3 Theories of Learning

3.1 Overview of Learning Theories
3.2 Behaviorism
3.3 Cognitivism
3.4 Constructivism
3.5 Learning as Social Process

Literature:

Learning is a Difficult Topic: Imprinting

• Konrad Lorenz (1952):
  – Chicklets of geese (Greylag geese) bond with the first moving stimulus they perceive – even if this is not a goose but a human being
  – Change of behavior typical for species

• Did the chicklets "learn"?
  – Is this "unlearned behavior"?
  – No "reinforced practice"
  – Definitely "experience"-based
## Theories of Learning: Overview

<table>
<thead>
<tr>
<th>Developed in</th>
<th>Behaviorism</th>
<th>Cognitivism</th>
<th>Construktivism</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913</td>
<td>1920</td>
<td>1945</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Paradigm of learning</th>
<th>Behaviorism</th>
<th>Cognitivism</th>
<th>Construktivism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulus–Reaction</td>
<td></td>
<td>Solving problems</td>
<td>Constructing knowledge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evaluation according to</th>
<th>Behaviorism</th>
<th>Cognitivism</th>
<th>Construktivism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factual knowledge</td>
<td></td>
<td>Conceptual knowledge</td>
<td>Overall competence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model of information flow</th>
<th>Behaviorism</th>
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<th>Construktivism</th>
</tr>
</thead>
</table>

![Model of information flow](image)

<table>
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<tr>
<th>Typical software</th>
<th>Behaviorism</th>
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<th>Construktivism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer-Aided Instruction (CAI)</td>
<td></td>
<td>Computer/Web-Based Training (CBT/WBT)</td>
<td>Simulation Micro World</td>
</tr>
</tbody>
</table>
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Literature:
http://www.psywww.com/intropsych/ch05_conditioning/
Classical Conditioning: Ivan Petrovich Pavlov

Ivan Pavlov (1849 – 1936)
Conditioning

- Unconditioned stimulus (US)
  - e.g. meat
- Conditioned stimulus (CS)
  - e.g. sound
- Unconditioned reaction (UR)
  - e.g. saliva
- Conditioned reaction (CR)
  - e.g. saliva
- CR and UR
  - same quality
  - CR lower magnitude than UR

- Unconditioned behavior: US → UR
- Training: US + CS → UR
- Conditioned behavior: CS → CR
Examples of Classical Conditioning

• Please think about examples in daily life where classical (Pavlov-like) conditioning takes place for humans!
Paradigm of Behaviorism

- Elaborate the laws of the relationship between stimulus and response
- *Learning* in behaviorism:
  - To condition the responses of the learning subjects to certain stimuli
- Not only Pavlov-like classical conditioning!
Edward Lee Thorndike: Connectionism

- Connection = neural connection between stimulus and response
- Assumption: All mammals learn in the same manner
  - Experiments with animals (e.g. cats and monkeys)
- Implicit assumption:
  - There is no reasoning involved in learning

Edward Thorndike (1874 – 1949)

Before the main behavioristic movement!

Thorndike puzzle boxes for cats
Thorndike: Law of Effect

- Response followed by a reward
  → strength of connection is increased

- Response followed by a punishment
  → strength of connection is decreased

- Revised law of effect (1930)
  - rewards work for reinforcement of connections
  - punishments do not influence the strength of a connection
Burrhus Frederic Skinner: Operant Conditioning

- Radical behaviorism
  - Rejects to use terms like “drive”, “motivation”
- Behavior
  - *Respondent behavior*
    » Elicited by known stimulus
    » Controlled by its *causes*
    » *“Type S” conditioning* (Pavlov-like)
  - *Operant behavior*
    » Not elicited by known stimulus
    » Just "emitted" by organism, seems to appear spontaneously
    » Probability of certain behavior is modified according to *consequences*
    » *“Type R” conditioning* (operant conditioning)

B.F. Skinner (1904 – 1990)
Principles of Operant Conditioning

• A response followed by a reinforcing stimulus tends to be repeated.
• “The only defining characteristic of a reinforcing stimulus is that it reinforces.”

To modify behavior:
• Find something that is reinforcing
• Wait until desired behavior appears
• Immediately reinforce!
The Skinner Box

- Grid floor (can be used for electric shocks)
- Light
- Lever
- Food cup (reinforcement)
Purely Observational Approach

• Reproducable experimental conditions:
  – “A pigeon is brought to a stable state of hunger by reducing it to 75 percent of its weight when well fed. It is put into an experimental cage for a few minutes each day. A food hopper attached to the cage may be swung into place so that the pigeon can eat from it. A solenoid and a timing relay hold the hopper in place for five sec. at each reinforcement.” (B.F. Skinner)

• Automated collection of data:

'SUPERSTITION' IN THE PIGEON
B. F. Skinner, Indiana University
First published in Journal of Experimental Psychology, 38, 168-172 (1947)
Discriminative Operant Conditioning

- Combination of cause- and effect-based conditioning
- Example:
  
  Light switched on → animal presses lever → food is dispensed
  
  discriminative stimulus → operant response → reinforcing stimulus

  (S\textsuperscript{D}) → (R) → (S\textsuperscript{R})

Association of interest

Is this the same as classical (Pavlov-style) conditioning?
Chaining

- **Chaining:** Reinforcing stimulus of one response acts as discriminative stimulus for another response
- Backward chaining: Adding a new stimulus to conditioned behavior
- Example:

  in test chamber $\rightarrow$ orient toward lever $\rightarrow$ light switched on $\rightarrow$ presses lever $\rightarrow$ ...

$$(S^D) \rightarrow (R) \rightarrow (S^R)$$

$$(S^D) \rightarrow (R) \rightarrow$$ ...

**Could we use this technique to learn animals to do tricks?**
Shaping of Behavior

• Over time, step-wise reinforcement of behaviors shapes behavior.

• Example:
  – How can we make pigeons to turn clockwise (completely)?
  – *Please describe how you would approach this task!*

• Is this learning? teaching?
Watch B. F. Skinner with a Conditioned Pigeon

www.youtube.com/watch?v=TtfQlkGwE2U
Extinction, Recovery

- **Extinction:**
  - Removal of reinforcement
  - Gradual process

- **Spontaneous Recovery:**
  - Learned behavior reappears

- Extinction has to be repeated several times

http://www.psywww.com/intropsych/ch05_conditioning/extinction_and_spontaneous_recovery.html
Superstitious Behavior

• *What happens if the reinforcement appears randomly, independent of what the subject animal is doing?*
  – E.g. food is dispensed at random times

• *Can you give examples of superstitious behavior of this kind in humans?*
Example: Multi-Armed Bandit


Read it up in:
(Dt.: Wie wirklich ist die Wirklichkeit?)
See also http://www.alex-sk.de/D_Wright.html
Negative Reinforcement and Punishment

- Negative reinforcement:
  - removed something desirable
- Punishment:
  - adds something non-desirable
- Estes (1944)
  - Punishment turned out as effective only in a very short time range
  - In the long run no more effective than „extinction“
- Skinner: Short term effect of punishment reinforces the punisher.
Criticism of Behaviorism

• (to be completed in classroom)
• Please list criticisms on the behaviorism approach to learning!
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Literatur:
The Gestaltists: Focus on the Human Being

• Kurt Lewin (1890 – 1947):
  – Field theory of human motivation
  – All psychological facts a human experiences make up a person’s *life space.*
  – The totality of these events determines behavior at any given time.
  – A person exists in a continually changing field of influences, and a change in one of them affects all the others.
  – Active role of the brain: acts on sensory information

• Max Wertheimer (1880 – 1943)
  – Gestalt laws for human perception
  – Rules for subjective interpretation of information by humans
Gestalt Law: Law of Closure

Gestalt Law: Law of Familiarity

- Human perception groups elements which give a known meaning.
- Several different interpretations of the same information are possible.
Wolfgang Köhler: Problem Solving in Apes

- Experiments with chimpanzees
  - Usage of tools, combinations, …
- Chickens would not be able to do that!
  - „Insightful learning“

Wolfgang Köhler (1887 – 1967)

www.youtube.com/watch?v=FwDhYUlbiQ
Wolfgang Köhler: Transposition

An experiment beyond stimulus-response connections:

Stimuli during Preliminary Training: Animal is fed only on light grey surface

Stimuli during Transposition Test: Which surface is preferred, light or dark grey?

Transposition: Principle learned in one problem, applied to another problem
Paradigm of Cognitivism

• **Cognition:**
  – Conception (Begriffsbildung)
  – Perception (Wahrnehmung)
  – Recognition (Wiedererkennen)
  – Reasoning (Schlussfolgern)

• **Learning:**
  – transformation of information to knowledge
Jean Piaget: Development of Intelligence

• Studies of variables influencing test performance of children

• **Schema**
  = potential to act in a certain way
  – E.g. “grasping”

• **Content**
  = particular manifestations of a schema (in response to specific stimuli)
  – Overt manifestations (e.g. reflexes, physical reactions)
  – Covert manifestations (thinking)
Assimilation and Accommodation

Assimilation (understanding):

NEW!
Select schema, integrate

Accommodation (learning):

NEW!
Modify schema
Learning and Failure

How is the development of knowledge related to failure?

Do all people learn in the same way from an experience?
Robert Gagné: Behaviorism & Cognitivism

• Eight kinds of learning processes:
  – Signal learning (similar to Pavlov’s theory)
  – Stimulus response (similar to Thorndike’s Instrumental Conditioning)
  – Chaining (as described by Skinner)
  – Verbal association
  – Discrimination learning
    » Different/identical responses to different stimuli
  – Concept learning
    » Generalization, classes, categories
  – Rule learning
    » Being able to demonstrate some defined behavior (e.g. calculating)
  – Problem solving