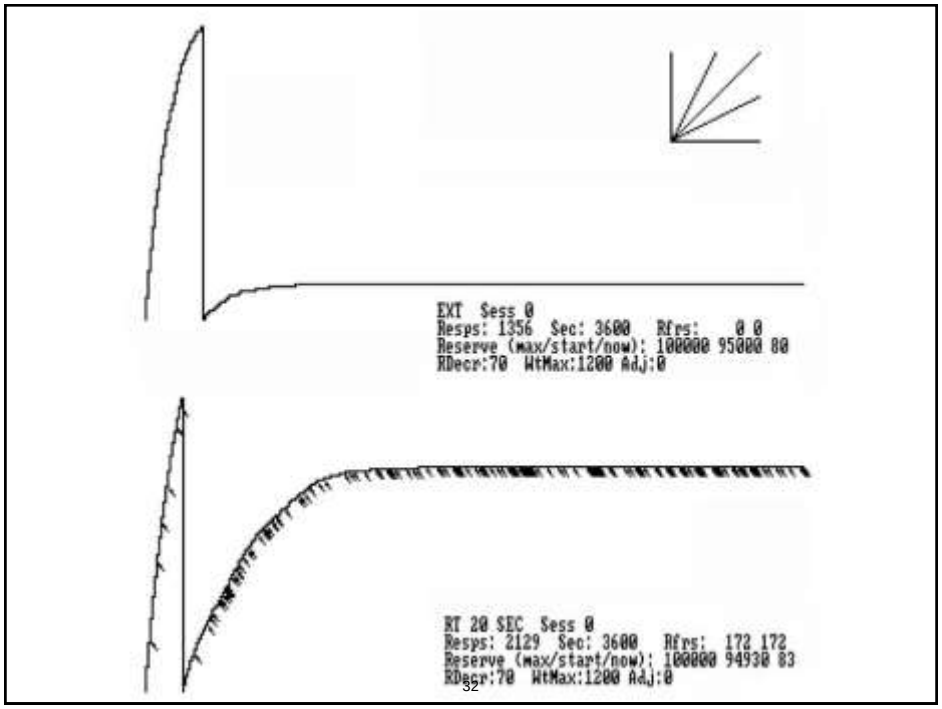
EXT Sess 0
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Reserve (max/start/now): 100000 95000 80
RDecr:70 WtMax:1200 Adj:0
RT 20 SEC Sess 0
Resps: 2129 Sec: 3600 Rfrs: 172 172
Reserve (max/start/now): 100000 94930 83
RDecr:70 WtMax:1200 Adj:0

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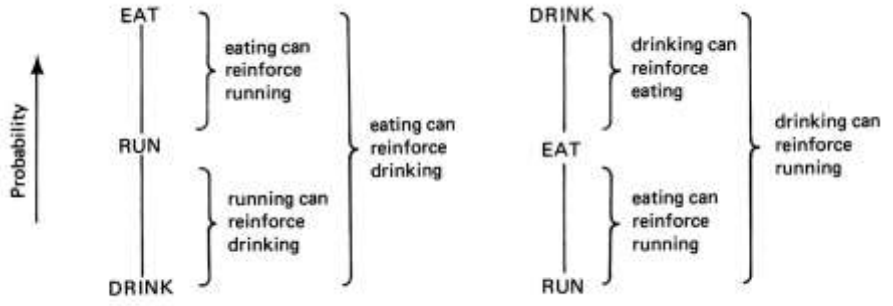

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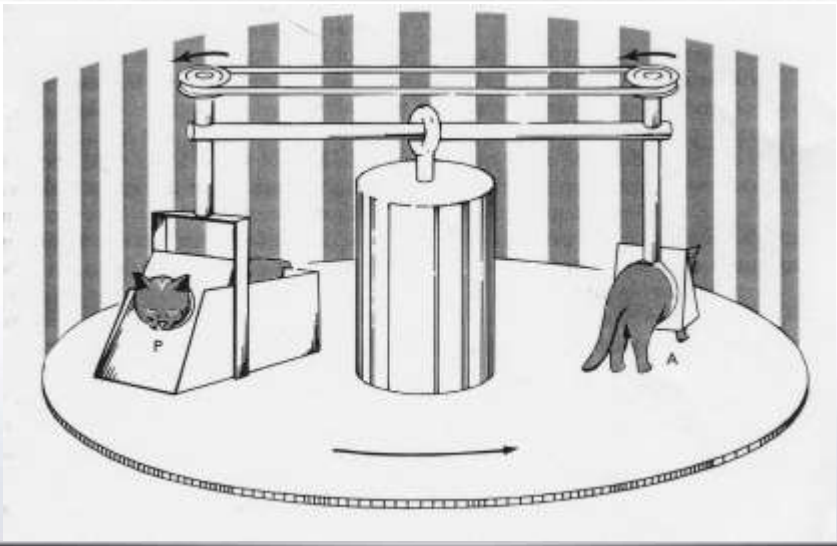
- Sensory-motor phenomena: The effects of subtle but pervasive contingencies

36



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- Sensory-motor phenomena: The effects of subtle but pervasive contingencies
- The shaping of phonetic structure in infants

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- Positive vs Negative Reinforcement
- Examples:
  - Food presentation and shock removal
  - Thirst and water reinforcers
  - Heat and cold
- Is there a behavioral criterion?

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Criteria for Distinguishing Positive and Negative Reinforcement and Punishment

	Responding Increases	*Responding Decreases*
Response Produces Stimulus	Positive Reinforcement	Positive Punishment
Response Removes or Prevents Stimulus	Negative Reinforcement	Negative Punishment

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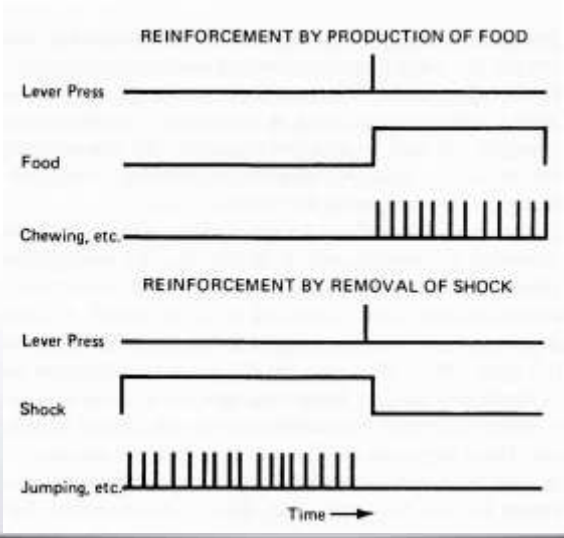

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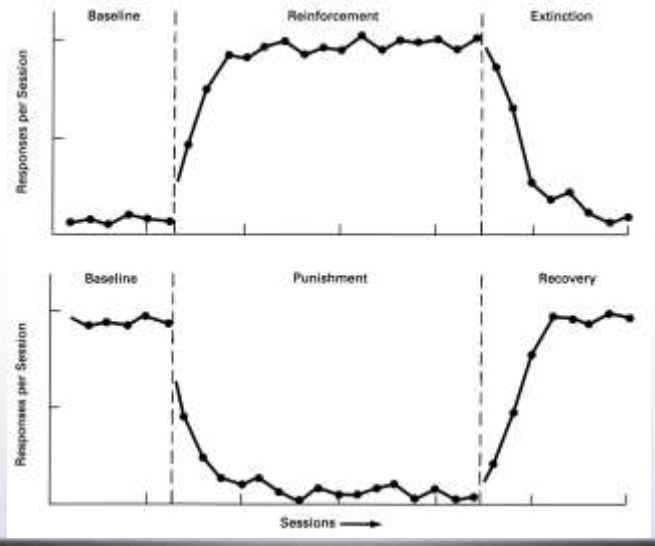
- Does punishment work?
- Criteria: Effectiveness while the contingency continues vs effectiveness after the contingency ends

47



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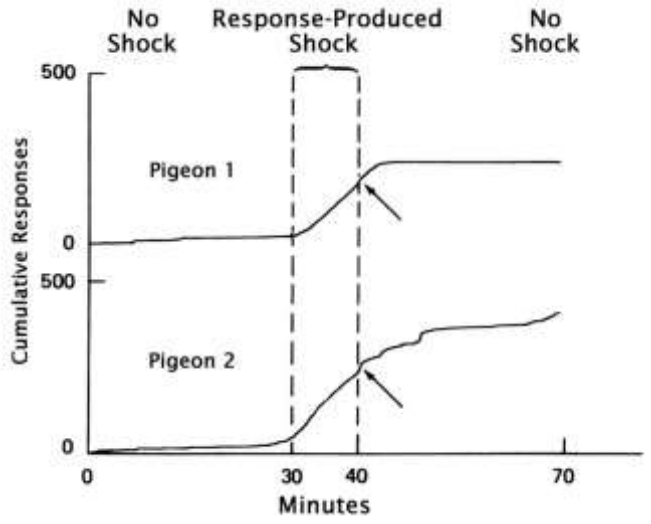
- Side-effects of punishers

49



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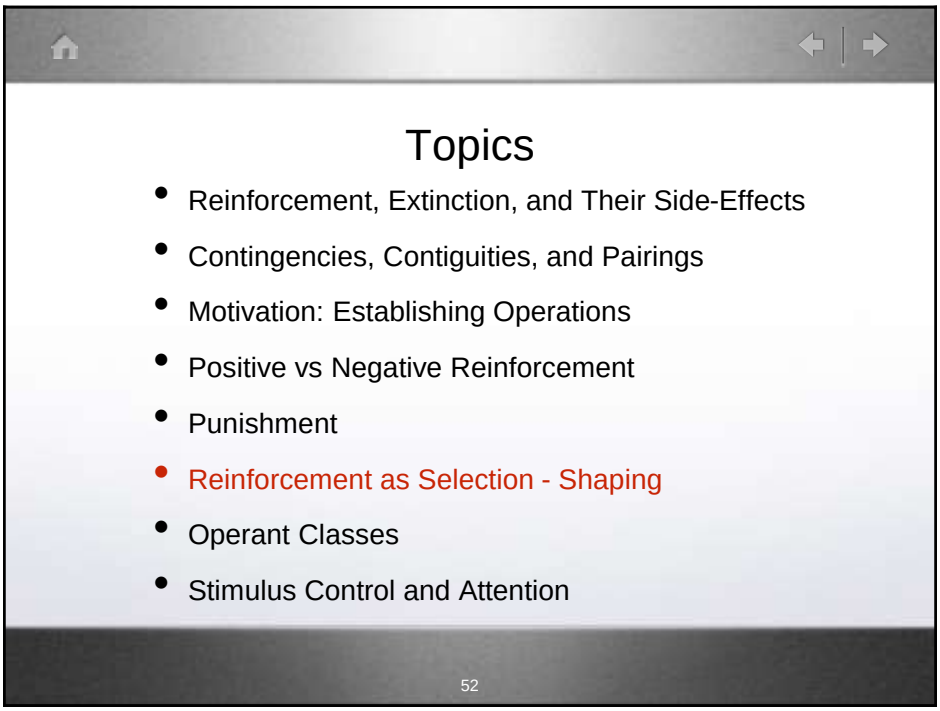
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- Evolution: Variation and Selection
  - Selection in Phylogenic and Ontogeny
  - Cultural Selection (Memetics)
- Artificial and Natural Selection

53

- Shaping as Selection

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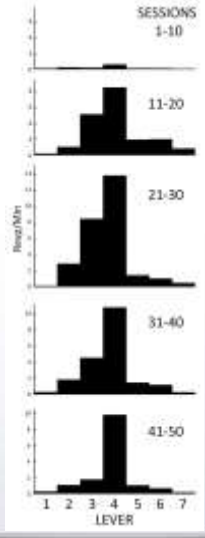

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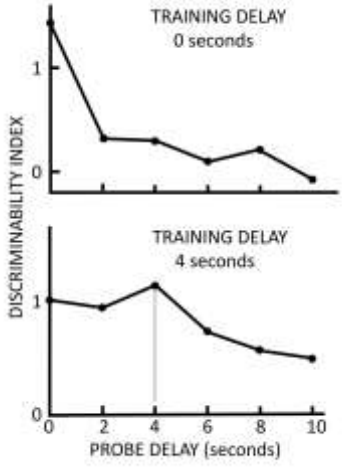
White, K. G. (2002). Psychophysics of remembering: The discrimination hypothesis. *Current Directions in Psychological Science, 11*, 141-145.



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- The selection of behavior
- Shaping as a skill and (sometimes) as an art form
- Function vs topography in the creation of operant classes
  - Lever presses and key pecks
  - SIB, attention getting and their variants
  - Higher-order classes

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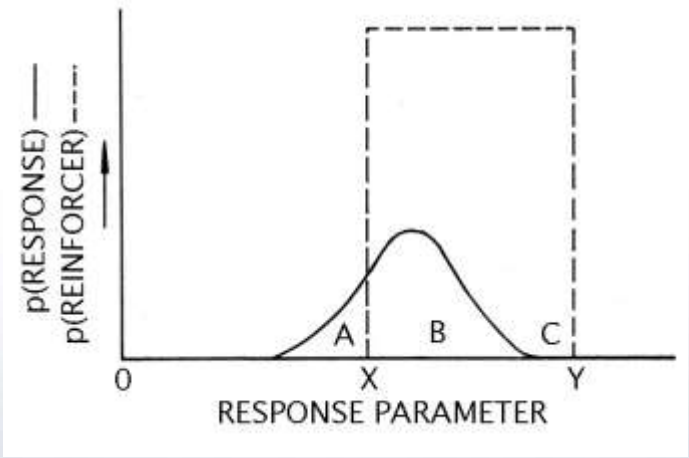

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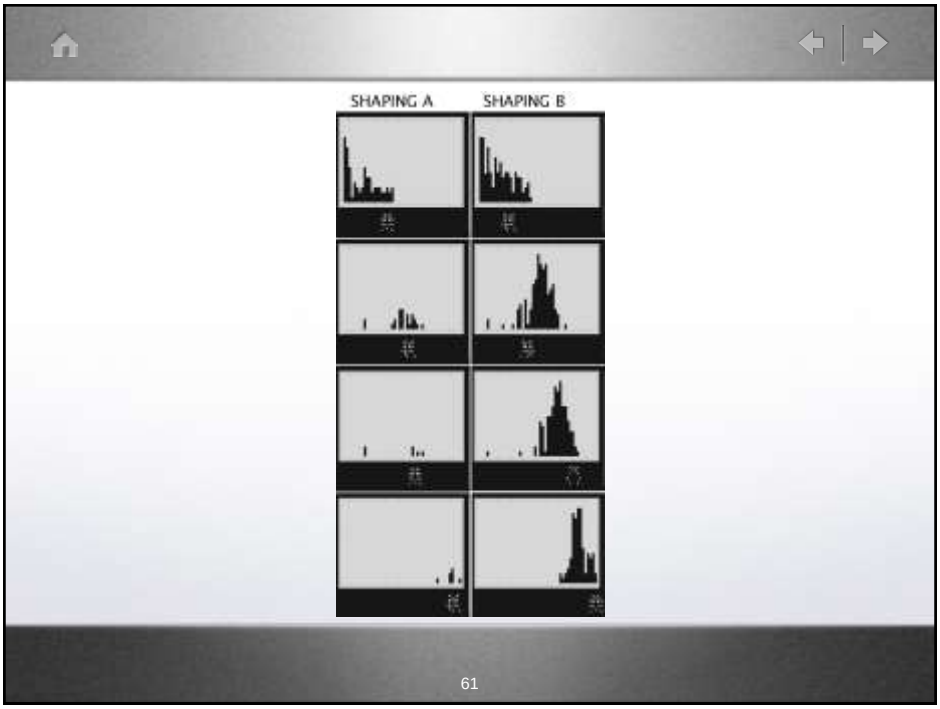
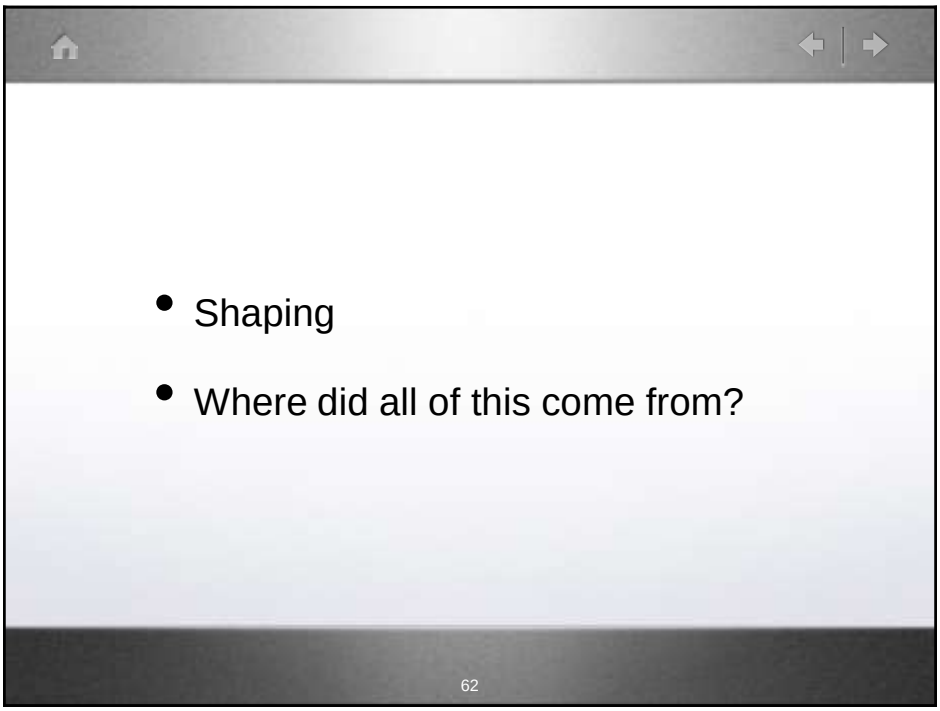

SHAPING A
SHAPING B
61


• Shaping
• Where did all of this come from?
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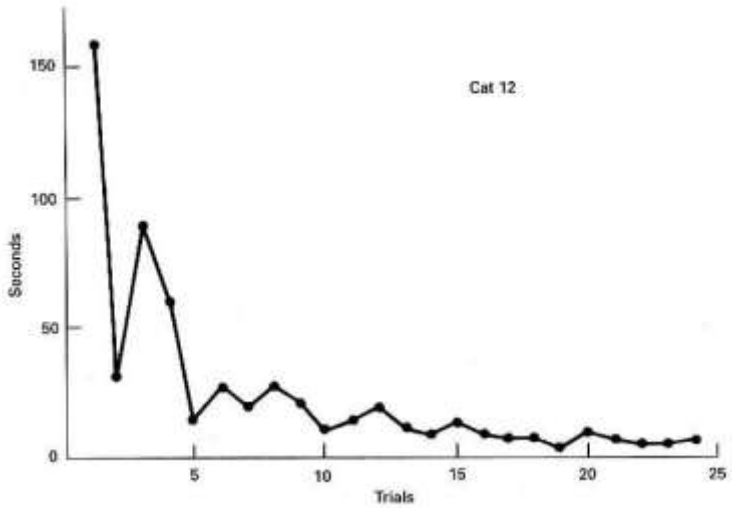

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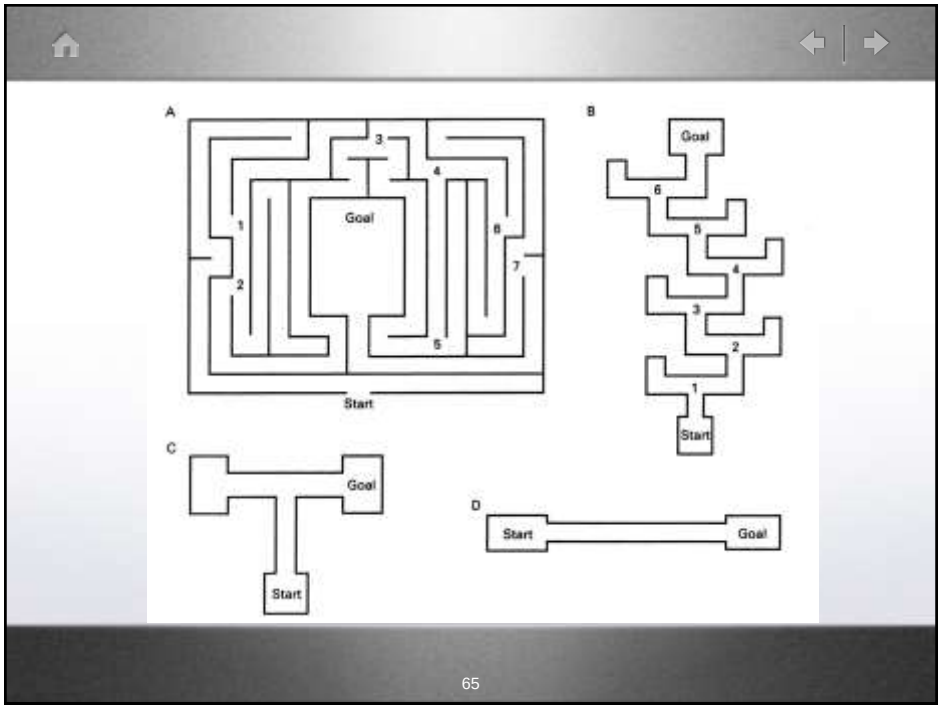

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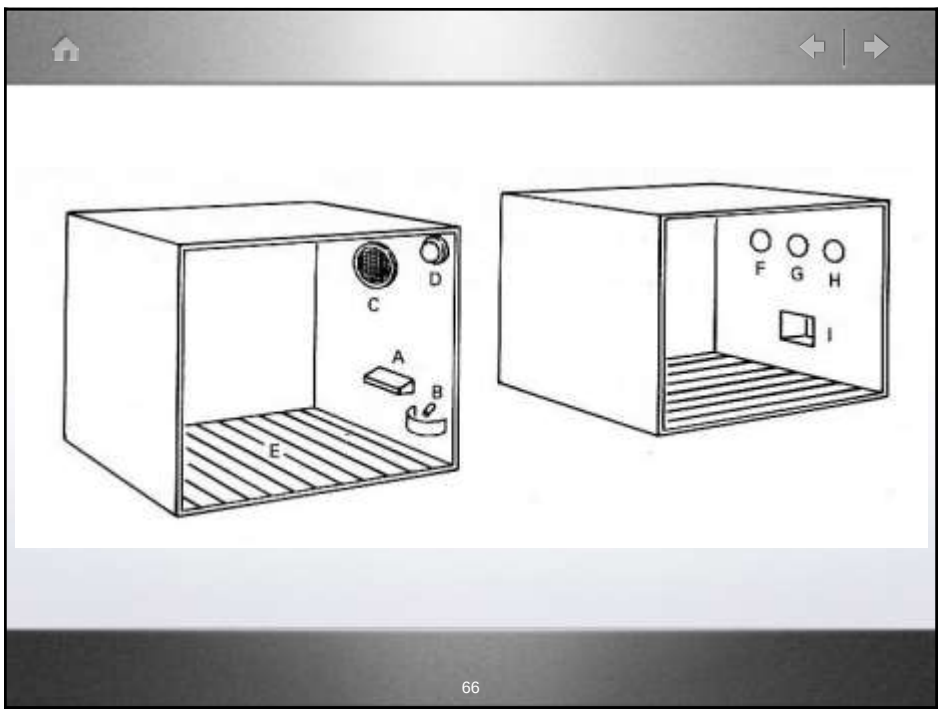

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- Why the lever press as an arbitrary class mattered

67

- Why the lever press as an arbitrary class mattered
- How about higher-order classes?
- And how about the other classes: the stimulus classes and the reinforcer classes?

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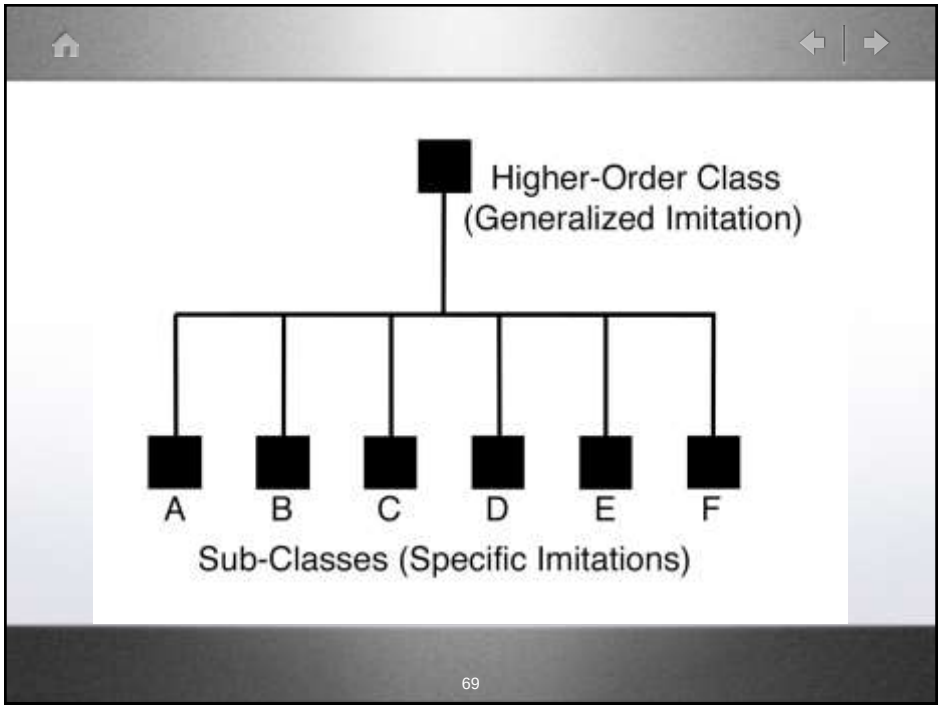

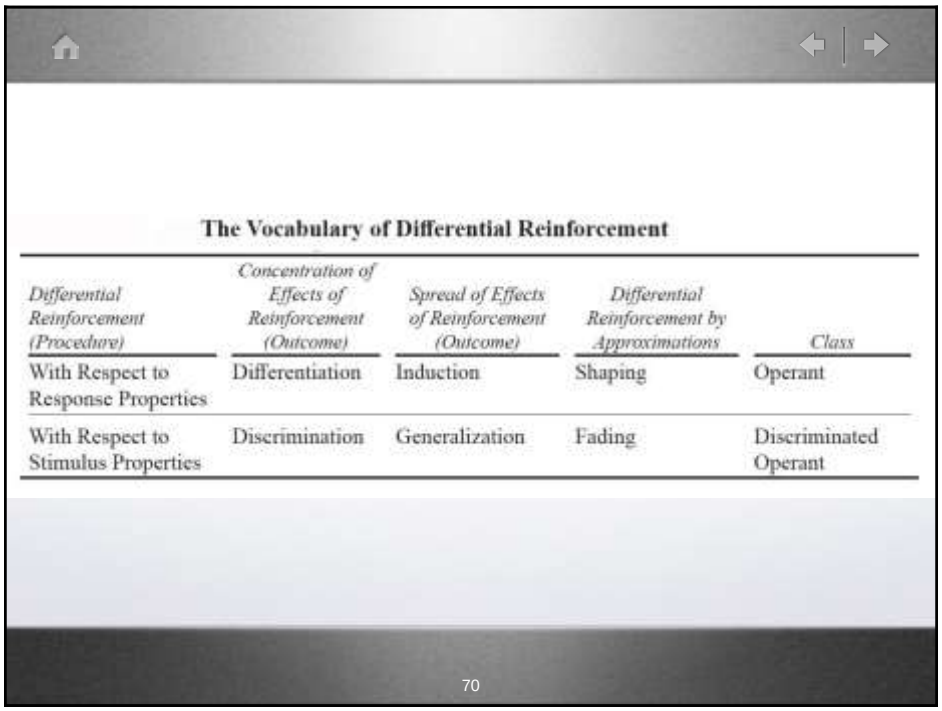

The Vocabulary of Differential Reinforcement

Differential Reinforcement (Procedure)	*Concentration of Effects of Reinforcement (Outcome)*	*Spread of Effects of Reinforcement (Outcome)*	*Differential Reinforcement by Approximations*	*Class*
With Respect to Response Properties	Differentiation	Induction	Shaping	Operant
With Respect to Stimulus Properties	Discrimination	Generalization	Fading	Discriminated Operant

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- Some Sources of Novel Behavior
  - Shaping
    - Direct reinforcement of novelty
  - Emergence based on higher-order classes
  - Adduction

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Sources of Novel Behavior

Source	*Definition*
Differential reinforcement in shaping, fading and the creation of operants	Creating new behavior by differentially reinforcing approximations to a new response or a new stimulus class; creating new behavior by reinforcing novel instances defined relative to the populations of which they are members
Emergence based on higher-order classes	Setting the occasion for new instances of the members of higher-order classes, including extensions of equivalence classes and frames
Combining behavior classes: adduction, transfer of function and their variations	Bringing the properties or members of different classes together in new ways; combining multiple sources of behavior so new functional classes emerge

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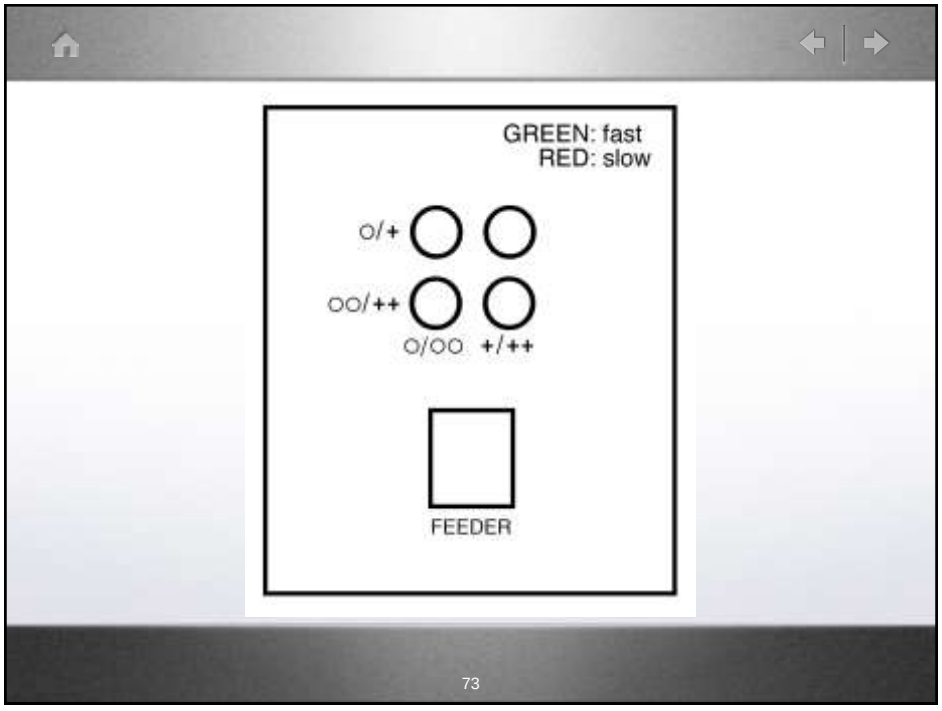
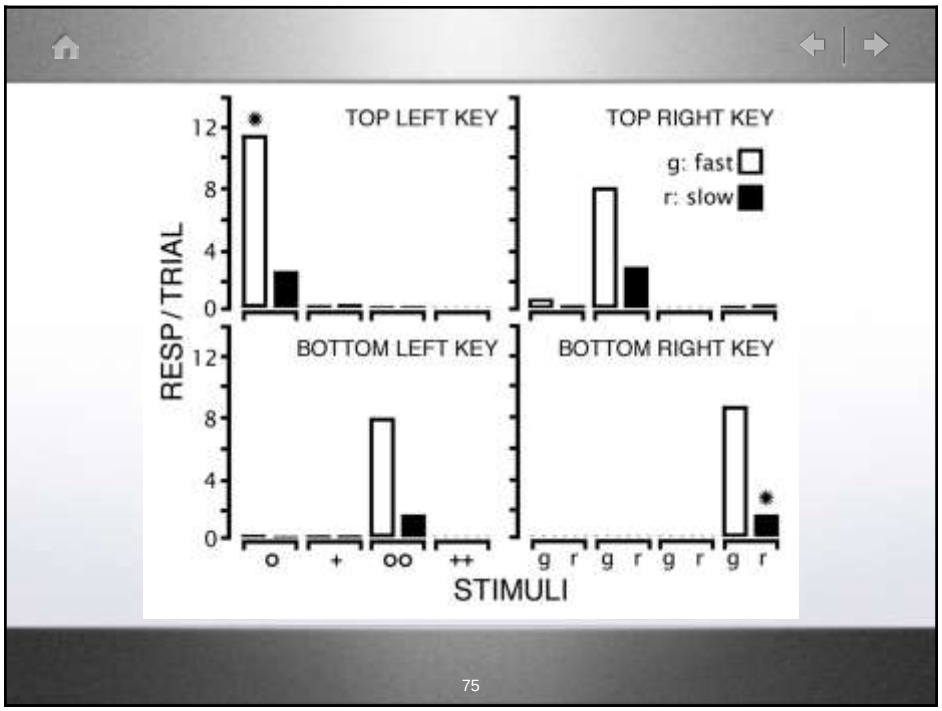

GREEN: fast
RED: slow
O/+
OO/++
O/OO
+/++
FEEDER
73


TOP LEFT KEY
TOP RIGHT KEY
g: fast
r: slow
BOTTOM LEFT KEY
BOTTOM RIGHT KEY
RESP / TRIAL
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+
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g r g r g r g r
STIMULI
75

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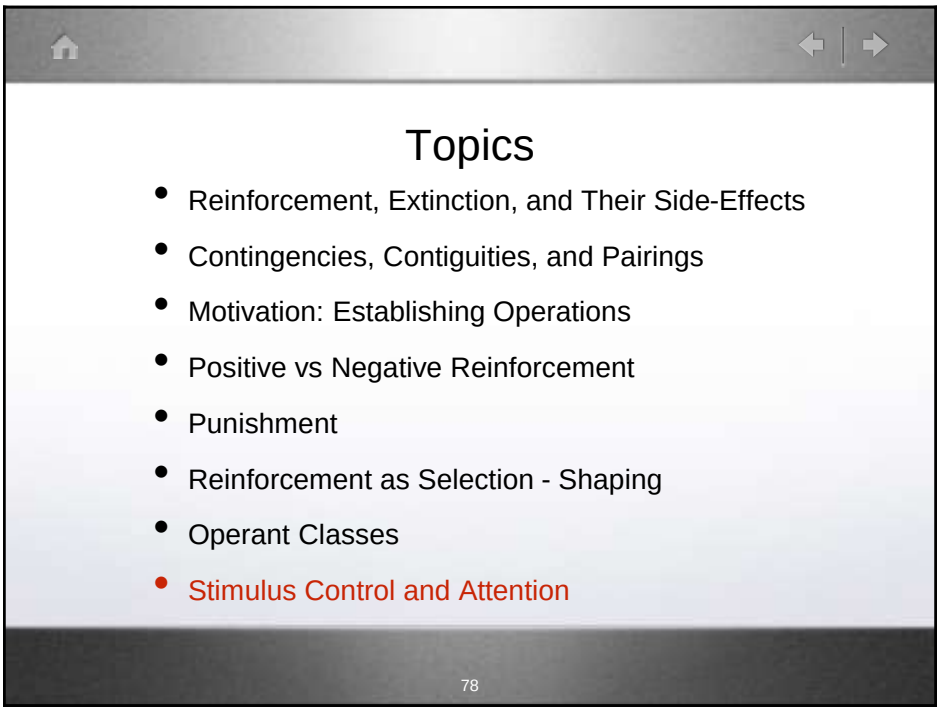
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- Stimulus control (discrimination)
- What is the role of attention?
- Should we look at the stimuli or at the behavior?

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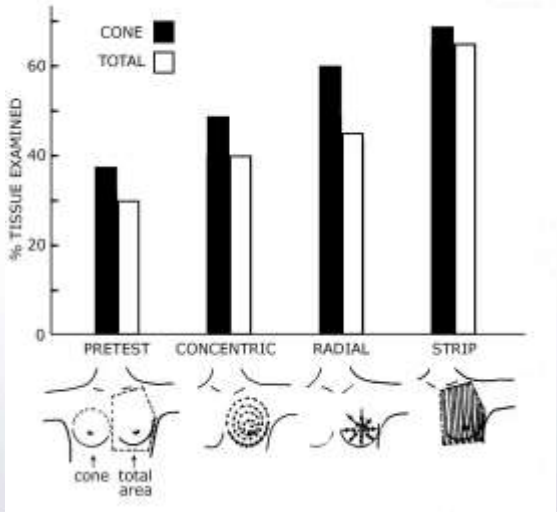

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Signal-Detection Contingencies in Breast Self-examination

	A lump is there	*No lump is there*
"Yes, a lump"	Hit (Correct Positive)	False Alarm (False Positive)
"No lump"	Miss (False Negative)	Correct Rejection (Correct Negative)

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The Three-Term Contingency

In presence of S1, R1 may produce C1

In presence of S2, R2 may produce C2

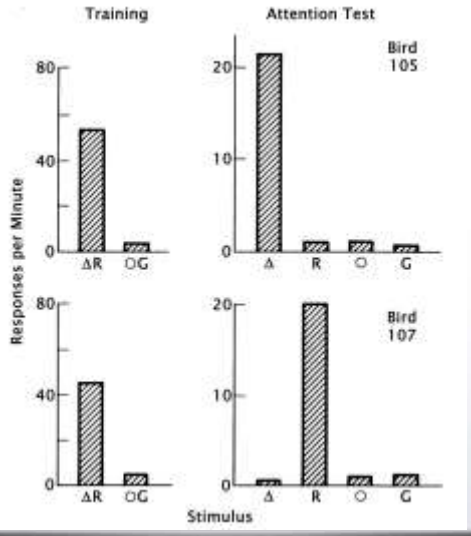
S = Stimulus

R = Response

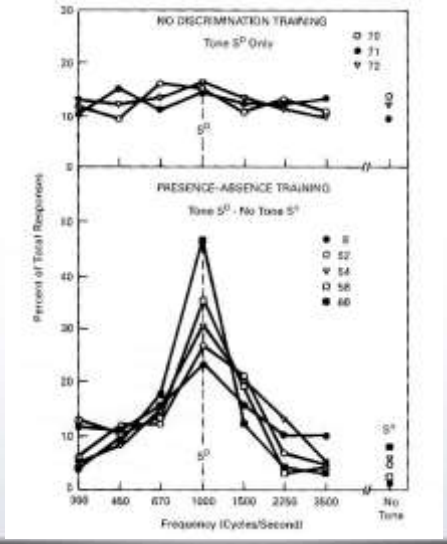
C= Consequence

When R1 in presence of S1 differs from R2 in presence of S2, we say that the individual discriminates S1 from S2.

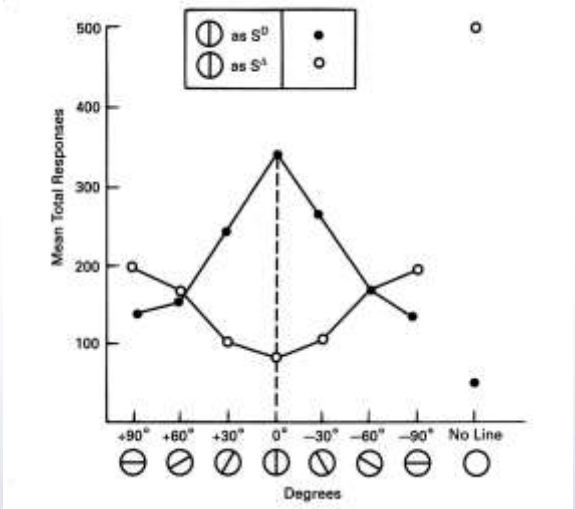
82


Training
Attention Test
Bird 105
Bird 107
Responses per Minute
80
40
0
20
10
ΔR
○G
Δ
R
○
G
Stimulus

83


NO DISCRIMINATION TRAINING
Tone S^D Only
70
71
72
S^D
PRESENCE-ABSENCE TRAINING
Tone S^D - No Tone S$^\Delta$
Percent of Total Responses
50
40
30
20
10
0
990
460
670
1000
1500
2250
3500
No Tone
Frequency (Cycles/Second)

84

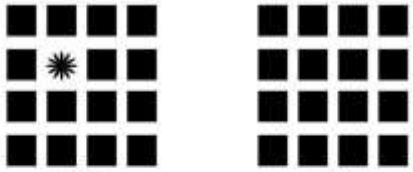


85

The Feature-Positive vs Feature-Negative Experiment

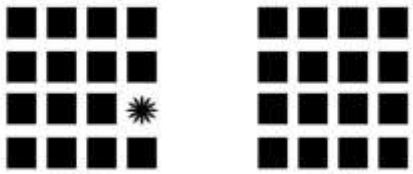
86

FEATURE POSITIVE



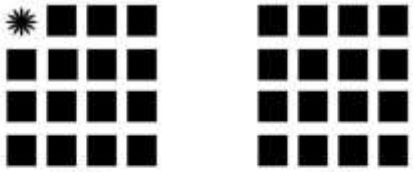
87

FEATURE POSITIVE



88

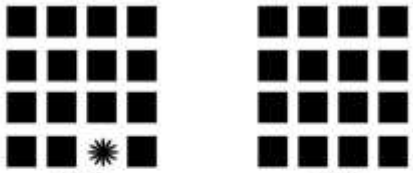
FEATURE POSITIVE



RFT EXT

89

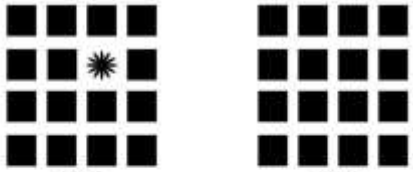
FEATURE POSITIVE



RFT EXT

90

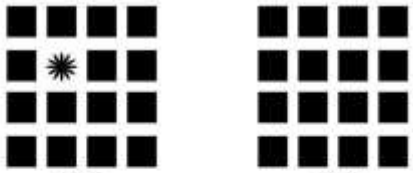
FEATURE POSITIVE



RFT EXT

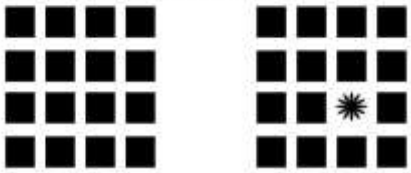
91

FEATURE POSITIVE



RFT EXT

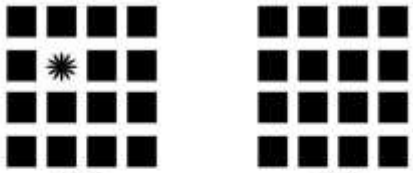
FEATURE NEGATIVE



RFT EXT

92

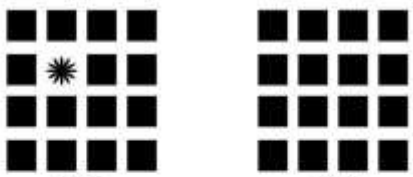
FEATURE POSITIVE



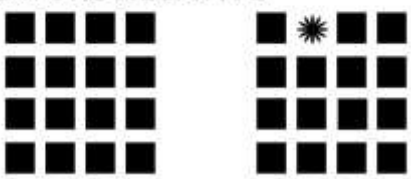
FEATURE NEGATIVE

93

FEATURE POSITIVE

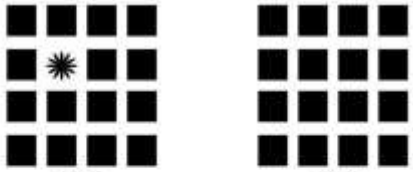


FEATURE NEGATIVE



94

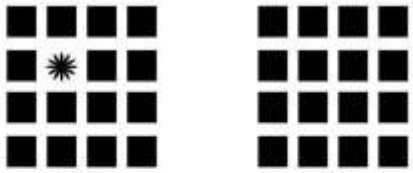
FEATURE POSITIVE



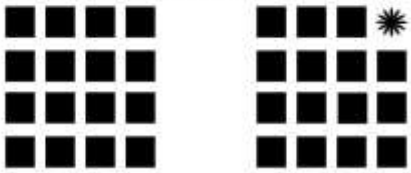
FEATURE NEGATIVE

95

FEATURE POSITIVE



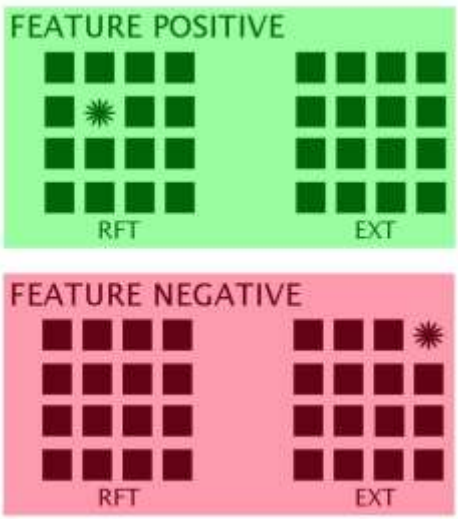
FEATURE NEGATIVE



96

Creating a Conditional Discrimination

97



98

Observing Response Procedures

- Two pigeon keys:
  - The schedule key, on which pecks may produce food
  - The observing key, on which pecks do not produce food but may change whether relevant stimuli are available on the schedule key

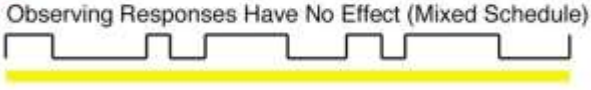
99

RFT or EXT

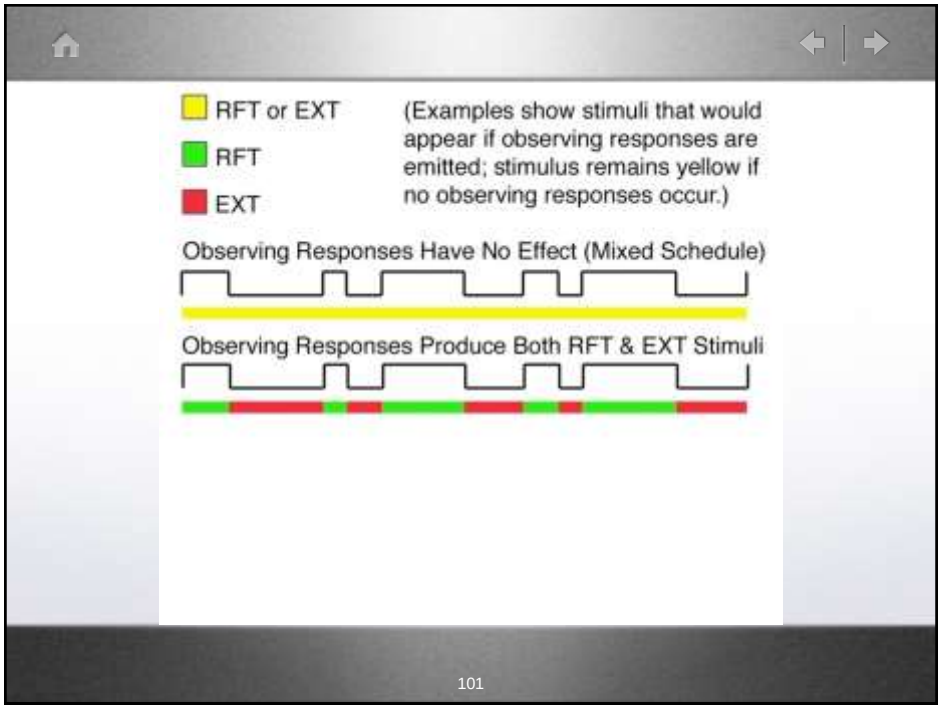
RFT

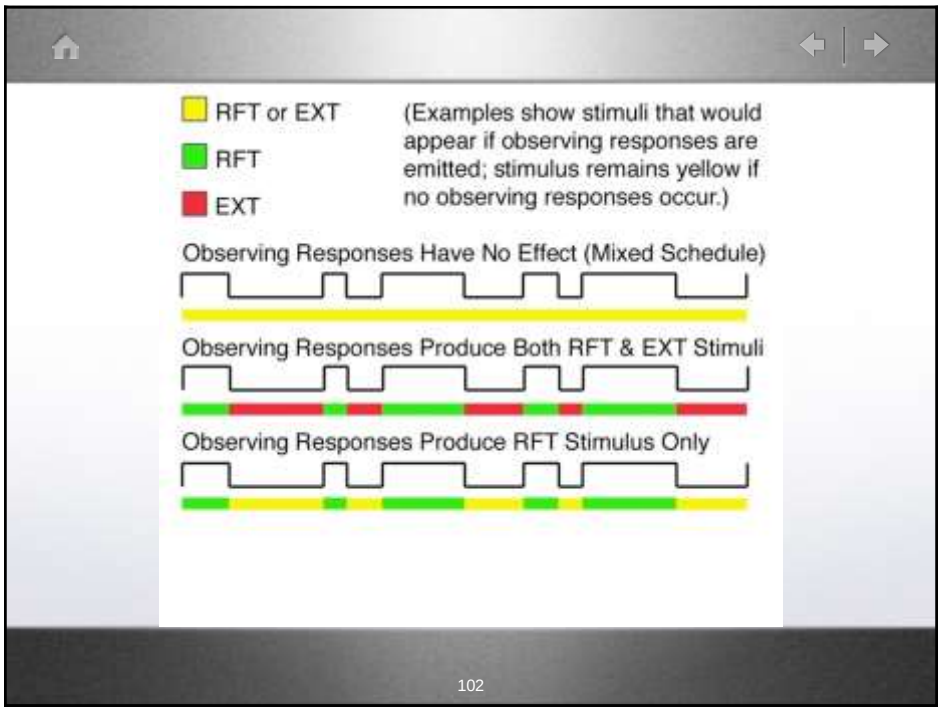
EXT

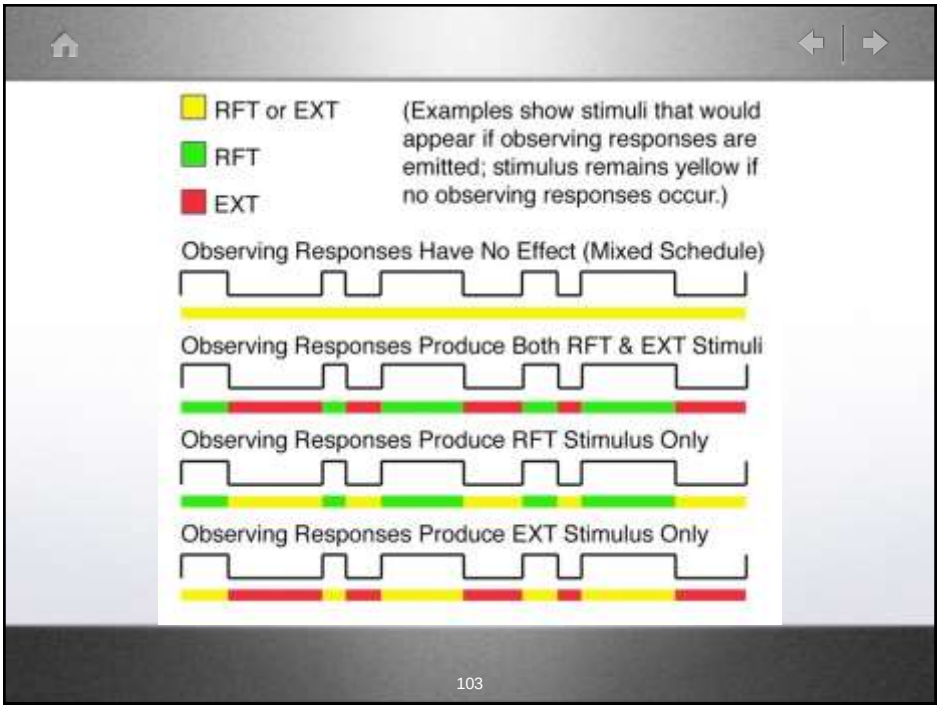
Observing Responses Have No Effect (Mixed Schedule)



100


RFT or EXT
RFT
EXT
(Examples show stimuli that would appear if observing responses are emitted; stimulus remains yellow if no observing responses occur.)
Observing Responses Have No Effect (Mixed Schedule)
Observing Responses Produce Both RFT & EXT Stimuli
101


RFT or EXT
RFT
EXT
(Examples show stimuli that would appear if observing responses are emitted; stimulus remains yellow if no observing responses occur.)
Observing Responses Have No Effect (Mixed Schedule)
Observing Responses Produce Both RFT & EXT Stimuli
Observing Responses Produce RFT Stimulus Only
102

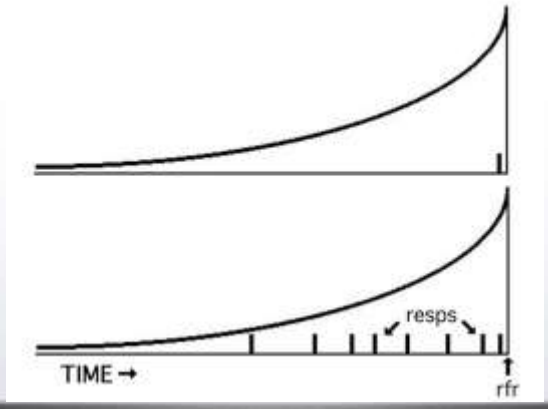

RFT or EXT
RFT
EXT
(Examples show stimuli that would appear if observing responses are emitted; stimulus remains yellow if no observing responses occur.)
Observing Responses Have No Effect (Mixed Schedule)
Observing Responses Produce Both RFT & EXT Stimuli
Observing Responses Produce RFT Stimulus Only
Observing Responses Produce EXT Stimulus Only
103

104

- Terminological issues in the language of stimulus control
  - The vocabularies of corrects and errors
    - The role of delayed reinforcement

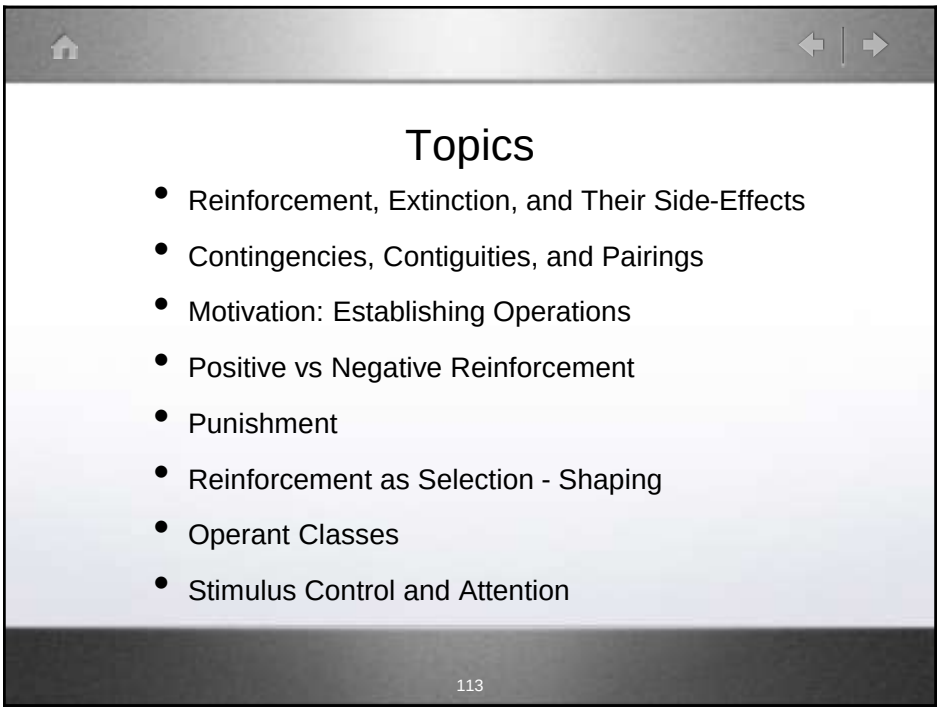
105

The relation between reinforcers and responses that precede them: at the top, only one response is followed by a reinforcer; at the bottom, many are followed, at different delays. Thus, the effect of the reinforcer is larger.



106

112



Topics

- Reinforcement, Extinction, and Their Side-Effects
- Contingencies, Contiguities, and Pairings
- Motivation: Establishing Operations
- Positive vs Negative Reinforcement
- Punishment
- Reinforcement as Selection - Shaping
- Operant Classes
- Stimulus Control and Attention

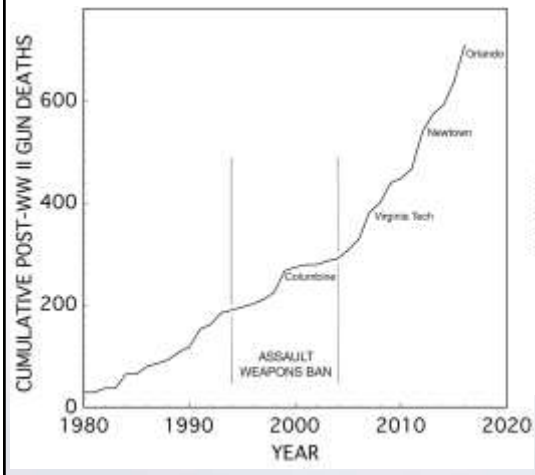
113

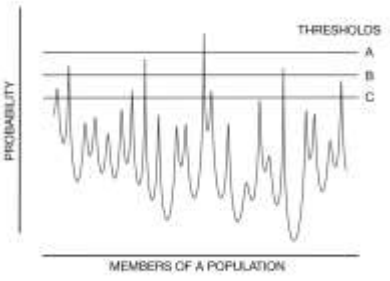
- Circular reasoning in everyday accounts of the causes of behavior
  - Attitudes
  - The language of emotions and feelings
    - Anger as a cause of behavior
    - Skinner's pecking order demonstration

115

- Multiple Causation
  - An example from Verbal Behavior: ordering at the fast food counter
    - lunchtime as establishing operation; sights and smells of food occasioning tacts; menus occasioning textual behavior; orders placed by others occasioning echoic behavior; server as audience occasioning manding; ....

116


CUMULATIVE POST-WW II GUN DEATHS
0
200
400
600
1980
1990
2000
2010
2020
YEAR
ASSAULT WEAPONS BAN
Columbine
Virginia Tech
Newtown
Orlando


PROBABILITY
THRESHOLDS
A
B
C
MEMBERS OF A POPULATION

117

118

- NOTE FOR ONLINE VIEWERS:
- SLIDES PAST THIS POINT ARE ABOUT OPTIONAL TOPICS THAT PROBABLY WOULD NEED MORE TIME THAN AVAILABLE FOR THE MAIN WORKSHOP.

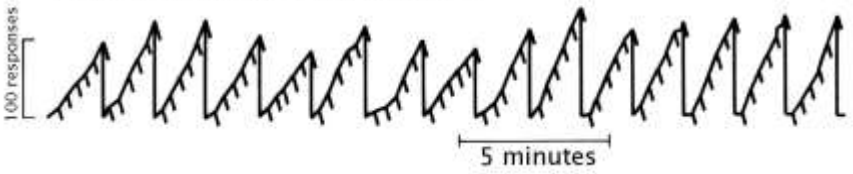
119

- Issues of behavior chains and extended sequences of behavior
- Chains vs chunks

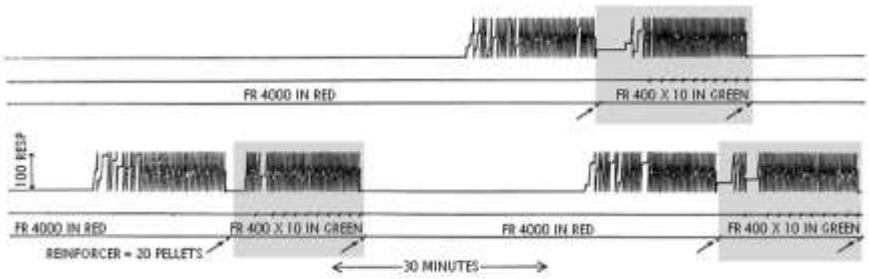
120

Chain (FI 15-s) x 6 (6 key colors in constant order)

Tandem (FI 15-s) x 6 (vertical lines)



121



122

BEHAVIOR CHAINS VS EXTENDED BEHAVIOR SEQUENCES: CHAINS VS CHUNKS

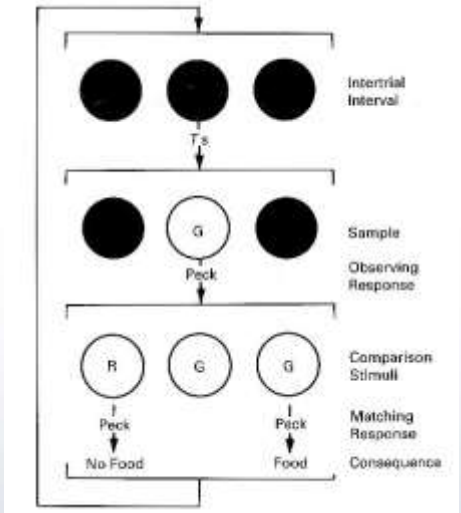
- How to decide:
  - Can sequences in which one response produces a discriminative stimulus that occasions the next one be identified?
  - This is not an issue of whether sequences are all chains or all chunks. Instead, given a behavior sequence, which kind is it?

123

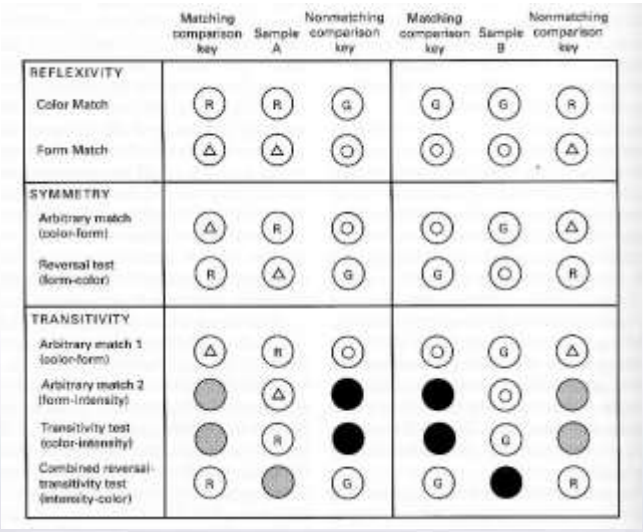
124

- Reinforcer classes in three-term contingencies
- Matching-to-sample as an example

125



126

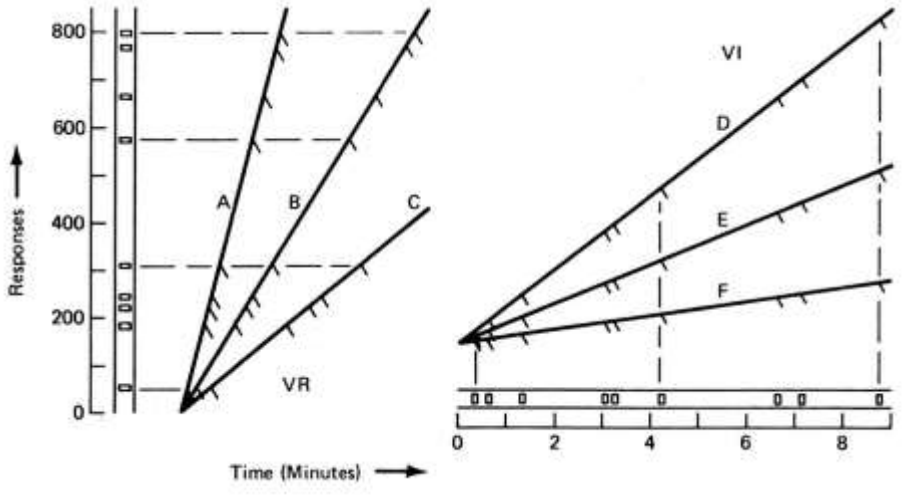

Matching comparison key
Sample A
Nonmatching comparison key
Matching comparison key
Sample B
Nonmatching comparison key
REFLEXIVITY
Color Match
Form Match
SYMMETRY
Arbitrary match (color-form)
Reversal test (form-color)
TRANSITIVITY
Arbitrary match 1 (color-form)
Arbitrary match 2 (form-intensity)
Transitivity test (color-intensity)
Combined reversal-transitivity test (intensity-color)

127

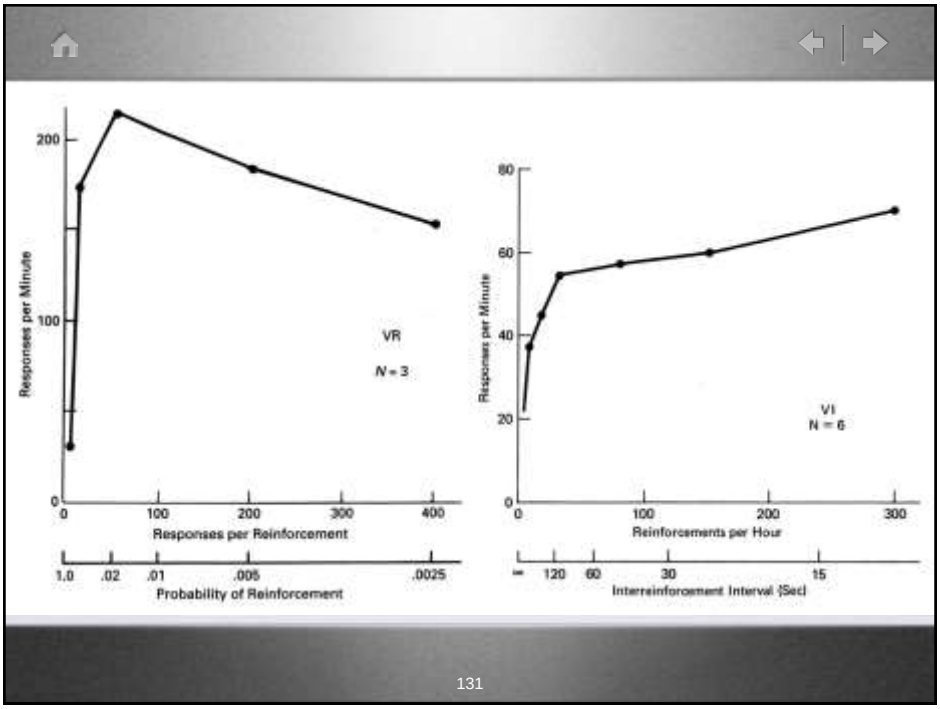
128

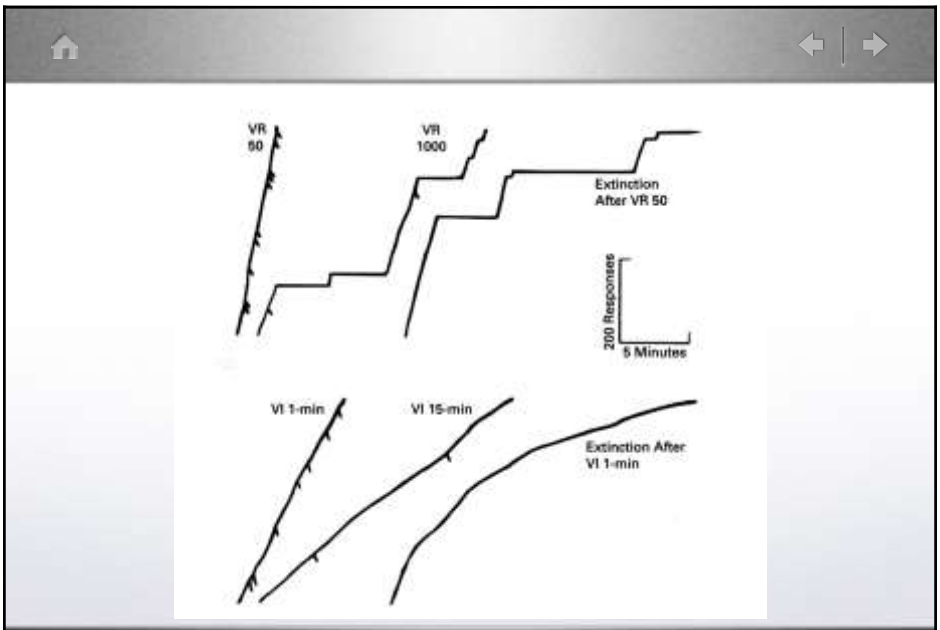
- Intermittent Reinforcement
  - Variable and fixed ratio and interval contingencies
    - VR, FR, VI, FI
  - Temporal contingencies
    - DRL, DRH, DRO and their variations

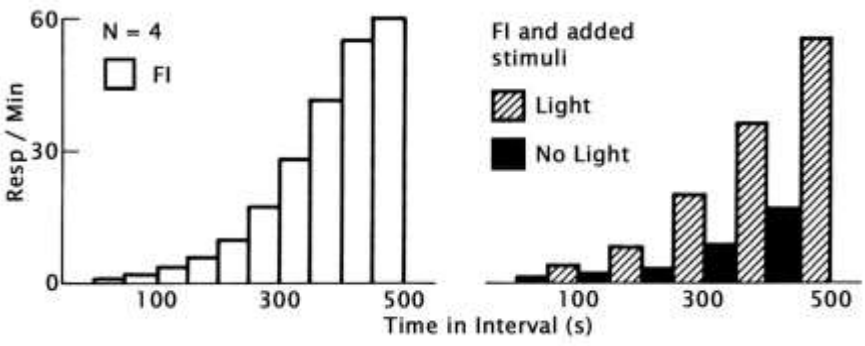
129



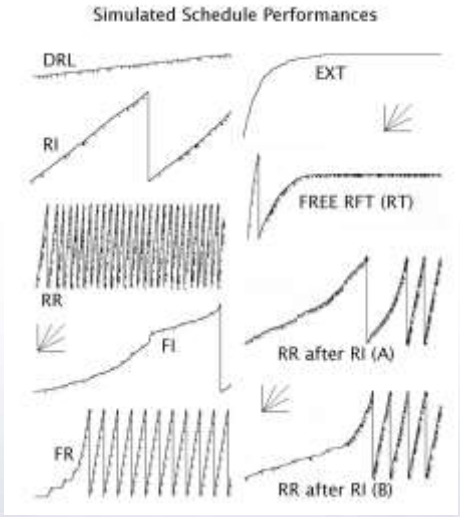
130


Responses per Minute
200
100
0
VR
N = 3
0
100
200
300
400
Responses per Reinforcement
1.0
.02
.01
.005
.0025
Probability of Reinforcement
Responses per Minute
80
60
40
20
0
VI
N = 6
0
100
200
300
Reinforcements per Hour
∞
120
60
30
15
Interreinforcement Interval (Sec)


VR
50
VR
1000
Extinction
After VR 50
200 Responses
5 Minutes
VI 1-min
VI 15-min
Extinction After
VI 1-min


60
30
0
Resp / Min
N = 4
FI
100
300
500
FI and added stimuli
Light
No Light
100
300
500
Time in Interval (s)

152


Simulated Schedule Performances
DRL
RI
RR
FI
FR
EXT
FREE RFT (RT)
RR after RI (A)
RR after RI (B)

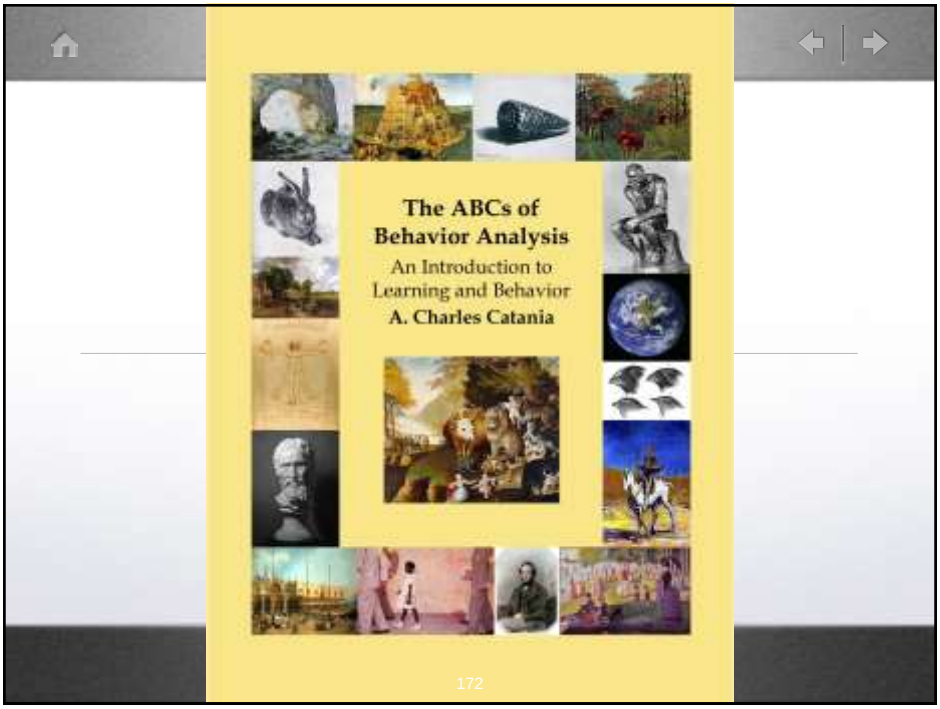
158

SCHEDULE COMBINATIONS

- Multiple and mixed
- Chained and tandem
  - Concurrent
    - Concurrent chains
- and many others....

159

171


The ABCs of
Behavior Analysis
An Introduction to
Learning and Behavior
A. Charles Catania
172

173