CHAPTER 7

Functional Relationships Between Fixed Stimuli and Fixed Responses: "Innate Behavior"

I. Introduction

- A. Evaluation leads to problem solution within the capacities of the organism1.
 - 2.

II. Prototypical Phenomena

III. Common Conceptual Issues

- A. Degree of dependence on environmental stimuli
 - 1. source of stimulus
 - a. exteroceptive
 - b. proprioceptive
 - 2. degree of sensitivity to contextual alterations
 - 3. degree of independence of eliciting and steering function
 - a. eliciting and target same
 - b. eliciting and target different
 - 4. degree of dependency on control feedback
 - a. substantial dependency on control feedback
 - b. minimal dependency on feedback
- B. Type of metaphor
 - 1. hydraulic metaphor
 - 2. control system
 - 3. correlative

IV. General Classes of Environment-Behavior Relationships

- A. Reflex $S\# \rightarrow R\#$ (part of the body)
 - 1. behavior general
 - a. the spinal cord and its segmental control functions
 - i. intrasegmental reflex

- (1) stretch reflex
- ii. crossed extensor reflex
- iii. intersegmental reflexes
- b. intersegmental reflexes
 - i. reflex "figure"
- ii. tonic neck reflex
- iii. visceral reflexes
- 2. medulla and its suprasegmental control functions
 - a. decerebrate reflexes
 - i. positive supporting reaction
 - b. righting reflex
- 3. other reflex control

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- 2. illustrative research
- 3. explanatory perspective
 - a. determinants of behavior
 - i. instantaneous
 - ii. semi-short
 - iii. short
 - iv. medium
 - v. long
 - b. population context
 - c. cellular machinery
- 4. conceptual and cognitive metaphors
- B. Kinesis
 - 1. behavior
 - 2. illustrative research
 - 3. explanatory perspective
 - a. determinants of behavior
 - i. instantaneous
 - ii. semi-short
 - iii. short
 - iv. medium
 - v. long
 - b. population context
 - c. cellular machinery
 - 4. conceptual and cognitive metaphors
- C. Taxis
 - 1. 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
- D. Modal (fixed) action pattern
 - 1. behavior
 - 2. illustrative research
 - 3. explanatory perspective
 - a. determinants of behavior
 - i. instantaneous
 - (1) magnitude of reaction
 - (a) normal releasers
 - (b) supernormal releasers
 - ii. short
 - iii. medium
 - iv. long
 - b. population context
 - c. cellular machinery
 - 4. conceptual and cognitive metaphors
- E. Reaction chain (reflex chain)
 - 1. 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
- F. Imprinting
 - 1. 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

- G. Adjunctive behavior
 - 1. 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

V. Changes in the Strength of a Reaction: Virtually Immediate, Virtually No Hysteresis

- A. Threshold
 - 1. 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
- B. Spatial summation
 - 1. 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
- C. Temporal summation
 - 1. 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
- D. Cooperation
 - 1. 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
- E. Successive induction
 - 1. 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
- F. Reciprocal inhibition / antithesis
 - 1. 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

- G. Momentum / after discharge
 - 1. 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
- H. Irradiation
 - 1. 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
- I. Latency
 - 1. 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
- J. Refractory period
 - 1. 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
- K. Sensitization
 - 1. 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
- L. Dishabituation
 - 1. 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
- M. Disinhibition
 - 1. 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
- N. Spontaneous recovery
 - 1. 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

VI. Changes in the Strength of a Reaction: Onset Hysteresis, Virtually No Offset Hysteresis

- A. Fatigue
 - 1. 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
- B. Sensory adaptation
 - 1. 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
- C. Habituation
 - 1. 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
- D. Pseudoconditioning
 - 1. 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
- E. Potentiation
 - 1. 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
- F. Exercise
 - 1. 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
- G. General emotional reactivity (affective dynamics)
 - 1. behavior
 - 2. illustrative research
 - 3. explanatory perspective

- a. determinants of behavior
 - i. instantaneous
 - ii. short
 - (1) shock
 - (2) love
 - (3) parachute jump
 - iii. medium
 - iv. long
- b. population context
- c. cellular machinery
- 4. conceptual and cognitive metaphors

CHAPTER 7

Functional Relationships Between Fixed Stimuli and Fixed Responses: "Innate Behavior"

I. Introduction

Note that this lower layer of the structure does not present short-term relationships, and that it has no dependence on ontogenetic contingency history. This class of functional relationships is neither flexible nor arbitrary, but rather is forced by the eliciting stimulus. The defining characteristic of this class of behavior is that the functional relationship between the fixed stimulus and the fixed response was selected across evolutionary time (long-term adaptation). This behavior is almost always studied in the instantaneous time domain; that is, stimuli are presented and the elicited response is measured. The functional laws are most typically determined by documenting how the response changes as a function of changes in the properties or context of the stimulus (i.e., instantaneous time scale). How the longterm contingencies actually developed the functional relationship is very difficult to experimentally study and is often, therefore, a post hoc presumption. Unfortunately, the weakness of that assumption is often lost somewhere along the line.

This bottom layer of the structure details functional relationships between what could be labeled fixed stimuli and fixed responses and is included in the conceptual structure figure (and in this manuscript) for pedagogical reasons. This bottom layer provides an evolutionary context for the rest of the structure, and the rest of the manuscript.



A fixed stimulus (S#) elicits a fixed response (R#). For example, light in the eye elicits pupillary contraction or a shift in the light cycle precipitates migration. Research into each of the various units of analysis and time scales of functional relationships involving innate behavior would reveal a different "dimension" of the "cause" of innate behavior. In the broadest sense, the cause would be the population distribution of the functional relationship, the reductionistic machinery of the functional relationship, the evolutionary, developmental, learning history, and details of the changes in the behavior as a function of changes in the immediate controlling stimuli. The epistemological position is that understanding a thing's covariance understands the thing itself and, in fact, is the thing. Each time scale is an important element in the expression of the entire functional relationship. However, rarely are all of the various aspects of the behavioral adaptation the object of study. Generally, all but one are accepted as givens. The most typically studied aspect of innate behavior are those functions that characterize how the appropriate response varies as a function of the characteristics of the eliciting stimulus. An analogous approach to the study of short-term adaptation would be to detail aspects of the behavior as a function of variations of the discriminative stimulus following discrimination training, without any manipulation of the details of the discrimination training itself. In both types of research, the complete task is to identify all the environmental events which cause behavior and to develop a systematic framework with which to successfully predict. But as a matter of practicality, the sources of variance that can be easily understood are generally attacked first.



This behavioral class (fixed behaviors to fixed stimuli) has the lowest level of requisite ontogenetic contingency history (i.e., virtually none). From a long-term reductionistic perspective, these relationships can be seen to be the result of phylogenetically modified synaptic connectability. Given a selective pressure for a constant relationship between the stimulus and response, the synapses evolved toward unconditional conduction from the given stimulus to the given response. For example, given light in an individual's eye, pupillary contraction will occur. From a molar population perspective, every member of the species exhibits the behavior.

These behaviors appear to be the "rational" acts of an "aware" being. The truth is, these highly adaptive behaviors can occur when the mind is absolutely known to be gone even to the most recalcitrant mentalists because many of these behaviors occur even when the head of the organism has been removed. Fixed stimuli eliciting fixed responses, or innate behavior:

- · evolved to deal with highly predictable situations
- are very fast (in fact feedback slows them down)
- are typically unaffected by short-term consequences (e.g., frogs lunge onto pin blocks)
- eliciting stimuli can control a directed response (e.g., scratch reflex in a decerebrate dog is targeted to point of stimulation)
 - A. Evolution Leads to Problem Solution Within the Capacities of the Organism
 - 1. If animal very small sensing concentration changes done over time
 - 2. Evolution does not evolve an ability if it requires some other ability that is not there.

II. Prototypical Phenomena

If a light is directed into the eye, the pupil contracts. Moths fly toward a light, and if the light cycle shortens, migration occurs in many bird species.

III. Common Conceptual Issues

A. Degree of Dependence on Environmental Stimuli

- 1. Source of Stimulus
 - a. Exteroceptive

External location sense. For example, you are capable of touching a spot on the wall or keeping your finger on a spot that's moving.

b. Proprioceptive

Internal location sense. For example, someone could move your leg while you had your eyes closed. You would know the position of your leg anyway.

2. Degree of Sensitivity to Contextual Alterations

Many factors alter the likelihood of a reflex or model action pattern occurring to a stimulus. This makes the behavior very much more adaptive.

The stretch reflex will not occur if it produces pain.

Male sticklebacks will not court a female until after they have built the nest, they will then court females, however, they will attack the female after egg laying.

3. Degree of Independence of Eliciting and Steering Function a. Eliciting and Target Same

Sticklebacks attack the intruder Moths fly toward light Arm moves away from a hot source

b. Eliciting and Target Different

Baby cichlids (pronounced sick lids) approach black spots on mother fish regardless of source of looming object.

Compass orientation in ants

Reflex figure reflex in mammals

4. Degree of Dependency on Control Feedback a. Substantial Dependency on Control Feedback

The side-to-side adjustment in egg retrieval in the gray lag goose is governed by the movement of the egg.

Nursing in infants is governed by the presence of a nipple.

Vestibular reflex maintains head orientation with respect to gravity

b. Minimal Dependency on Feedback

Pulling the neck in (egg retrieval itself) in gray lag geese is independent of the continuing presence of the egg once the behavior is initiated.

Spiders spin cocoon independent of the functionality of the actual cocoon.

Pupillary contraction occurs even if it produces an increase in brightness

B. Type of Metaphor

There are three conceptual models used in discussions of fixed behaviors occurring to fixed stimuli. The first two are in a sense necessarily correct because the referents for their terms are adjusted based on empirical evidence until they are correct. However, this eliminates the possibility of their being explanation. The tautological nature of the hydraulic metaphor is obvious.

1. Hydraulic Metaphor

The first, a hydraulic metaphor, is simplistic, dated, and surely wrong, but it is a metaphor that is intuitively satisfying to the lay and communicates an ability to

make generally correct predictions in some situations. Unfortunately, that is little more than saying it works when it works. Its value is in its ability to satisfy the lay.

Descartes boy with foot in fire In Burghardt in Reynolds, Nevin, Burghardt

2. Control System

The second, "a control system" is probably right in that whatever is the ultimate truth will be able to be described as a control system, but in the absence of empirical systems is too vague to be very useful. Creating, post hoc, each of the steps as an intervening variable (process thought to intervene between input and output) adds nothing to our knowledge base).



3. Correlative

This approach specifies the relationship among inputs and outputs. It does not suggest how they are "connected." In fact, it can simply specify shared variance and provide an equation which specifies how the dependent variable varies as a function of all the values the independent variable could take.



IV. General Classes of Environment-Behavior Relationships

Each of the following six sections is divided into: 1) the defining characteristics of the environment/behavior class of interest (e.g., a reflex), 2) illustrative research, 3) the empirical observations of behavior as a function of environmental changes across the four time scales, 4) connections to population statistics to provide a molar context, and 5) connections to phenomena at a lower level of molarity (cellular, biological) in order to provide reductionistic machinery. Note that these last two connections (i.e., to more molar or more molecular levels) are informative but are not necessary for an productive explanation. And finally, we will explore, 6) conceptual metaphors which could also be used to "explain" the behavior. Note that these metaphors or theories are our best current explanations for the phenomenon rather than necessarily a final and flawless statement of all possible empirical functional relationships.

Because, to date, the almost exclusive research focus on fixed behaviors to fixed stimuli has been on immediate-term functional relationships, the other time scale headings will often be empty sets. Additionally, research focus has been very much more targeted to reductionistic machinery than molar contexts, even to the point of ignoring the function relating the output to systematic changes in the input. The bad news is that the various categories in which we are interested will often be empty. The good news is that vast areas of ignorance remain to be conquered. Take your pick of areas and become the progenitor of an entire field. Be the Pavlov or Skinner of your area of interest.

A. Reflex $S# \rightarrow R#$ (part of the body)

1. Behavior General

A reflex is a simple, relatively fixed, virtually inevitable, stereotyped movement of a part of the body in response to a relatively specific simple stimulus. The functional relationship occurs in virtually every member of the species. For example, pupillary contraction to light. An eliciting stimulus is said to elicit the response. Reflexes are somewhat atypical of the behaviors discussed in this chapter because reflexes are most often seen as actions of a part of the organism rather than the whole organism.

Sechenov and Sherrington, as well as Pavlov in the early portion of his career, studied how a stimulus elicited a subsequent response. Their studies were examples of examining functions in the instantaneous time scale.



a. The Spinal Cord and its Segmental Control Functions

2 Behavior Examples

This research concerns the mediation of local segmental spinal reflexes in "spinal" animals." These reflexes do not require a head. The are very low level reflexes which control surprisingly complex behaviors. Often these behaviors are seen as guided by a mind. This is clearly a ridiculous explanation considering the effective absence of the head.

Spinal mammals show the basic rhythmicity of quadruped locomotion even though they cannot move about or cater to their needs. Those behaviors apparently require control or coordination from higher centers.

Spinal reflexes occur in the absence of ontogenetic experience and are presumably phylogenetically programmed. In fact, they seem impervious to learning. When limbs buds were reversed in amphibians, the animal moved in inappropriate directions and did not get better with experience.

i. Intrasegmental Reflex

These reflexes work when the spinal cord is cut at either end of the segment, so that no control from the brain, or other spinal segment for that matter, is possible.

(1) Stretch Reflex

One example is the monosynaptic stretch reflex. Passive stretch of one of the limbs results in resistance caused by compensatory contraction triggered by the stimulus of stretching. Virtually all muscles show this response but it is strongest in those that counteract gravity. The extensors can be inhibited by withdrawal from pain which is prepotent over postural stretch reflexes. The inhibition of antagonists is caused by reciprocal innervation.

ii. Crossed Extensor Reflex

A second example of an intrasegmental reflex is the crossed extensor reflex. When the flexor of a limb contracts in response to stimulation, that response is accompanied by the extension of the contralateral limb. This reflex permits the support of the body posture.

b. Intersegmental Reflexes

These reflexes are the results of interconnections between several segments of the spine.

i. Reflex "Figure"

If we stimulate one limb we get:

- 1. withdrawal of that limb
- 2. extension of the limb on the other side
- 3. flexion of the limb on the other side other end
- 4. extension of the limb on the same side other end

This pattern keeps the animal upright when a leg is raised.

ii. Tonic Neck Reflex

If we turn the head to the right, right limbs extend and left limbs flex. This reflex prepares the animal for turning.

If we tip the head up, the forelimbs extend, and the rear limbs flex. This reflex prepares the animal to jump, sit, or "look at a bird"

If we tip the head down, the forelimbs flex, the rear limbs extend. This reflex prepares the animal to eat or "look at a mouse."

iii. Visceral Reflexes

Visceral reflexes such as consummatory sexual response, alimentary, and excretory functions.

2. Medulla and its Suprasegmental Control Functions

These reflexes require the section of the spine which is in the skull (medulla) but do not require any higher brain at all. The medulla is the modified rostral extension of the spinal cord. As a result, it controls the reflexes in its segment, the head. It receives and sends fibers to the head by way of ten cranial nerves. The medulla functions to control integrated postural and righting reactions across all segments.

a. Decerebrate Reflexes

These reflexes are exhibited in decerebrate animals in which all connections from the medulla to higher centers is severed. They cannot be explained by appeals to a mind, in that none of the higher brain remains.

i. Positive Supporting Reaction

Contact with the skin of the hoof (and the separation of the toe pads in the dog) produces a continuous reflex which turns the limbs into rigid pillars (but in the absence of a vestibular system such an animal will topple when it's balance is disturbed).

b. Righting Reflex

Reflexes associated with the vestibular system maintains the head in a horizontal position no matter what the orientation of the body. Tonic neck reflex then aligns the body with the head if possible. This reflex can be easily seen in a normal cat by dropping it upside down. It will quickly right itself.

3. Other Reflex Control

A low mesocephalic cat will take a few unsteady steps when intensely stimulated. Respiration is organized in the medulla and can continue in a rabbit with all of its brain removed with the exception of the medulla. Decerebrate animals can swallow when food is placed into the pharynx. Vomiting which requires the coordination of respiratory, gastric and other behaviors is also controlled in the medulla.

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 reflexes operating at this time scale of adaptation include; what stimulus precipitates the response and the minimally sufficient strength of the requisite stimulus, the functional relationships include the structural details of the resulting behavior, and how the behavior changes as a function of changes in the stimulus. 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.

For example,

x x

ii. Semi Short

The determinants of reflexes operating at this time scale of adaptation include; how the behavior to a stimulus change, changes as the result of repeated presentations across a short time span. It is how exposure to repeated events change behavior. Examples would be habituation, potentiation, sensitization, fatigue, and sensory adaptation.

iii. Short

Generally, associative or short-term effects are not considered with respect to reflexes as such because they are not applicable. The topic of this course is associative short-term behavior adaptation (reflex and operant conditioning).

For example,

X

x

iv. Medium

The determinants of reflexes operating at this time scale of adaptation include; how behavior changes "irreversibly" (for that individual) as the result of repeated or enduring exposure to stimuli or functional relationships. This class of functional relationships has been traditionally labeled "developmental" phenomena. Some changes in reflexes are purely a function of maturation rather than experience (such as the change in the Babinski reflex with age). It is an open question whether these changes should be considered medium-term adaptation or simply a genetically programmed reflex which is enabled or disabled at a certain age. An example medium-term change in reflexes is the change from phonetic to semantic generalization with exposures (Razran, in Malone p 87).

x x

v. Long

The determinants of reflexes 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 produce a species). This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena. Note that evolution does not produce behavior adaptive for the future. Rather, it is adaptive for the past. Moths fly toward light which is generally a pretty good idea for the species as a whole, but obviously not for the individual moth near a candle at night. Note also that most research categorized in textbooks as evolutionary, innate or instincts is actually instantaneous time scale research because it only measures immediate output as a function of immediate input. Longterm time scale research would breed behavioral changes.

It is relatively easy to infer that the reflex exhibits long-term adaptation (i.e., it is altered across evolutionary time). For example, in dogs flexors are controlled by foot pain, while in sloth's extensors are controlled by foot pain. But, an evolutionary source of the difference is an inference rather than an experimentally supported fact.

Staddon has pointed out that the common ancestor of humans and octopuses did not have an eye, so the eye evolved independently in the two species, yet they both have analogous reflexes. This is a strong indication that the forces which guided the evolution of systems which protect visual sensors from strong light are reliable.

The clearest examples of effects across this time scale are studies in behavior genetics (in Hall). Currently, the most exciting research is done by Lyudmila Trut in Siberia.

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b. Population Context

This class of explanations for reflexes includes how the population frequency of specific functional relationships are changed by experimental manipulations. Note that not all time scales are exhaustively detailed in this section. Note also that this class of information is often provided without a conceptual context (e.g. 37% of the subjects responded ...) This class of explanation has traditionally been labeled "sociological" phenomena. Some reflexes are extremely pervasive in the population. For example, pupillary contraction occurs in every human (and in fact, in virtually every species with an eye). The population frequencies for a behavior or functional relationship across a given time scale are important in correctly interpreting those behaviors and relationships. The most obvious example being the data that lead to Mendelian genetics.

x x

c. Cellular Machinery

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

A reflex arc is defined as the set of neurons containing afferent sensory neurons which activate efferent (motor or visceral) neurons, typically by way of intervening neurons.

Substantial work has been done on the effects of various surgical or chemical interventions on the characteristics of a wide variety of reflexes.

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3. Conceptual and Cognitive Metaphors

This class of explanations for reflexes include: 1) quantitative models which specify output as some mathematical transformation of the input, 2) models which quantitatively or qualitatively characterize how the process which actually intervenes between the input and the output works, 3) hypothetical models which produce correct predictions of output based upon 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.

Descartes - animal spirits flow up and are reflected back

Sherrington - neurons, synapses, excitation and inhibition

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B. Kinesis

1. Behavior

Overall undirected body movement; not oriented with respect to the source of the stimulation; random orientation but "engaged" by the stimulus. Stimuli affect the overall class of behavior, but not its orientation. Orthokinesis is a change in the rate of a behavior. Klinokinesis is a change in the rate of turning (K & T page 129).

The distinction between a reflex and a kinesis is somewhat arbitrary, but a reflex is seen as simpler, activates only a part of the body, is less extended in time, and is not generally involved in relocating the entire organism with respect to some environmental determinant.



2. Illustrative Research

The prototypical example is the movement of wood lice. Wood lice are typically found in humid or damp areas and are rarely found in dry areas. Analysis has shown that they move more often in dry areas than in humid areas. thus, "taking" them *to* and "keeping" them *in* humid areas. Similarly, Flat worms stop in dark and move in light. Body lice alter their rate of turning to accomplish similar ends. The absence of "host" stimuli lead to straight line movements. When moving in to decreasing stimuli, the louse turns. Other animals turn more in favorable conditions, thus staying where it is good.

- 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 kinesis 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. Semi Short

x

X

iii. Short

The determinants of kinesis 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.

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iv. Medium

The determinants of kinesis 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.

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v. Long

The determinants of kinesis 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 produce a species). This class of functional relationships has been traditionally labeled "comparative or ethological" phenomena.

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b. Population Context

This class of explanations for kineses includes how the population frequency of specific functional relationships are 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

c. Cellular Machinery

This class of explanations or kineses 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 or kineses 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

Most typically the kineses are explained as a control systems (i.e., act, test, and either stop or return to act). It is simply a broad concept and, in its most abstract, is surely correct. Unfortunately, it is also of little use beyond providing the most general intuitions of what to expect.

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C. Taxis

1. Behavior

Overall stimulus directed body orientation. Technically, the orientation is the tactic behavior. The locomotion is nontactic. For example:

• a moth flying toward a light

- an earthworm turning away from light
- a maggot moving away from light
- a tree snail moving away from gravity (pull on shell)
- an ant moving in straight line at a constant angle to sun

The distinction between a kinesis and a taxis is that a kinesis is undirected whereas a taxis is directed.

Technically, several taxes are recognized:

Klinotaxis. Successive comparisons of light on either side of body via pendulumlike movements

Tropotaxis Simultaneous comparison of amount of stimulation on both sides of body without side-to-side movements.

Telotaxis. Animal orients to one or two light sources even with one eye.

Menotaxis. Animal orients at a constant angle to the light source.



2. Illustrative Research

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



a. Determinants of Behavior

i. Instantaneous

The determinants of taxes 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 taxes 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 taxes 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 taxes 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.

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b. Population Context

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

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c. Cellular Machinery

This class of explanations for taxes 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 taxes 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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D. Modal (Fixed) Action Pattern (MAP)

1. Behavior

Stimulus elicits a series of complex behaviors which:

- 1) are part of the repertoire of virtually all members of a species; and may be unique to that species.
- 2) require no learning experience (but common behavior doesn't prove absence of learning)
- 3) often have a fixed form and rigid order, regardless of adaptiveness.
- 4) are activated by a specific stimulus (sign stimulus or releasing stimulus)

For example, Herring Gull chicks peck at a red dot located near the end of the adult's beak in the absence of any training or reinforcing history.

The distinction between modal (fixed) action patterns and a simple reflex is somewhat arbitrary but a reflex is: seen as simpler, activates only a part of the body, is less extended in time, and does not involve an extended sequence of interrelated behaviors. A modal action pattern differs from a kinesis and a taxis in that the latter are simple functions which only relocate simple organism, whereas a modal action pattern could be any of a wide variety of behaviors, including those behaviors necessary to relocate birds to a different hemisphere during different seasons.



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 MAPs 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.

(1) Magnitude of Reaction(a) Normal Releasers

Herring Gull chicks peck their parent's beaks. This is a stimulus that elicits regurgitation in the parent. This, in turn, produces food in front of the chick and the chick then gets a meal. Analysis has shown that the chick will peck a red dot located on any long thin object pointed downward.

Squirrels bury nuts with stereotyped sequence near base of tree or rock. It digs, pushes nut with nose, then covered with sweeping motions followed by tamping. Analysis has shown cage-reared monkeys (deprivation experiment) fed liquid diet will do same thing when first given nuts.

Male Sticklebacks will attack a rival male in their territory. Analysis has shown that the Stickleback will attack almost anything with a red underside. The male stickleback will not attack males with their undersides painted over.

(b) Supernormal Releasers

Herring Gulls will retrieve eggs that roll out of the nest. Analysis has shown that green > yellow > brown > blue eggs; that more speckled > less speckled; and that larger > smaller. The gull will retrieve a very unnatural egg in preference to its own.

ii. Short

The determinants of MAPs 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 MAPs 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.

х

iv. Long

The determinants of MAPs 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 for MAPs includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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c. Cellular Machinery

This class of explanations or MAPs 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.

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4. Conceptual and Cognitive Metaphors

This class of explanations or MAPs 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 works, 3) hypothetical models which produce correct predictions of output based upon 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 two conceptual models used most often in discussions of modal action patterns are the hydraulic metaphor and a control system (both previously discussed).

E. Reaction Chain

1. Behavior

This category refers to very complex behavioral adaptation which is in actuality a series of isolated MAPs under the control of a series of stimuli produced by the sequence of behaviors. Each reaction continues until a new stimulus which, in turn, elicits next response. For example,

x x

> Hermit crabs without shells have no shell - locomote see a shell - approach shell touch shell - explore shell external OK - search for hole hole full - dig out hole empty hole - try on shell



2. Illustrative Research

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



Explanatory Perspective Determinants of Behavior Instantaneous

The determinants of reaction chains 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 reactions chains 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 reaction chains 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 reaction chains 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 for reaction chains includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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Х

c. Cellular Machinery

This class of explanations for reaction chains includes how underlying cellular activity (neuronal and 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 reaction chains 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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F. Imprinting

1. Behavior

Exposure to a stimulus within a temporal window (such as early in life) that controls a response. This exposure also alters the functionality of that stimulus in the future. Imprinting straddles the fixed stimulus producing fixed response category. It is like a taxis in that the stimulus controls a directed behavior, but it is like learning in that it requires specific ontogenetic experiences to define the stimulus, but altered functionality of a stimulus is most typically the result of learning via contingency. This class is also atypical of the general category in this manuscript section in that the effect of the exposure can occur many years later.



2. Illustrative Research

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



a. Determinants of Behavior

i. Instantaneous

The determinants of imprinting 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 imprinting 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.

х

х

iii. Medium

The determinants of imprinting 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 imprinting 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.

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b. Population Context

This class of explanations for imprinting includes how the population frequency of specific functional relationships are 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

c. Cellular Machinery

This class of explanations for imprinting includes how underlying cellular activity (neuronal and 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

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4. Conceptual and Cognitive Metaphors

This class of explanations for imprinting 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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G. Adjunctive Behavior

1. Behavior

The intrusion of some other behavior into a procedure which did not originally control that behavior. The occurrence of this functional relationship requires a "training" phase. After extended exposure to some specific procedure, a reflexive behavior emerges. It is as if the threshold for the elicitation is decreased by the extended exposure. The required training phase makes this functional relationship somewhat atypical of the others in this chapter. However, the fixed stimulus eliciting a fixed response identifies it with the others of this class.



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 adjunctive 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 adjunctive 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 adjunctive 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.

х

X

iv. Long

The determinants of adjunctive 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 for adjunctive behavior includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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c. Cellular Machinery

This class of explanations for adjunctive behavior 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 adjunctive behavior 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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V. Changes in the Strength of a Reaction: Virtually Immediate, Virtually No Hysteresis

Behavior is not invariant, it is sensitive to variations in the eliciting stimulus as well as variations in the context of the eliciting stimulus. The context may be as simple as the occurrence of other stimuli or it could be the history of experience with that particular stimulus.

Traditionally, immediate-term effects, population frequencies, and connec- tions to reductionistic systems are the exclusive interest of research in this area.

A. Threshold

1. Behavior

The defining property of this class of adaptation is that the intensity of the eliciting stimulus alters the probability of the reaction occurring. Stimulus intensity must exceed some minimum energy to control a response. Proportion of time a stimulus is effective increases as a sigmoid function of the energy level of the stimulus.



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 thresholds 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.

Almost all traditional classical psychophysics goes here.

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ii. Short

The determinants of thresholds 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.

The acquisition of a probability or a payoff effect and the contingencies that alter it would go here.

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iii. Medium

The determinants of thresholds 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.

The effects of aging on the threshold would not go here unless it had to do with specific exposures.

х

х

iv. Long

The determinants of thresholds 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.

Species differences in hearing thresholds (e.g., dogs and humans) could be used as a likely example here. Genetic manipulations showing differences in sensitivity to specific substances would go here.

x x

b. Population Context

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

This would be characterizing the population frequencies of threshold sensitivities and what procedures changed those population frequencies and in what way. х

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c. Cellular Machinery

This class of explanations for thresholds 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.

This would be the biological variations that cause variations in the threshold.

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4. Conceptual and Cognitive Metaphors

This class of explanations for thresholds 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 works, 3) hypothetical models which produce correct predictions of output based upon 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. Classical psychophysics threshold theory
- 2. Theory of signal detection and how an observer makes decisions based on criterion

х х **B.** Spatial Summation

1. Behavior

Two subthreshold stimuli if presented in spatial proximity will elicit the behavior.



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 spatial summation 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 spatial summation 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 The determinants of spatial summation 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 spatial summation 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.

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b. Population Context

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

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c. Cellular Machinery

This class of explanations for spatial summation 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

4. Conceptual and Cognitive Metaphors

This class of explanations for spatial summation 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 works, 3) hypothetical models which produce correct predictions of output based upon 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

C. Temporal Summation

1. Behavior

Two subthreshold stimuli if presented together in temporal proximity will elicit

the behavior.



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 temporal summation 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 temporal summation 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.

х

iii. Medium

The determinants of temporal summation 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 temporal summation 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 for temporal summation includes how the population frequency of specific functional relationships are 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

c. Cellular Machinery

This class of explanations for temporal summation 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

4. Conceptual and Cognitive Metaphors

This class of explanations is for temporal summation 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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D. Cooperation

1. Behavior

Subthreshold stimulus for withdrawal and subthreshold stimulus for scratch together enough to lift leg, even though they are two different systems.





2. Illustrative Research

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



Explanatory Perspective Determinants of Behavior Instantaneous

The determinants of cooperation 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 cooperation 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.

х

iii. Medium

The determinants of cooperation 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 cooperation 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.

х

х

b. Population Context

This class of explanations for cooperation includes how the population frequency of specific functional relationships are 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

c. Cellular Machinery

This class of explanations for cooperation 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.

х

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4. Conceptual and Cognitive Metaphors

This class of explanations for cooperation 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

E. Successive Induction

1. Behavior

A response can be facilitated by the prior activation of its opponent. For example, if CS+ and CS- alternate, then successive induction is evidenced by the CS- controlling an especially low rate immediately following the CS+, and CS+ controlling an especially high rate immediately following the CS-.

$$S_{-1}^{\#} \longrightarrow R_{-1}^{\#} \qquad S_{1}^{\#} \longrightarrow 0 \qquad S_{-1}^{\#} S_{1}^{\#} \longrightarrow R_{1}^{\#}$$

2. Illustrative Research

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



i. Instantaneous

The determinants of successive induction 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 successive induction 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. х

iii. Medium

The determinants of successive induction 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 successive induction 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 for successive induction includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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Х

c. Cellular Machinery

This class of explanations for successive induction 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

х

4. Conceptual and Cognitive Metaphors

This class of explanations for successive induction 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 works, 3) hypothetical models which produce correct predictions of output based upon 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. Perceptual contrast - it's as if the negative procedure makes the positive procedure more positive and vice versa.

x

F. Reciprocal Inhibition/Antithesis

1. Behavior

The activation of a flexor can inhibit activity in the extensor. Principle of antithesis when it refers to the whole organism as in "aggression" and "submission."

$$S_{-1}^{\#} \longrightarrow R_{-1}^{\#}$$
 $S_{1}^{\#} \longrightarrow R_{1}^{\#}$ $S_{-1}^{\#}S_{1}^{\#} \longrightarrow 0$

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 reciprocal inhibition 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 reciprocal inhibition 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.

х

Х

iii. Medium

The determinants of reciprocal inhibition 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 reciprocal inhibition 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.

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b. Population Context

This class of explanations for reciprocal inhibition includes how the population frequency of specific functional relationships are 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

c. Cellular Machinery

This class of explanations for reciprocal inhibition 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 reciprocal inhibition 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

G. Momentum/After Discharge

1. Behavior

A phasic reflex response can continue after its elicitor has been removed.

Chapter 7

$S_1^{\#} \longrightarrow R_1^{\#} \qquad R_1^{\#} \qquad R_1^{\#} \qquad R_1^{\#}$

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 after discharge 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 after discharge 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 after discharge 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 after discharge 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.

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b. Population Context

This class of explanations for after discharge includes how the population frequency of specific functional relationships are 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

c. Cellular Machinery

This class of explanations for after discharge 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.

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4. Conceptual and Cognitive Metaphors

This class of explanations for after discharge 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

H. Irradiation

1. Behavior

More intense stimuli control behavior in more response systems.



2. Illustrative Research

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



The determinants of irradiation 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 irradiation 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 irradiation 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.

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iv. Long

The determinants of irradiation 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 for irradiation includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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X

c. Cellular Machinery

This class of explanations for irradiation 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 irradiation 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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I. Latency

1. Behavior

Stronger stimuli produce a response with shorter delay from stimulus onset.



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 latency 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.

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ii. Short

The determinants of latency 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 latency 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.

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iv. Long

The determinants of latency 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 for the refractory period for the latency includes how the population frequency of specific functional relationships are 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

c. Cellular Machinery

This class of explanations for the refractory period for the latency 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

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4. Conceptual and Cognitive Metaphors

This class of explanations for the refractory period for the latency 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

J. Refractory Period

1. Behavior

After once elicited, the threshold may increase for a short time. It takes more to elicit a reaction the second time if the attempts are made in quick succession.



2. Illustrative Research

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



Explanatory Perspective a. Determinants of Behavior i. Instantaneous

The determinants of the refractory period 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 the refractory period 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.

х

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iii. Medium

The determinants of the refractory period 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 the refractory period 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 for the refractory period includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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c. Cellular Machinery

This class of explanations for the refractory period 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 the refractory period 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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K. Sensitization

1. Behavior

A stimulus presentation which increases the effectiveness of some other specific stimulus. It appears that the sensitizing stimulus decreases the threshold for the test stimulus. Less stimulus-specific than habituation. Strong stimuli often tend to produce sensitization. For example,



2. Illustrative Research

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

(Davis, 1974) 25-min loud noise 80 dB --> increased startle to tone for 10-15 min afterwards

Other procedures --> increased hind limb flexion for 3 seconds

Stronger stimulus --> more sensitizing effect for longer

Effect generalizes more broadly than habituation. Foot shock increases effect of both visual and auditory.

Shock does not sensitize taste. Appears that exteroceptive and interoceptive are "seen" as different stimuli.

3. Explanatory Perspective

a. Determinants of Behavior

i. Instantaneous

The determinants of sensitization 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 sensitization 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 sensitization 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.

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iv. Long

The determinants of sensitization 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.

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b. Population Context

This class of explanations for sensitization includes how the population frequency of specific functional relationships are 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

c. Cellular Machinery

This class of explanations for sensitization 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.

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4. Conceptual and Cognitive Metaphors

This class of explanations for sensitization 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 works, 3) hypothetical models which produce correct predictions of output based upon 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 L. Dishabituation

1. Behavior

Following habituation training, exposing the subject to a strong stimulus abolishes habituation.

 $S_{1}^{\#} \rightarrow R_{1}^{\#}$ $S_{1}^{\#} \rightarrow R_{1}^{\#}$ $S_{1}^{\#} \rightarrow 0$ $S_{2}^{\#} - R_{2}^{\#}$ $S_{1}^{\#} \rightarrow R_{1}^{\#}$

2. Illustrative Research

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

It appears that sensitization will reactivate the response to the habituated stimulus. Kaplan, Werner & Rudy (1990) showed that if during the course of habituation in infants to a visual pattern a strong stimulus is presented (75 dB 1000 Hz sounded with stimulus), then responding is reinstated.



As can be seen, this is an effect on the habituated stimulus rather than to the novel stimulus.

3. Explanatory Perspective

a. Determinants of Behavior

i. Instantaneous

The determinants of dishabituation 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

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ii. Short

The determinants of dishabituation 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 dishabituation 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 dishabituation 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 for dishabituation includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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c. Cellular Machinery

This class of explanations for dishabituation 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

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4. Conceptual and Cognitive Metaphors

This class of explanations for dishabituation 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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M. Disinhibition

1. Behavior

Following inhibition training, exposing the subject to a strong stimulus abolishes inhibitory control.



2. Illustrative Research

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

Pavlov (1927?) drops of saliva to each of four trials each 30 seconds long during three trial metronome sounded. Drops of saliva increased in the first part of the trial.

3. Explanatory Perspective

a. Determinants of Behavior

i. Instantaneous

The determinants of disinhibition 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

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ii. Short

The determinants of disinhibition 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.

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iii. Medium

The determinants of disinhibition 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 disinhibition 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.

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b. Population Context

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

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c. Cellular Machinery

This class of explanations for disinhibition 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.

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4. Conceptual and Cognitive Metaphors

This class of explanations for disinhibition 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.
Chapter 7

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N. Spontaneous Recovery

1. Behavior

The return of a previously eliminated response which had been eliminated by some procedure The return requires only time and no special procedure (or only some unsuspected procedures). Following conditioning and extinction of a behavior, a long delay will return the behavior. The return is smaller than the original and is less enduring. With multiple spontaneous recovery procedures, the return is smaller with each implementation.



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 spontaneous recovery 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.

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ii. Short

The determinants of spontaneous recovery 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 spontaneous recovery 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 spontaneous recovery 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.

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b. Population Context

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

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c. Cellular Machinery

This class of explanations for spontaneous recovery 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

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4. Conceptual and Cognitive Metaphors

This class of explanations for spontaneous recovery 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

VI. Changes in the Strength of a Reaction: Onset Hysteresis, Virtually No Offset Hysteresis

This functional class is not short-term adaptation because it recovers without a contrary contingency.

A. Fatigue

1. Behavior

Reduction in the reaction to a stimulus as the result of "over use" of the motor system.



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 fatigue 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 fatigue 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 fatigue 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.

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iv. Long

The determinants of fatigue 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.

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b. Population Context

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

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c. Cellular Machinery

This class of explanations for fatigue 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.

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4. Conceptual and Cognitive Metaphors

This class of explanations for fatigue 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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B. Sensory Adaptation

1. Behavior

Reduction in the reaction to a stimulus as the result of "over use" of the sensory system.



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 sensory adaptation 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 sensory adaptation 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 sensory adaptation 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 sensory adaptation 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.

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b. Population Context

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

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c. Cellular Machinery

This class of explanations for sensory adaptation 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

4. Conceptual and Cognitive Metaphors

This class of explanations for sensory adaptation 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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C. Habituation

1. Behavior

Successive presentations of the same stimulus diminish the effectiveness of

reflex elicitation. Habituation is the diminution of a reflexive response as the result of repeated elicitations. For example, if someone were giving a lecture and said your name over and over, you would initially look up each time, but would eventually cease looking up each time.

1) may not be associative

not R1 (look up) paired with anything (e.g., S2 (faculty smile or reinforcer)) not S1 (saying your name) paired with anything (e.g., S2 (foot shock))

- 2) not sensory adaptation because only one of many responses to the stimulus may drop out. For example, you could continue to take notes during the lecture
- 3) not response fatigue because a different stimulus will elicit the same reaction. A different person could say your name and you would respond by looking up.

Original functional relationship returns with the passage of time. For example, after several weeks of not saying your name, if the lecturer said your name, you would again look up.



Typically, a simple decrease in responsiveness; with more complex stimuli there is often an increase followed by a decrease.

Generally, the time course of habituation is shorter than that of learning

- Type 1 Dissipates quickly (in the seconds to minutes range) and shows spontaneous recovery.
- Type 2 Possibly lasts for many days, but this type is not always found. (The question then becomes how is it different than learning?)

2. Illustrative Research

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



Peeke and Veno (1973) showed that aggression directed toward conspecific males that bordered the territory of a male decreased but that new males would elicit aggression.

Specific fish in specific locations - re-exposed to same fish same location, same fish different location, different fish same location, different location.

Minimal aggression to same fish same location, more aggression to different fish and different locations.

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Example: (Leaton, 1976) startle response in rats with 2-sec tone

3. Explanatory Perspective a. Determinants of Behavior i. Instantaneous

The determinants of habituation 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.

- 1. Initially large decrements which asymptotically approach zero
- 2. longer absence of stimuli --> more recovery
- 3. stimulus intensity effect habituation faster with weak stimuli. Habituation may not occur with very intense stimuli.
- 4. Rapid presentations of weak stimuli produce more habituation.
- 5. Overlearning effect can show effectiveness of additional trials even after

there is no observable response to the stimulus

6. Stimulus generalization reaction also occurs to similar stimuli.

ii. Short

The determinants of habituation 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.

Two classes of habituation: 1) short-term dissipates within seconds to minutes, 2) long-term persists for many days.

1. relearning effect - habituation proceeds more rapidly with each new series of exposure to the same stimulus.

iii. Medium

The determinants of habituation 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 habituation 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.

It could be speculated that habituation may be adaptive because it eliminates irrelevant background stimuli (i.e., it reduces the noise). It therefore increases signal-to-noise ratio. This may help the organism to "focus."

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b. Population Context

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

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c. Cellular Machinery

This class of explanations for habituation 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.

Kandel and Schwartz (1982) tested aplysia (sea slug). Aplysia is an apt subject because it has only a few thousand neurons. Every single one has been mapped. The behavioral adaptation was the gill withdrawal reflex. Touch siphon and it is withdrawn for a few seconds (there are 24 sensory neurons and six motors neurons). The cellular change was that the sensory neurons released less neurotransmitter.



4. Conceptual and Cognitive Metaphors

Precisely speaking, habituation is the loss of behavior like the loss of a "bank balance." Unfortunately, the same word is used for the process that produces this loss. The habituation process is that which lowers behavior like "spending." So there is the habituation effect (loss of balance) and there is the habituation process (spending).

One explanatory system, the dual process theory, suggests that there are two mechanisms. One, the S-R mechanism is activated each time a stimulus elicits a response. It is a simple "connection" type of metaphor. The second mechanism, the state mechanism is a simple energization type metaphor. It is activated only under special circumstances (e.g., being in a room at night where you have seen several cockroaches crawling around energizes you or sensitizes you so that if something touches you, you react strongly). The state mechanism may be sensitized by repeated presentations.

An important benefit of the dual process theory is the focus on secondary factors (state factor) on the progress of habituation (neurophysiological factors or drugs such as stimulants or depressants).



Rats exposed to the same tone either decreased or increased their responding depending on the background.

D. Pseudoconditioning

1. Behavior

Successive presentations potentiate effectiveness of <u>any</u> other stimulus. The S2 stimulus cannot normally elicit the reaction at even when a stronger intensity. The pseudoconditioning procedure appears to enable almost any stimulus to elicit a response related to the UR. For example,



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 pseudoconditioning 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 pseudoconditioning 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.

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iii. Medium

The determinants of pseudoconditioning 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 pseudoconditioning 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 for pseudoconditioning includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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c. Cellular Machinery

This class of explanations for pseudoconditioning 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

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4. Conceptual and Cognitive Metaphors

This class of explanations for pseudoconditioning 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

Chapter 7

X

x

1. Behavior

Successive presentations increase effectiveness of reflex elicitation. Original functional relationship returns with passage of time. For example,



Kimble and Ray 1965 If touch same spot over and over get decrease. if touch different spot over and over get increase

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 potentiation 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 potentiation 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

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iii. Medium

The determinants of potentiation 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 potentiation 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 for potentiation includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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c. Cellular Machinery

This class of explanations for potentiation 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.

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4. Conceptual and Cognitive Metaphors

This class of explanations for potentiation 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

Chapter 7

X

x

F. Exercise

1. Behavior

Practice infants at walking produces earlier walking.



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 the exercise effect 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 the exercise effect 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 the exercise effect 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 the exercise effects 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.

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b. Population Context

This class of explanations for the exercise effect includes how the population frequency of specific functional relationships are 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

c. Cellular Machinery

This class of explanations for the exercise effect 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.

4. Conceptual and Cognitive Metaphors

This class of explanations for the exercise effect 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 works, 3) hypothetical models which produce correct predictions of output based upon 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.

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G. Affective Dynamics

1. Behavior

An organism's general emotional reactivity to a situation or what is labeled "affective dynamics" shows several characteristic changes. The first is the change from the presence to the absence of the emotion arousing stimulus. The second is a change in that emotional reaction over the course of multiple exposures.

Initial onset Initial removal additional exposures subsequent removal continuing absence strong emotional response strong opposite affect minimal emotional response strong opposite affect still occurs eventual absence of affect

$$S_{1}^{\#} -> R_{1}^{\#} \quad \overline{S}_{1}^{\#} -> R_{-1}^{\#} \qquad S_{1}^{\#} -> R_{1}^{\#} \quad \overline{S}_{1}^{\#} -> R_{-1}^{\#} \qquad S_{1}^{\#} -> 0 \qquad \overline{S}_{1}^{\#} -> R_{-1}^{\#}$$

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 affective dynamics 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 affective 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 behavior.

The critical issue with respect to the placement of the following three examples is whether the effect is more like learning or more like habituation.

x x

(1) Shock

Dog restrained and shocked (Church, LoLordo, Overmier, Solomon, Turner (1966) - number of 10-sec shocks

first experience - during strong emotional response (terror) first experience - after hesitant unfriendly



extensive experience - during moderate emotional response annoyed anxious

extensive experience - after strong "joy" response rushed around, jumped on people, wagged tail

extensive experience - long after normal behavior



	(2) Love
initial during	1. love and affection in presence
initial after	2. sadness
extensive during	1. tolerance
extensive after	2. grief
	(3) Parachute Jump
initial during	1. terror
initial after	2. relief
extensive during	1. neutral
extensive after	2. high

iii. Medium

The determinants of affective dynamics 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 affective dynamics 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 for affective dynamics includes how the population frequency of specific functional relationships are changed. Note that not all time scales are exhaustively detailed in this section. This class of explanation has traditionally been labeled "sociological" phenomena.

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c. Cellular Machinery

This class of explanations for affective dynamics 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 affective 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 works, 3) hypothetical models which produce correct predictions of output based upon 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 opponent process theory was advanced to address the habituation of primary emotional responses. It is a homeostatic theory. It asserts that body reactions occur which counteract strong emotional swings and that the stabilizing response has a slow offset hysteresis and that there is no "c" response which would in turn attenuate it. b changes with experience

- 1. b becomes active sooner after onset of stimulus
- 2. its maximum intensity is greater
- 3. its slower to decay



The initial exposure triggers the primary process and virtually no compensatory opponent process



early in series of experience the b process is occurring but not asymptotically



Later in training the b process has diminished the impact of the emotion arousing stimulus almost to zero. But the long hysteresis of the b process remains so that the after effect of the presentation is the only effect. The asymptotic negative after effect is stronger than its initial effect. The b is totally responsible for after reaction.