CHAPTER 9

Functional Relationships Between Arbitrary Stimuli and Fixed Responses: "Reflex Conditioning"

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(1) instantaneous
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(3) medium
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   1. procedure and behavior
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         i. instantaneous
         ii. short
         iii. medium
         iv. long
      b. population context
      c. cellular machinery
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      a. Pavlov's theory
         i. supporting evidence
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      a. determinants of behavior
         i. instantaneous
         ii. short
         iii. medium
         iv. long
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   3. explanatory perspective
      a. determinants of behavior
         i. instantaneous
         ii. short
         iii. medium
         iv. long
      b. population context
      c. cellular machinery

4. conceptual and cognitive metaphors

D. Behavior system as a determinants of the CR
   1. procedure and behavior
   2. illustrative research
   3. explanatory perspective
      a. determinants of behavior
         i. instantaneous
         ii. short
         iii. medium
         iv. long
      b. population context
      c. cellular machinery
   4. conceptual and cognitive metaphors

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         i. procedure and behavior
         ii. illustrative research
         iii. explanatory perspective
            (1) correlative determinants
            (2) population context
            (3) cellular machinery
         iv. conceptual and cognitive metaphors
            (1) competing conditioning
            (2) salience reduction
            (3) learned irrelevance
            (4) reproductive utility
      b. familiarity of US
         i. procedure and behavior
         ii. illustrative research
         iii. explanatory perspective
            (1) correlative determinants
            (2) population context
            (3) cellular machinery
         iv. conceptual and cognitive metaphors
            (1) competing conditioning
            (2) salience reduction
            (3) learned irrelevance
            (4) reproductive utility
      c. intensity of CS and US

i. procedure and behavior
ii. illustrative research
iii. explanatory perspective
(1) correlative determinants
(2) population context
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(1) salience reduction
(2) connection strength

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e. relative strength of CS and US
i. procedure and behavior
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iii. explanatory perspective
(1) correlative determinants
(2) population context
(3) cellular machinery
iv. conceptual and cognitive metaphors

f. motivation
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ii. illustrative research
iii. explanatory perspective
(1) correlative determinants
(2) population context
(3) cellular machinery
iv. conceptual and cognitive metaphors

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ii. illustrative research
iii. explanatory perspective
(1) correlative determinants
(2) population context
(3) cellular machinery
iv. conceptual and cognitive metaphors

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(1) correlative determinants
(2) population context
(3) cellular machinery
iv. conceptual and cognitive metaphors

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a. retraining
i. procedure and behavior
ii. illustrative research
iii. explanatory perspective
(1) correlative determinants
(2) population context
(3) cellular machinery
iv. conceptual and cognitive metaphors
2. manipulation during testing
a.
i. procedure and behavior
ii. illustrative research
iii. explanatory perspective
(1) correlative determinants
(2) population context
(3) cellular machinery
iv. conceptual and cognitive metaphors
(1) competing conditioning

C. Effects of long-term manipulations
a.
i. procedure and behavior
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(1) correlative determinants
(2) population context
(3) cellular machinery
iv. conceptual and cognitive metaphors

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A. Cellular manipulations
1. substance effects
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i. determinants of behavior
(1) instantaneous
(2) short
(3) medium
(4) long
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2. mechanical effects
a. procedure and behavior
b. illustrative research
c. explanatory perspective
i. determinants of behavior
(1) instantaneous
(2) short
(3) medium
(4) long
ii. population context
iii. cellular machinery
d. conceptual and cognitive metaphors

B. Population exposure manipulations
1.
a. procedure and behavior
b. illustrative research
c. explanatory perspective
i. determinants of behavior
(1) instantaneous
(2) short
(3) medium
(4) long
ii. population context
iii. cellular machinery
d. conceptual and cognitive metaphors

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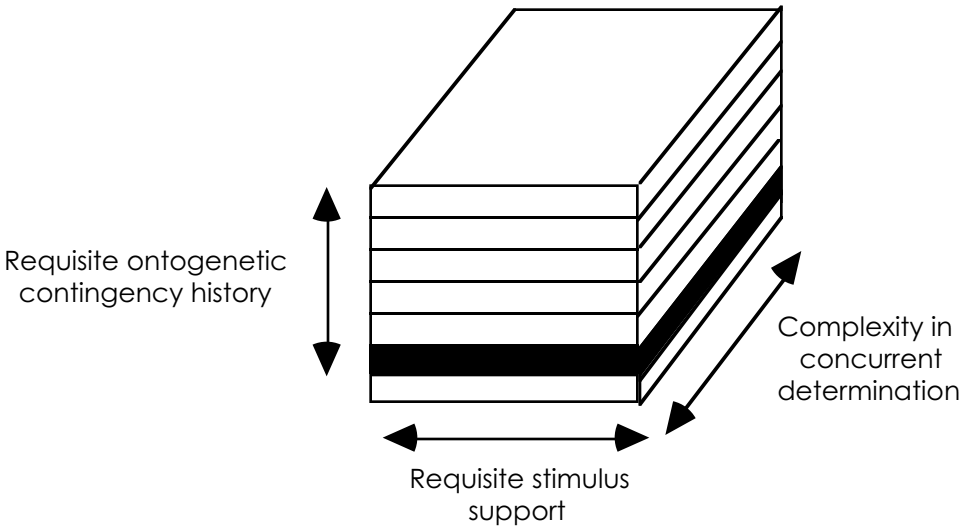
CHAPTER 9

Functional Relationships Between Arbitrary Stimuli and Fixed Responses: "Reflex Conditioning"

I. Introduction

A previous chapter examined simple reflex behavior, behavior which shows virtually no short-term hysteresis. The behavior changes in that chapter could be seen as instantaneous adaptations to a stimulus. The various particular stimulus response relationships themselves could be seen as having developed over evolutionary time and would, therefore, be long-term adaptations.

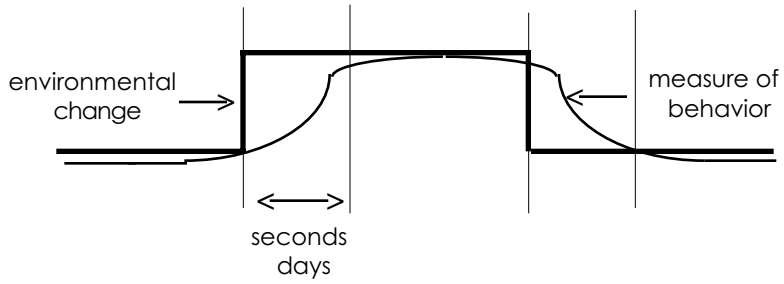
Now we proceed to behavioral adaptation resulting from ontogenetic experience.



In particular short-term adaptation, in which a phylogenetically arbitrary stimulus comes to control a response normally controlled by an eliciting stimulus.

An arbitrary stimulus comes to elicit a fixed response.

S → R#



R# can be a UR; an acquired UR; appetitive behavior, foraging or a UR getting response; a compensatory UR to a state displacement; or the rising or falling edge of a UR. Acquisition and loss of the functional relationship show short-term hysteresis. Ontogenetic experience enables a previously neutral stimulus to control previously reflexive responses after a short amount of experience. This second level of requisite ontogenetic contingency history is labeled a conditional or conditioned reflex.

Even though understanding the correlative relationship controlling the actual behavior of an organism is our focus as well as being a necessary prerequisite to understanding any other type of explanation, a potential reductionistic explanation of a conditioned reflex would be simple. Reinforcement provides the feedback to the synaptic mechanism necessary to modify just activated synaptic membranes in the activated direction (some form of back propagation). We should keep in mind however, that even though it would be interesting to know the neurology in addition to the correlative account, the reductionistic account is speculative, and the correlative causation of reflex conditioning is a necessary prerequisite to understand its neurology.

Our basic questions is what causes an organism to exhibit short-term adaptation? What causes behavior to semi-permanently change over repetitions of a task (it remains until sufficient exposure to a contrary contingency removes it). The fundamental issue underlying these questions is, of course, what are the functions which describe learning, what factors cause it, by how much, and under what conditions?

II. Prototypical Procedure Resulting in a Functional Relationship Between an Arbitrary Stimulus and a Fixed Response

Do nothing	------>	get nothing
Bell	------>	get nothing
Meat powder	------>	get salivation
bell/meat powder	------>	get salivation
Do nothing	------>	get nothing
bell/meat powder-	------>	get salivation
Do nothing	------>	get nothing
bell/meat powder-	------>	get salivation
bell	------>	get salivation

The nearly unimaginable significance of the fact that learning takes place is illustrated by the following experiment with a desk. If I do nothing to a desk, it does nothing in return. If I say lookout to a desk, the desk continues to do nothing. I could say lookout and then kick the desk and repeat this procedure ten times. What if when I then said 'look out' without a kick, and the desk moved. We would be amazed that a simple mass of atoms learned to be adaptive (i.e., kept from being dented). We should be no less amazed when a person learns an adaptive behavior. At the bottom, people are also nothing more than a simple mass of atoms.

Please contemplate this issue at this point. At bottom, we really are nothing but a mass of atoms, but we are capable of very wondrous behaviors. The object is to understand that complexity without putting a telephone operator in the brain of the telephone operator. Only the ignorant can be satisfied with that type of solution. Our task is to truly understand why behavior occurs.

III. Conceptual Precursor: Terminology

A. Terminology for Procedural Elements

UCS

A stimulus which unconditionally always elicits a response (UCR). Most correctly stated, it should be written UCS-UCR together. It is a reflex. The UCS never occurs without the UCR.

UCR

The reflexive response elicited by the UCS.

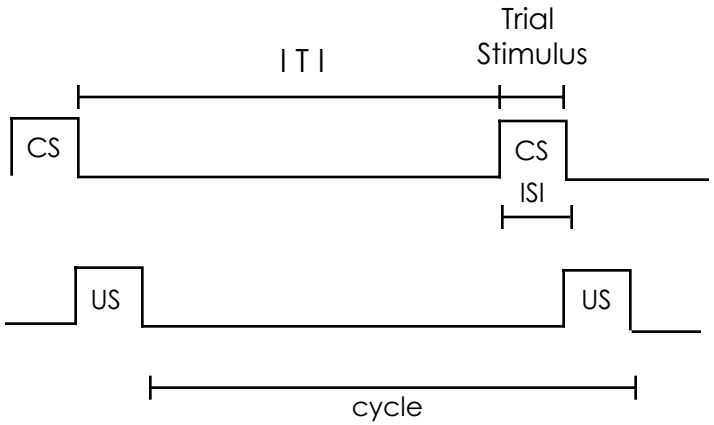
CS

Most technically stated, initially it should be the to-be-CS which is an arbitrary

neutral stimulus with no power to elicit what will be the CR. After training the to-be-CS becomes the conditioned stimulus by coming to elicit the CR.

CR

The behavior which comes to be elicited by the CS. It generally has some nonarbitrary relationship to the UCR.



Historical usage

conditioned/conditional

The original translation of Pavlov's work mistranslated the Russian word as conditioned rather than conditional as it should have been. The word conditioned has such a long history of usage, the tendency is to keep it.

trial/trial

Trial is sometimes used to refer to the trial stimulus (CS) and is sometimes used to refer to each exposure to the learning task (ITI + CS + UCS).

B. Terminology for Temporal Arrangement of Elements

1. Strict Simultaneous

typically does not come to control the "UR"
sometimes does control the UR but at a weaker level but is weaker than short delay
the control of <u>some</u> behavior is a different question.

2. Short Delay

typically most effective at controlling the UR
typically less than 1 minute in duration
increases up to about 0.5 seconds, then decreases (young = 0.4; old = 1.0)

3. Long Delay

less conditioning of the "UR" than with short delay
response starts at onset - maximum amplitude at time of US
initial suppression called inhibition of delay
typically 5-10 minutes in duration

4. Trace

less effective conditioning of the "UR" than short delay procedure
can be inhibitory
no eye blink at 2 sec trace interval

5. Backward

typically does not come to control the "UR"
sometimes does work but is weaker than short delay
control of some behavior is a different situation

6. Compound

two stimuli presented at the same time
x
x

7. Serial

Series of stimuli after an ITI
x
x

8. Clock

Series of stimuli across entire IFI
x
x

9. Temporal

No explicit stimuli, only passage of time or the temporal stimuli since some temporal anchor paired with UCS
x
x

IV. Experimental Preparations ("paradigms") ("situations")

Initially was salivation (and knee jerk), later eye blink, most recently it is pigeons in an autoshaping paradigm. Note that the word paradigm has two usages: 1) the overall philosophical, conceptual frame of reference (often pronounced *pair a dim*), and 2) the specific procedure used to obtain results (often pronounced *pair a dime*).

A. *Nictitating Membrane (NMR) (eye blink)*

1. Response

Eye blink response is discrete with a very short time course

2. Subjects

Rabbits are the typical subject because they normally don't move, and rarely blink.

3. Procedure for Production

CS - 0.5 - 1.0 sec stimulus
US - 0.1 sec infra-orbital shock

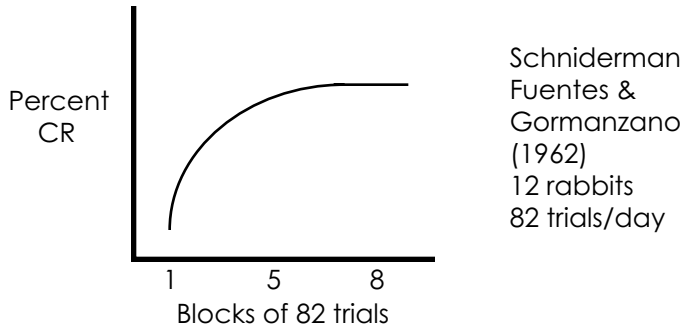
4. Procedure for Demonstration

blank trials
dependent variable often percent trials with conditioned response

5. Typical Results

100 pairings - 50% trials have CR (5% trials have CR in baseline)
80 trials/day for 10 days

6. Illustrative Research



B. *Sign-tracking (Autoshaping)*

1. Response

The response is discrete key pecks that tends to occur continually throughout the CS

2. Subjects

Pigeons are the typical subjects because they are handy and are well known.

3. Procedure for Production

ITI - 30-60 sec
CS - 10 sec key light
US - 4 sec food

4. Procedure for Demonstration

Same procedure as used for production

Measure keypecking to CS

Dependent variable: trials to acquisition, pattern of responding, percent trials with peck, or response rate

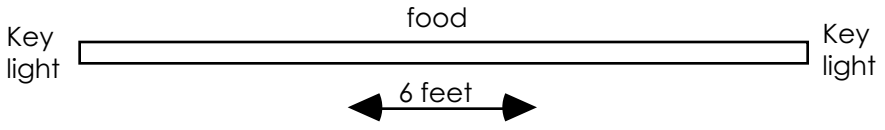
This behavior differs from operant conditioning in that the dependent variable must be the measurement of approach and contact of the CS. If the CS is not capable of detecting directed behavior then the procedure will not produce the dependent variable. It is CS approach that is engendered rather than an arbitrary behavior.

5. Typical Results

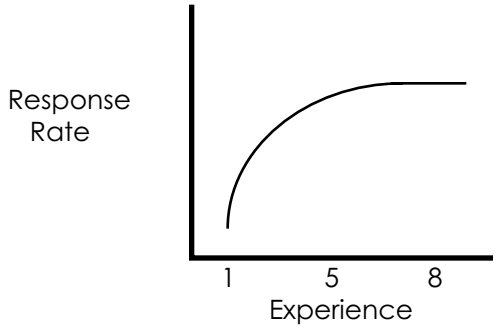
10-100 trials 90% trials CR
3 pecks/sec

6. Illustrative Research

Long box experiment



Brown & Jenkins 1968


Response
Rate
1
5
8
Experience

C. *Conditioned Suppression (CER) (fear conditioning)*

1. Response

The response is diffuse and continuous. It has a long time course and continues throughout the CS.

2. Subjects

Rats are the typical subjects because they are handy, well known, and easy to shock.

3. Procedure for Production

ITI 15-30 min
CS 1-2 min
US 1 sec foot shock

4. Procedure for Demonstration

Develop operant, e.g., VI for food
impose CS on ongoing baseline
dependent variable = percent suppression (disruption) during food schedule)

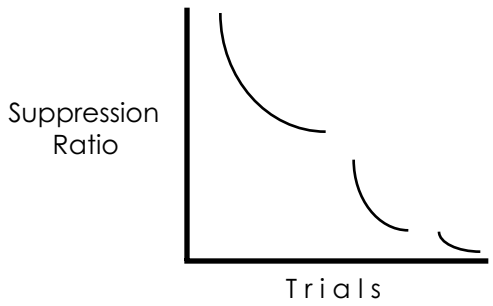
$$\frac{\text{CS Response}}{\text{CS Response + Pre-response}} \qquad \frac{10}{10 + 10} = 0.5 \quad \text{no suppression}$$

$$\frac{0}{0 + 1\ 0} = 0.0 \quad \text{total suppression}$$

5. Typical Results

3-5 trials ---> total suppression

6. Illustrative Research



Domjan (unpublished)
3 rats
3 days

D. *Taste Aversion (poison avoidance)*

1. Response

The aversion is an enduring response tendency

2. Subjects

Rats are the typical subjects
handy, well-known
omnivores - good taste aversion subject

3. Procedure for Production

ITI 24 hours or only one trial
CS flavored water
US lithium or other drug injection
radiation

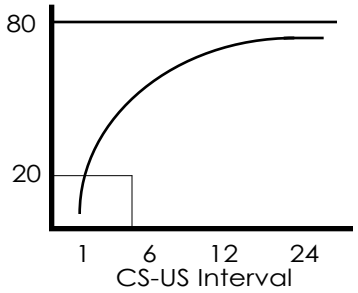
4. Procedure for Demonstration

Test with choice procedure
Dependent variable - number of licks
- volume consumed

5. Typical Results

Conditioning in 1 trial 1 trial and 24 hour ISI make it interesting

6. Illustrative Research



Smith & Roll (1967)
Rats
1% sachharin
0-24 hr ITI
xray
test in choice for 2 days

E. *Skin Conductance - (SCR) (electrodermal) (galvanic skin response) (GSR)*

1. Response

The response is slow change and recovery in skin conductance

2. Subjects

Humans are the typical subjects

3. Procedure for Production

ITI typically about 60 seconds
CS often complex stimulus such as words
US = shock, fear or surprise

4. Procedure for Demonstration

x
x

5. Typical Results

x
x

6. Illustrative Research

F. *Interoceptive Conditioning*

The lack of knowledge about this type of conditioning is both surprising and sad. Many applied problems may be the fact that an interoceptive stimulus is functioning as a CS or an interval response is the CR.

1. Response

The stimuli and response can be any of a wide variety of internal events.

2. Subjects

x
x

3. Procedure for Production

x
x

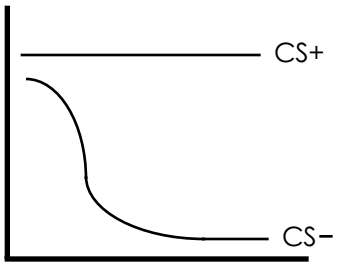
4. Procedure for Demonstration

x
x

5. Typical Results

x
x

6. Illustrative Research



Bykov
stimulus mild saline or mild acid (scour)
Catheter to small intestine
S_1 - no shock
S_2 - shock
Condition heart rate within 16 trials.

In paraplegic
CS mild shock to thigh
UCS strong shock to thorax
UCR urination
CR urination

V. Procedures Causing Short-Term Adaptation

A. Correlated Stimulus Presentations

1. *Acquisition*

a. Procedure and Behavior

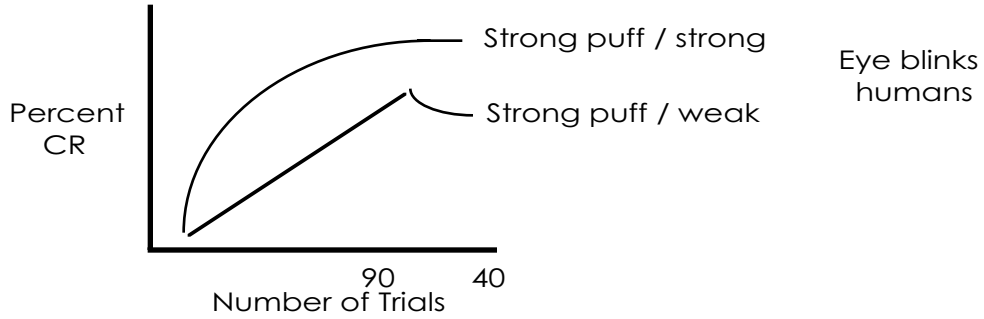
If bell + meat powder and no bell + no meat powder then, percentage CR increases over trials (i.e., "acquisition")

Stable maximum is called asymptote

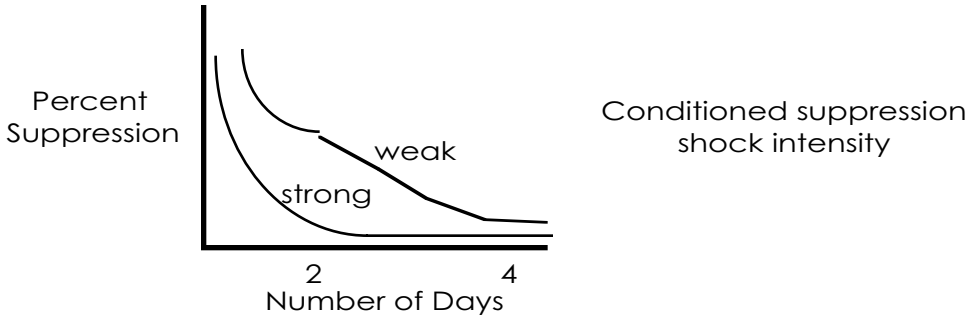
US intensity determines rate of acquisition (and asymptotic CR magnitude)

b. Illustrative Research

Trappold & Spence (1960)



Annau, Kamin (1961)



c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of acquisition operating at this time scale of adaptation include; what unlearned responses occur to which stimuli, the strength of the

requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimuli change properties of the acquisition.

The following factors have been shown to affect this phenomenon. They are detailed in the next section.

novelty of CS
novelty of US
intensity of CS and US
motivational factors
incentive
deprivation

x
x

(2) Short

The determinants of acquisition operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change acquisition.

These are the procedural factors that affect the time course of conditioning, such as spaced trials, delay and other details of the procedure.

x
x

(3) Medium

The determinants of acquisition operating at this time scale of adaptation include; how acquisition changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.

These are the ontogenetic experience factors that affect the time course of acquisition permanently for that individual, such as the reacquisition effect or "learning to learn."

x
x

(4) Long

The determinants of acquisition operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of

behavior, can change the acquisition for those members of a species. This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

The effects of this time scale have been studied in selective breeding experiments (Tryon, Hirsh) and by inference based on likely value for reproductive success (Garcia).

If intelligence is the speed of acquisition and if intelligence is genetically determined, then the study of intelligence would go here.

x

x

ii. Population Context

This class of explanations for acquisition includes how the population frequency of acquisition is changed. Note that not all time scales are exhaustively detailed in this section. This is not necessarily different than the previous determinants, it's just that the treatment is given to a group and the dependent measure is the percentage of the group that show that acquisition.

This measure was very popular under the Hullian research paradigm. Skinner's emphasis on individual animals has made this approach less popular.

x

x

iii. Cellular Machinery

This class of explanations for acquisition includes how underlying cellular activity (neuronal & glandular) result in or affect acquisition. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena. This is not necessarily different than the previous determinants, it's mechanical or substance interventions that alter acquisition.

x

x

d. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

i. Pavlov's Spreading Cortical Fields

Pavlov wanted to extend Sherrington's integrative functions of the spine to the more general case of integrative activities of the cortex over all behavior. He approached it as spreading fields of excitation and inhibition (essentially the field version of Sherrington's excitatory and inhibitory synapses).

ii. Rescorla and Wagner's Linear Operator Model

$$\Delta V = \alpha\beta\,(\lambda - \sum V)$$

This model successfully predicts (explains) many typical acquisition functions. See extended treatment in Section X.

x

x

2. *Equilibrium*

a. Procedure and Behavior

Asymptotic behavior shows characteristic patterns to the procedures which maintain them. For example, if there is a 5-minute ITI and a 1-minute CS followed by food, the CR comes to occur to the CS onset, but only weakly. The CR maximum occurs at the approximate time of the UCS. (This particular pattern of behavior is labeled inhibition of delay.)

b. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of equilibrium operating at this time scale of adaptation include; what unlearned responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimuli change properties of the equilibrium.

x

x

(2) Short

The determinants of equilibrium operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in

correlations between stimuli and/or responses change equilibrium.

These are the factors that affect the asymptotic pattern of conditioning, such as details of the procedure. The distribution of responding across a long delay stimulus is different than across a short delay stimulus.

x

x

(3) Medium

The determinants of equilibrium operating at this time scale of adaptation include; how equilibrium changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.

x

x

(4) Long

The determinants of equilibrium operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the equilibrium for those members of a species. This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

This is the Tryon selective breeding, or the fruit flies or the Garcia effect with respect to their equilibrium.

x

x

ii. Population Context

This class of explanations for equilibrium includes how the population frequency of equilibrium is changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

x

x

iii. Cellular Machinery

This class of explanations for equilibrium includes how underlying cellular activity (neuronal & glandular) result in or affect equilibrium. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.

x
x

d. Conceptual and Cognitive Metaphors

This class of explanations for equilibrium include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

Inhibition of delay is used as an explanation for the low CR rate at stimulus onset in long delay stimuli.

3. *Dynamics*

a. Procedure and Behavior

x
x
x

b. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of dynamics operating at this time scale of adaptation include; what unlearned responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimuli change properties of the equilibrium.

x
x

(2) Short

The determinants of dynamics operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change equilibrium.

These are the factors that affect the asymptotic pattern of conditioning, such as

details of the procedure. The distribution of responding across a long delay stimulus is different than across a short delay stimulus.
x
x

(3) Medium

The determinants of dynamics operating at this time scale of adaptation include; how equilibrium changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.
x
x

(4) Long

The determinants of dynamics operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the equilibrium for those members of a species. This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

This is the Tryon selective breeding, or the fruit flies or the Garcia effect with respect to their equilibrium.
x
x

ii. Population Context

This class of explanations for dynamics includes how the population frequency of equilibrium is changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.
x
x

iii. Cellular Machinery

This class of explanations for dynamics includes how underlying cellular activity (neuronal & glandular) result in or affect equilibrium. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.
x
x

d. Conceptual and Cognitive Metaphors

This class of explanations for dynamics include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

Inhibition of delay is used as an explanation for the low CR rate at stimulus onset in long delay stimuli.

B. Uncorrelated Stimulus Presentation

1. *Extinction*

a. Procedure and Behavior

Following the acquisition of a behavior through reinforced practice, there will be a loss of behavior with unreinforced exposure (i.e., extinction).

Not forgetting - must be with repeated exposure
Not habituation - must not spontaneously recover entirely
must be previously conditioned
Not inhibition - extinction stimulus fails retardation and fails summation test.
Not unlearning - because the behavior can come back, spontaneous recovery or with disinhibition stimulus

Similarities of habituation and extinction
ITI about same for maximum loss. Both react to novel stimulus with dishabituation or dis-extinction (disinhibition)

1. induced sleep
2. paradoxical phase
3. equilibrium phase (Malone)
4. ultraparadoxical phase
5. extinction below zero

b. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of extinction operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the extinction .

Rate of responding in extinction can be changed by changing the motivation and/or by presenting a "surprising" stimulus.

x

x

(2) Short

The determinants of extinction operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change extinction.

How extinction changes as a function of things like partial reinforcement.

If extinction is continued well past the loss of responding, the likelihood of spontaneous recovery is less and the inhibitory effects of the extinction stimulus are greater. This effect is labeled extinction below zero.

x

x

(3) Medium

The determinants of extinction operating at this time scale of adaptation include; how extinction changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.

Extinction faster with repeated extinctions.

x

x

(4) Long

The determinants of extinction operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change extinction for those members of a species. This class of functional relationships has been traditionally labeled "comparative or ethological"

phenomena.

An example of likely evolutionary contingencies is that avoidance behaviors extinguish much more slowly than approach behaviors.

x

x

ii. Population Context

This class of explanations or extinction includes how the population frequency of extinction is changed. Note that not all time scales are exhaustively detailed in this section.

x

x

iii. Cellular Machinery

This class of explanations for extinction includes how underlying cellular activity (neuronal and glandular) result in or affect characteristics of extinction Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.

Drug effects on extinction.

x

x

d. Conceptual and Cognitive Metaphors

This class of explanations for extinction include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

A typical explanation is discrimination and least effort, i.e., to the degree that the stimuli are discriminably different and to the degree that effort can be minimized, then behavior will not occur to nonreinforced stimuli. Unfortunately, this principle is tautological. It is invoked when it works and it is ignored when it doesn't explain the behavior.

x

x

C. Reinforcer Correlated Then Stimulus Correlated Presentations

1. *(Higher-Order Conditioning)*

a. Procedure and Behavior

A conditioned stimulus can come to function as a reinforcer and as a result can condition new behavior (i.e., higher-order conditioning).

B S*
AB
A-->R

b. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of higher-order conditioning operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of higher-order conditioning.

It is likely that stimuli from the same modality condition better.

x
x

(2) Short

The determinants of higher-order conditioning operating at this time scale of adaptation include; how the higher-order conditioning changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change higher-order conditioning.

Some procedures (e.g., temporal spacings) produce stronger higher-order conditioning.

x

x

(3) Medium

The determinants of higher-order conditioning operating at this time scale of adaptation include; how higher-order conditioning changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.

As more experience with similar procedures accrues, then higher-order conditioning is likely to occur faster.

x

x

(4) Long

The determinants of higher-order conditioning operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change aspects of higher-order conditioning for those members of a species. This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

x

x

ii. Population Context

This class of explanations for higher-order conditioning includes how the population frequency of higher-order conditioning is changed. Note that not all time scales are exhaustively detailed in this section.

x

x

iii. Cellular Machinery

This class of explanations higher-order conditioning includes how underlying cellular activity (neuronal and glandular) results in or affects higher-order conditioning. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.

x

x

d. Conceptual and Cognitive Metaphors

This class of explanations higher-order conditioning include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

The initial conditioned stimulus is thought to take on the properties of the UCS. With these new powers, it can then condition the earlier stimulus.

x

x

D. Stimulus Correlated Then Reinforcer Correlated Presentations

1. *(Sensory Preconditioning)*

a. Procedure and Behavior

Given two stimuli which are correlated (in absence of a reinforcer). If one is subsequently correlated with a reinforcer, then the other may control a response related to the reinforcer (i.e., sensory preconditioning).

B A
AS*
B-->R

b. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of sensory preconditioning operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the sensory preconditioning.

It is likely that salient stimuli from a common modality will condition faster.

x

x

(2) Short

The determinants of sensory preconditioning operating at this time scale of adaptation include; how sensory preconditioning changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change sensory preconditioning.

It is likely that some procedures work better than others.

x

x

(3) Medium

The determinants of sensory preconditioning operating at this time scale of adaptation include; how sensory preconditioning changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.

x

x

(4) Long

The determinants of sensory preconditioning operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the sensory preconditioning for those members of a species. This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

x

x

ii. Population Context

This class of explanations for sensory preconditioning includes how the population frequency of sensory preconditioning are changed. Note that not all time scales are exhaustively detailed in this section.

x

x

iii. Cellular Machinery

This class of explanations for sensory preconditioning includes how underlying cellular activity (neuronal and glandular) affect sensory preconditioning. Note that not all time scales are exhaustively detailed in this section. This class of

explanation has traditionally been labeled "biological or neuroscience" phenomena.
x
x

d. Conceptual and Cognitive Metaphors

This class of explanations for sensory preconditioning include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

Explanations from sensory preconditioning are strained because there is no clear reinforcer. That requires:

1. deny absence of reinforcer (e.g., sensory reinforcement)
2. deny conditioning
3. deny reinforcement necessary for learning

E. Negatively Correlated Stimulus Presentation

1. *(Inhibitory Conditioning)*

a. Procedure and Behavior

Seen as part of homeostatic mechanism, whereas excitation increases behavior - inhibition suppresses behavior.

Inhibition is a response tendency in opposition to the "typical" behavior
1. cancellation of excitatory
2. bidirectional response

As a rule of thumb, inhibition occurs in situations where an explicit stimulus is associated with a lower or worse outcome than otherwise.

Procedures

1	CS+ S^* CS+ CS – $\overline{S}^*$	strong inhibitory conditioning
2	CS+ S^* CS – $\overline{S}^*$	not always effective
3	S^* CS – $\overline{S}^*$	not always effective

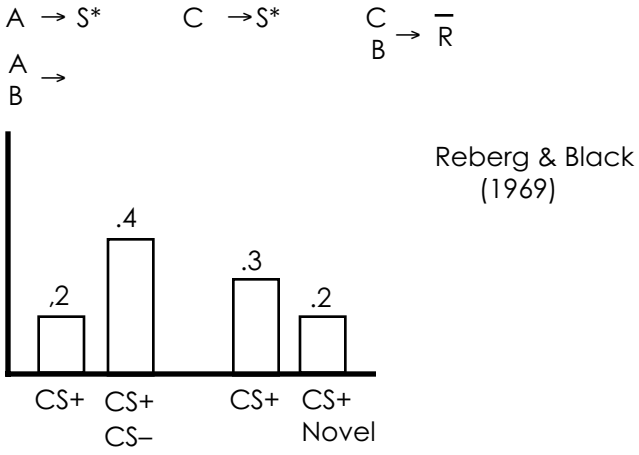
b. Illustrative Research

Inhibition of delay
early in CS responses suppressed and dogs more likely to go to sleep
subject to disinhibition

Inhibition paradox
can use long delay positive conditioning and get strong inhibition to both CS and

UCS. Get no salivation even to food. Additionally the effect extinguishes.

Summation Test



Retardation of Acquisition Test

c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of inhibitory conditioning operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the inhibitory conditioning.

Disinhibition with presentation of novel stimulus.

x

x

(2) Short

The determinants of inhibitory conditioning operating at this time scale of

adaptation include; how the inhibitory conditioning changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change inhibitory conditioning.

Some procedures produce inhibitory conditioning, some procedures do not.

x

x

(3) Medium

The determinants of inhibitory conditioning operating at this time scale of adaptation include; how inhibitory conditioning changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.

x

x

(4) Long

The determinants of inhibitory conditioning operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change inhibitory conditioning for those members of the species. This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

x

x

ii. Population Context

This class of explanations for inhibitory conditioning includes how the population frequency of inhibitory conditioning is changed. Note that not all time scales are exhaustively detailed in this section.

x

x

iii. Cellular Machinery

This class of explanations for inhibitory conditioning includes how underlying cellular activity (neuronal and glandular) result in or affect inhibitory conditioning. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.

x

x

d. Conceptual and Cognitive Metaphors

This class of explanations for inhibitory conditioning include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

1. incompatible response

x
x

2. bipolar behavior

x
x

VI. Determinants of the Nature of the CR

Understanding the nature of the CR has been an important goal of the study of reflex conditioning because of its potential impact on understanding the nature of reflex conditioning. For example, if the CR is the UR, then stimulus substitution is the likely explanation of reflex conditioning. If the CR is truly orthogonal to the UR then the CR "being connected" to the UR or US is unlikely.

A. *Stimulus Substitution*

1. Procedure and Behavior

x
x

2. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

3. Explanatory Perspective

a. Determinants of Behavior

i. Instantaneous

The determinants of behavior operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the behavior.

x
x

ii. Short

The determinants of behavior operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change behavior.

x

x

iii. Medium

The determinants of behavior operating at this time scale of adaptation include; how behavior changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.

x

x

iv. Long

The determinants of behavior operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the behavior of a species (or more correctly produce a species). This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

x

x

b. Population Context

This class of explanations includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section.

x

x

c. Cellular Machinery

This class of explanations includes how underlying cellular activity (neuronal & glandular) result in the observed behavior. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.

x

x

4. Conceptual and Cognitive Metaphors

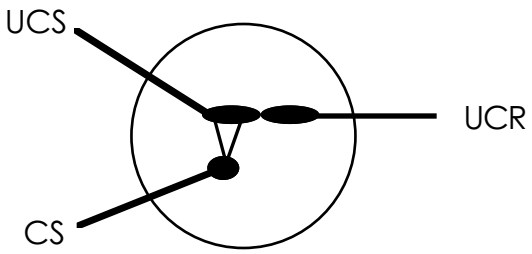
This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

a. Pavlov's Theory

Learning is a new functional pathway. The CS activates the UCS center which in turn results in activation of UCR center which then produces overt UCR.



i. Supporting Evidence

CSs conditioned with different USs will control different responses and that response is related to the UR. Salivation does not occur to tone following tone puff.

tone	food	-----	tone salivation
tone	puff	-----	tone blink
key light	food	-----	key light bite
key light	water	-----	key light drink

ii. Problematic Evidence

There are differences between the CR and the UR

shock	increase respiration
CS for shock	decrease respiration

food lower head to food
CS for food look at bell
no chewing

iii. Procedures Revealing What Factors are Important

(1) Devaluation to Reveal Connection Type

Holland and Rescorla (1975) devaluation methodology

The view is that if the US-UR path is blocked by devaluing the US, the absence of a CR shows that it the CS-US-UR path. Unfortunately, Holland and Rescorla's explanation for these results is mentalistic tautology but the phenomenon is important.

In their view:

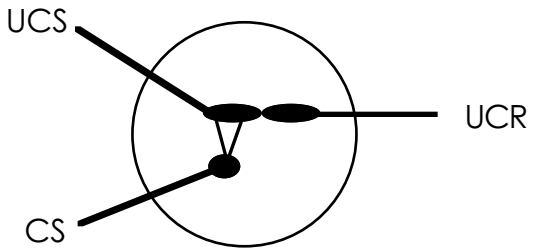
The CS elicits a representation of the US and the subsequent CR is appropriate to the CS and the UR, that would be controlled by that representation of the US.

The concept of representation adds nothing and one has to wonder "who" is looking at the representation and how does that thing decide what to do.

As an illustration of the superfluity of the mentalistic concept of "representation", think of an automobile that has the transmission fluid drained (i.e. a devaluation). It does not drive around following the devaluation, , yet there is no need for a concept like "representation".

The devaluation results have been used in two ways.

What kind of reductionistic connections are made? The fact that it was impaired indicated that the "connection" is SS not SR.



(2) Evaluation to Reveal Connection Type

Sensory preconditioning support this conceptualization. Sensors Preconditioning is obviously S-S. The fact that it only needs to be "energized" supports the belief that conditioning is S S.

(3) Devaluation to Assess Process Differences

Is there a difference in first and second order?

CS-US	US devaluation	CS X
CS_1-US		
CS_2-CS_1	CS_1 Ext	CS_2 CR

Sometimes extinction of CS_1 hurts CS_2s ability to CR
Sometimes not
If CS_1-CS_2 are presented simultaneously, more likely to be S-S.

B. *Compensatory Response Model*

1. Procedure and Behavior

Shock increase respiration
CS for Shock decrease respiration

epinephrine decrease gastric secretion
CS for epinephrine increase gastric secretion

2. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

3. Explanatory Perspective

a. Determinants of Behavior

i. Instantaneous

The determinants of behavior operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the behavior.
x
x

ii. Short

The determinants of behavior operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change behavior.

x
x

iii. Medium

The determinants of behavior operating at this time scale of adaptation include; how behavior changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.

x
x

iv. Long

The determinants of behavior operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the behavior of a species (or more correctly produce a species). This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

x
x

b. Population Context

This class of explanations includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section.

x
x

c. Cellular Machinery

This class of explanations includes how underlying cellular activity (neuronal & glandular) result in the observed behavior. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.

x
x

4. Conceptual and Cognitive Metaphors

This class of explanations include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively

characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which act as if they actually intervened between input and output and produce correct predictions even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.
x
x

The compensatory response model asserts that the CR is actually a compensatory response. That means that the actual CR is opposite in vector to that of the UR.

US primary reaction
CR anticipatory homeostatic compensatory response which
minimizes the disruptive effect of the US (a conditioned response)

note that opponent process theory of emotional adaptation asserts
that the b process is an unlearned reaction to aftereffect of US

Whereas compensatory response theory of conditioning asserts
that the CR is a learned anticipatory reaction to the US

a. Implications with Respect to Drug Tolerance

Each drug administration is in a context. These cues come to elicit a compensatory response which suppresses the effectiveness of the US.

Support for this view is that

1) when morphine effectiveness has been reduced due to heavy use, its effectiveness can be restored if the drug is given in a new context
2) if the apparatus and context (CS) is pre-exposed, then tolerance development is retarded
3) if tolerance has been developed, it can be extinguished if CS is presented without US

But there are problems with the compensatory response model

CRs are not always compensatory

amphetamine increase
CS for amphetamine increase

Changing context does not always produce a reinstatement (but then other cues may also be conditioned).

Solution is to suggest that what is conditioned is the aftereffect. If the US produces an unconditioned aftereffect, then the CS will elicit that aftereffect. If there is no aftereffect, then the CR will mimic the UR.

C. *The CS as the Determinant of the CR*

1. Procedure and Behavior

The form of the CR is dependent on the nature of the CS

Holland (1977)

sound CS — head jerk - startle
visual CS — standing by food cup

Timberlake and grant

rat CS — social contact

2. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

3. Explanatory Perspective

a. Determinants of Behavior

i. Instantaneous

The determinants of behavior operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the behavior.

x

x

ii. Short

The determinants of behavior operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally

labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change behavior.
x
x

iii. Medium

The determinants of behavior operating at this time scale of adaptation include; how behavior changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.
x
x

iv. Long

The determinants of behavior operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the behavior of a species (or more correctly produce a species). This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.
x
x

b. Population Context

This class of explanations includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section.
x
x

c. Cellular Machinery

This class of explanations includes how underlying cellular activity (neuronal & glandular) result in the observed behavior. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.
x
x

4. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

D. *Behavior System as a Determinant of the CR*

1. Procedure and Behavior

Timberlake and Grant (1975)

rat presented prefood

stimulus substitution	go to food cup
stimulus surgation	eat rat
compensatory response	?
behavior system	social contact

2. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

3. Explanatory Perspective

a. Determinants of Behavior

i. Instantaneous

The determinants of behavior operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the behavior.

x

x

ii. Short

The determinants of behavior operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally

labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change behavior.
x
x

iii. Medium

The determinants of behavior operating at this time scale of adaptation include; how behavior changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.
x
x

iv. Long

The determinants of behavior operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the behavior of a species (or more correctly produce a species). This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.
x
x

b. Population Context

This class of explanations includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section.
x
x

c. Cellular Machinery

This class of explanations includes how underlying cellular activity (neuronal & glandular) result in the observed behavior. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.
x
x

4. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

The behavior system theory argues that behavior is organized into hierarchical units which are preorganized with respect to time to the biologically important event (or stimulus correlated with the biologically important event) which solve particular needs such as food getting, predator avoidance, etc. Those units come to occur under the control of stimuli which are spatially or temporally appropriate. That behavior adaptation has occurred across long, medium and short time scales.

Pavlovian conditioning presents a particular stimulus and temporal relation preceding some biologically important event. This activates some aspect of the appropriate behavior system. What a CS elicits depends on the behavior system and the temporal and spatial relation of the CS to the outcome, and the optimization that the organism has already received with respect to that stimulus-outcome conjunction.

Holland (1984)

"a comprehensive account of the form of the CR will require knowledge of the normal functions of behavior systems engaged by the various CSs, the natural unlearned organization within those systems, and the ontogeny of those systems.

VII. Effects in Terms of Manipulations of Other Time Scales on Short-Term Adaptation

Research is not always integrated in terms of conditioning procedures as was done in the previous section. This present section integrates findings in terms of time scale of manipulation on what are primarily short-term procedures.

In essence, it is going through roughly the same information in terms of "rows" rather than in terms of "columns."

A. *Effect of Instantaneous Manipulations*

1. Manipulation Preceding and During Training

a. *Familiarity of CS*

i. Procedure and Behavior

If CS-CS-CS-CS-CS, then CS-US yields less conditioning

The critical issue is whether the pre-exposure effect is enduring (exhibits offset hysteresis).

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

iii. Explanatory Perspective

x

x

(1) Correlative Determinants

x
x

(2) Population Context

x
x

(3) Cellular Machinery

x
x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x
x

(1) Competing Conditioning

The CS is occurring in a context, therefore, the animal could be learning something that is interfering with subsequent conditioning, e.g., $(\lambda - \sum V)$ discrepancy could be reduced by the procedure.

x
x

(2) Salience Reduction

Simple habituation to the CS may make it less salient or less able to participate in learning. Alpha could be reduced. The implication here is the effect is instantaneous effect.

x
x

(3) Learned Irrelevance

Animals can learn that stimuli are irrelevant, therefore, the stimuli don't participate in conditioning very well. The implication here is that the effect is a short-term effect.

x

x

(4) Reproductive Utility

The ability to separate novel stimuli from the background would have tremendous reproductive utility. The implication here is that the effect is a long-term effect.

x

x

b. *Familiarity of US*

i. Procedure and Behavior

If US-US-US-US-US, then CS-US less conditioning

x

x

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

iii. Explanatory Perspective

x

x

(1) Correlative Determinants

x

x

(2) Population Context

x

x

(3) Cellular Machinery

x

x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

(1) Competing Conditioning

The US is occurring in a context, therefore, learning in that context is occurring, that conditioning may interfere with subsequent conditioning, e.g., the $(\lambda - \sum V)$ discrepancy would be reduced. This would make the US pre-exposure a learned effect.

x

x

(2) Salience Reduction

Simple habituation to the US may make it less salient or less able to participate in learning. Beta could be reduced. The implication here is that it is an instantaneous effect.

x

x

(3) Context Conditioning

The US could condition the context later when a new CS is added. The context would block the conditioning of the CS.

x

x

(4) Reproductive Utility

The ability to be more affected by novel US, would allow the animal to be more attune to new contingencies. Presumably this would have tremendous reproductive utility.

x

x

c. *Intensity of CS and US*

i. Procedure and Behavior

Most learning procedures presume moderate stimulus intensities. If the CS or US are made extreme, then the typical functional laws may not apply.

x

x

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

iii. Explanatory Perspective

x

x

(1) Correlative Determinants

x

x

(2) Population Context

x

x

(3) Cellular Machinery

x

x

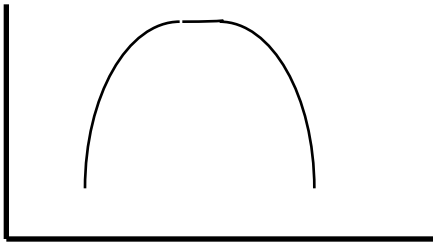
iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

As intensity increases, conditioning increases and then decreases (as Yerkes-Dodson would suggest).



(1) Salience Effect

It could be that more intense stimuli are more novel, and are therefore more strongly conditioned

x

x

(2) Connection Strength

It could be that stronger stimuli are more strongly conditioned simply by virtue of being stronger stimuli.

x

x

d. *Relevance or Belongingness of CS and US*

i. Procedure and Behavior

Some CSs are easier to condition with some USs.

The effect does not require the two CSs to be presented together, nor does it require extensive ontogenetic experience. It is, therefore, an instantaneous effect.

x

x

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

Stimulus relevance in aversion conditioning (Garcia & Koeling, 1966).

Taste	taste ≈
Audiovisual shock	audiovisual CR
Taste	taste CR
Audiovisual sickness	audiovisual ≈

iii. Explanatory Perspective

x

x

(1) Correlative Determinants

x

x

(2) Population Context

x
x

(3) Cellular Machinery

x
x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x
x

(1) Time Course

May be via time course similarity in the CSs and the USs.

x
x

(2) Genetic Predisposition

It would be plausible to infer that the nature of the effect is an instance of a long-term adaptation and had some reproductive utility. The effect itself is an immediate effect and therefore is an instantaneous adaptation.

x
x

e. *Relative Strength of CS and US*

i. Procedure and Behavior

It is not easy to condition a food presentation CS with a bell US even though the bell does control a UCR and food presentation is a stimulus.

x

x

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

iii. Explanatory Perspective

x

x

(1) Correlative Determinants

x

x

(2) Population Context

x

x

(3) Cellular Machinery

x

x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

Pavlov thought that it was necessary for the CS to be weak and the US to be stronger.

x

x

A Positive Ramification

Biological strength would explain higher-order conditioning. Once the CS is conditioned, it becomes stronger and can then function as a US

	CS_1 -US	first order - excellent
CS_2	- CS_1	second order - OK
CS_2	CR	third order - occasionally

Problematic Data

Counterconditioning with two strong USs such as food and shock can occur, but something must affect the direction.

x

x

Sensory preconditioning with two innocuous stimuli

x

x

Implication of Notion of Biological Strength

It may be that conditioning is almost always taking place and that we just don't see it because what was conditioned is weak - with a stronger US we come to be able to see it because the conditioning has been potentiated. Unfortunately, this could devolve into unfalsifiable hand waving.

x

x

f. *Motivation*

i. Procedure and Behavior

x
x

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

iii. Explanatory Perspective

x
x

(1) Correlative Determinants

x
x

(2) Population Context

x
x

(3) Cellular Machinery

x
x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

2. *Manipulation During Test*

a. *Stimulus Similarity*

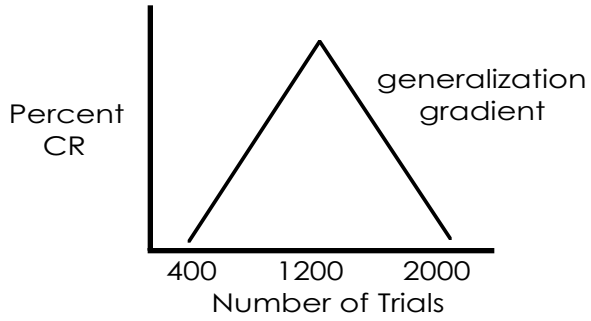
i. Procedure and Behavior

The similarity of the response to the CS as compared to the response to the UCS is in part controlled by the similarity of the test CS to the training CS.

x

x

ii. Illustrative Research



Moore (1972)
rabbits
eye blink
several hundred at S*

iii. Explanatory Perspective

x

x

(1) Correlative Determinants

x

x

(2) Population Context

x

x

(3) Cellular Machinery

x

x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

b. *Motivation*

i. Procedure and Behavior

x
x

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

iii. Explanatory Perspective

x
x

(1) Correlative Determinants

x
x

(2) Population Context

x
x

(3) Cellular Machinery

x
x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

B. *Medium-Term Manipulations*

1. *Manipulation During Training*

a. *Retraining*

i. Procedure and Behavior

Acq - Ext - Acq
Second acquisition is faster than initial acquisition
x
x

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

iii. Explanatory Perspective

x
x

(1) Correlative Determinants

x
x

(2) Population Context

x
x

(3) Cellular Machinery

x
x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

Typical explanation is that many of the components were never actually extinguished.

x
x

2. *Manipulation During Testing*

a.

i. Procedure and Behavior

x
x

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

iii. Explanatory Perspective

x
x

(1) Correlative Determinants

x
x

(2) Population Context

x
x

(3) Cellular Machinery

x
x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

C. *Long-Term Manipulations*

1.

a.

i. Procedure and Behavior

A number of genetic effects on behavior have been demonstrated (Geoff Hall).

x

x

ii. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

iii. Explanatory Perspective

x

x

(1) Correlative Determinants

x

x

(2) Population Context

x
x

(3) Cellular Machinery

x
x

iv. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x
x

VIII. Effects in Terms of Manipulations of Different Levels of Molarity

A. *Cellular Manipulations*

1. *Substance Effects*

a. Procedure and Behavior

x
x

b. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of behavior operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the behavior.

x
x

(2) Short

The determinants of behavior operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli

and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change behavior.
x
x

(3) Medium

The determinants of behavior operating at this time scale of adaptation include; how behavior changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.
x
x

(4) Long

The determinants of behavior operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the behavior of a species (or more correctly produce a species). This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.
x
x

ii. Population Context

This class of explanations includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section.
x
x

iii. Cellular Machinery

x
x

d. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the

input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

2. *Mechanical Effects*

a. Procedure and Behavior

x
x

b. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of behavior operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the behavior.

x
x

(2) Short

The determinants of behavior operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change behavior.

x
x

(3) Medium

The determinants of behavior operating at this time scale of adaptation include; how behavior changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.

x

x

(4) Long

The determinants of behavior operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the behavior of a species (or more correctly produce a species). This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

x

x

ii. Population Context

This class of explanations includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section.

x

x

iii. Cellular Machinery

x

x

d. Conceptual and Cognitive Metaphors

This class of explanations for acquisition include: 1) quantitative models which specify output as some mathematical transformation of the input; 2) models which qualitatively characterize how the process which actually intervenes between the input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x

B. *Population Exposure Manipulations*

1.

a. Procedure and Behavior

x
x

b. Illustrative Research

- What led to the question?
- Logic of the solution strategy
- Experimental design
- Results
- Conclusion

c. Explanatory Perspective

i. Determinants of Behavior

(1) Instantaneous

The determinants of behavior operating at this time scale of adaptation include; what responses occur to which stimuli, the strength of the requisite stimulus, and the structural details of the resulting behavior. This class of functional relationships has been traditionally labeled "Perceptual" phenomena. It is how changes in the properties of the stimulus change properties of the behavior.

x
x

(2) Short

The determinants of behavior operating at this time scale of adaptation include; how the behavior to a stimulus changes as the result of correlations between stimuli and/or responses. This class of functional relationships has been traditionally

labeled "learning" phenomena. It is how exposure to changes in correlations between stimuli and/or responses change behavior.
x
x

(3) Medium

The determinants of behavior operating at this time scale of adaptation include; how behavior changes "irreversibly" (for that individual) as the result of exposure to multiple overlapping correlations between stimuli and/or responses. This class of functional relationships has been traditionally labeled "developmental" phenomena.
x
x

(4) Long

The determinants of behavior operating at this time scale of adaptation include; how selective reproduction with respect to some behavior, or index of behavior, can change the behavior of a species (or more correctly produce a species). This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.
x
x

ii. Population Context

x
x

iii. Cellular Machinery

This class of explanations includes how underlying cellular activity (neuronal & glandular) result in the observed behavior. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "biological or neuroscience" phenomena.
x
x

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input and the output work; 3) hypothetical models which produce correct predictions of output based on input even though they are not thought to actually intervene between input and output; and 4) analogies and metaphors which communicate some ability to predict behavior better than chance.

x

x