Generalization, Discrimination, & Concept Learning

EXP 4404

Generalization

- Observed during both Classical and Operant Conditioning
- Training Stimulus (S+) is reinforced during conditioning
- Test probes of other (non-trained) stimuli are presented to measure size of response to these stimuli

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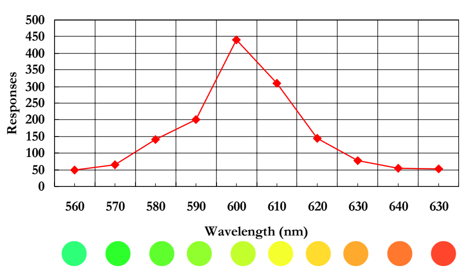
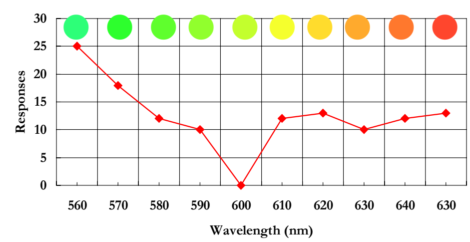
Excitatory Generalization Gradient



Training Stimulus (S+) is 600 nm

Inhibitory Generalization Gradient



Training Stimulus (S-) is 600 nm

Factors that Influence Generalization Gradients

- Degree of Original Learning
  - *stronger training*
    - *larger response to S+*
    - *reduced response to S-*
- Level of Motivation
  - *stronger response to S+ when motivation is high*
  - *shape of generalization gradient depends on the type of measure used*
    - *steep gradients when absolute responses (counts) are used as the measure*
    - *shallower gradients when relative response measure is used*

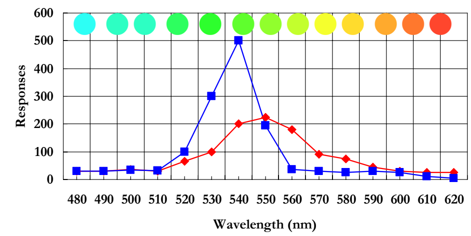
Effects of Time between Training & Test

- The longer the interval between training sessions on S+ and test sessions, the shallower the generalization gradient
- Reflects some forgetting about the details of the S+ characteristics
- Adaptive value of this form of forgetting

Effects of Prior Discrimination Training

- Steeper generalization gradients
- Peak Shift

Peak Shift



Training: S+ is 550 nm

Training: S+ is 550 nm and S- is 560

Explaining Generalization

- Explanations based on responses learned to stimuli
  - *variations in perception of stimulus during training cause spread of responses to related stimuli*
  - *contextual cues are also being conditioned and these vary from trial to trial*
  - *forgetting of stimulus attributes over time*
- Peak Shift explained in terms of a summation of excitatory and inhibitory generalization gradients

Discrimination Learning

- Training combines excitatory conditioning for one stimulus (S+) and inhibitory conditioning for a second stimulus (S-)
  - *Responses to S+ earn reinforcement*
  - *Responses to S- are extinguished (no reinforcement)*
- S+ comes to have stimulus control over behavior
  - *behavior occurs only in presence of S+*

Methods for Training Discriminations

- Successive Training
  - *only one stimulus is presented at a time*
  - *animal learns to respond when S+ is on and not respond when S- is on*
- Simultaneous Training
  - *both stimuli (S+ and S-) are presented at the same time*
  - *animal must make a choice and respond to either S+ or S-*

Practical Application of Discrimination Training

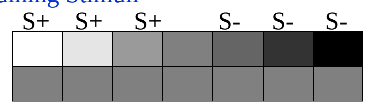
- Usefulness in determining whether an animal can sense the difference between characteristics of two stimuli
  - *Do foxes have color vision or do they see the world in shades of grey?*
  - *What are the highest and lowest sounds that elephants can hear?*
- If an animal has the sensory ability to detect that two stimuli are different, it can learn the discrimination task

Explaining Discriminations

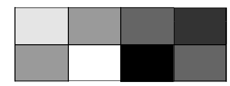
- **Conntinuity Theories**
  - *animals respond to the absolute value of a stimulus*
  - *strength of S - R connections determine whether a response is made*
  - *responses are determined by the summation of excitatory and inhibitory connections*
- **Non-Continuity Theories**
  - *focus on the role of attention: which stimulus dimension is the animal learning about?*
  - *treats learning a discrimination as a form of hypothesis testing in which animals test the validity of rules for predicting which stimuli earn reinforcement*

Explaining the Peak Shift Phenomenon

Training Stimuli



Test Stimuli



Role of Attention to Stimulus Dimensions

- **Intradimensional Shift Problems**
  - *animal learns one discrimination*
    - *e.g. is the S+ and is the S-*
  - *task changes but new discrimination uses the same characteristics*
    - *e.g., is now the S+ and is now the S-*
- **Extradimensional Shift Problems**
  - *animal learns one discrimination*
    - *e.g. is the S+ and is the S-*
  - *task changes but new discrimination is based on a different stimulus dimension*
    - *e.g., is the S+ and is the S-*

Concept Learning

- **Related to Generalization and Discrimination**
- **Requires responding to different stimuli as if they were the same (generalization)**
  - *e.g., robins, parrots, eagles, turkeys, penguins*
- **Also requires responding to different stimuli differently**
  - *e.g., horses, pigs, chickens, and goats are different from cougars, alligators, pelicans, and raccoons*

How are Concepts Represented?

- **Concepts defined in terms of a set of attributes**
  - *what defines a number as "odd" or "even"?*
    - *Logical categories can be defined clearly by a specific set of features or attributes*
  - *what defines an activity as a "game"?*
    - *Natural categories are not defined in terms of a specific set of features or attributes*
- **Family Resemblances used to determine category/concept membership**
  - *members of the category will possess some but not all attributes*
  - *not all members will possess the same set of defining attributes*

Network Models of Concept Representations

- **Nodes represent concepts**
- **Defining attributes are attached to nodes**
- **Nodes are arranged hierarchically**
  - *Cognitive Economy*
    - *attributes that characterize a node in the hierarchy also apply to all subordinate nodes in the hierarchy*
  - *Category membership and information about attributes are accessed by a process of spreading activation through the network*

Hierarchical Semantic Network

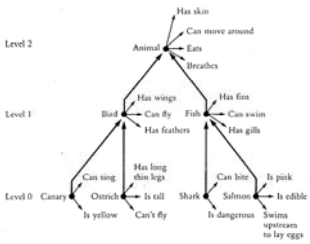
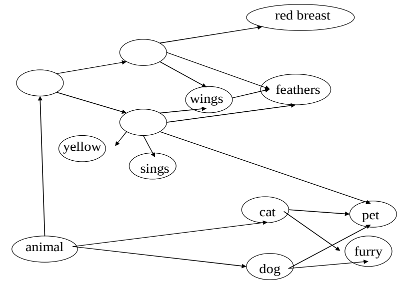


FIGURE 9.4 Example of a hierarchically organized memory structure.

Spreading Activation Semantic Network



Prototype Theory

- Proposes that concepts are represented as an abstracted set of attributes that are common to all members of the category
- Posner & Keele constructed categories based on dot patterns derived from a prototype
  - *although they never studied the prototype stimulus, subjects were very likely to correctly identify it as a member of the category*
- Prototypes don't explain our ability to correctly categorize atypical examples of a category
  - *e.g., an ostrich is a bird*

Exemplar Theory

- Proposes that we store a representation of each example (exemplar) of a category
  - *robin is stored as an example of a bird*
  - *penguin is stored as an example of a bird*
  - *sparrow is stored as an example of a bird*
- New examples are compared to our stored representations
  - *a new species of bird shares many characteristics of stored examples of birds, so we decide that it is a bird*
  - *even though an emu does not resemble many examples of birds, we may have a correctly labeled representation already stored*

Categories Have a Hierarchical Organization

- Superordinate categories
  - *very broadly based categories*
    - *plants, animals, living things*
  - *diversity of members of these categories is too broad to make them of much use*
- Basic Level categories
  - *more narrowly defined*
    - *trees, flowers, fruits, furniture, vehicles*
  - *these categories seem to be easily learned and used*
- Subordinate categories
  - *specific examples*
    - *oak tree, apple tree, pine, maple*
  - *specificity limits usefulness for making general statements*