3 Theories of Learning

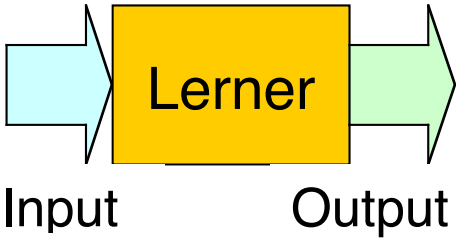
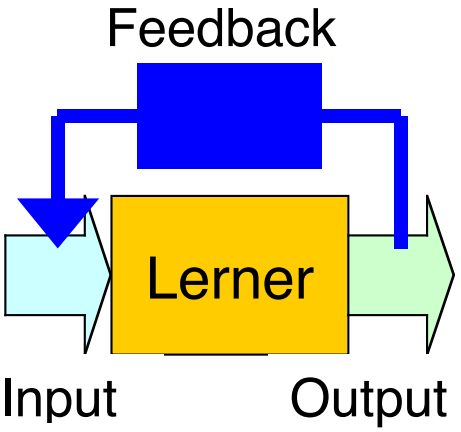
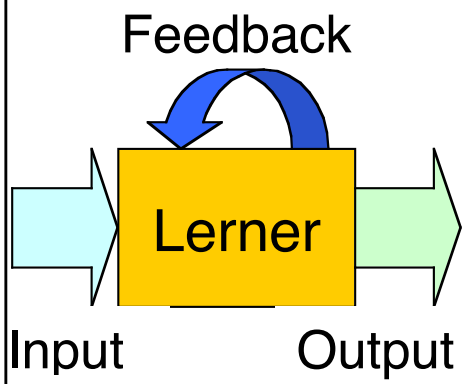
Literature:

B.R. Hergenhahn, M. H. Olson: An Introduction to Theories of Learning, 6th edition, Prentice-Hall 2001, Revised edition 2012

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

	Behaviorism	Cognitivism	Construktivism
Developed in	1913	1920	1945
Paradigm of learning	Stimulus–Reaction	Solving problems	Constructing knowledge
Evaluation according to	Factual knowledge	Conceptual knowledge	Overall competence
Model of information flow			
Typical software	Computer-Aided Instruction (CAI)	Computer/Web-Based Training (CBT/WBT)	Simulation Micro World

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

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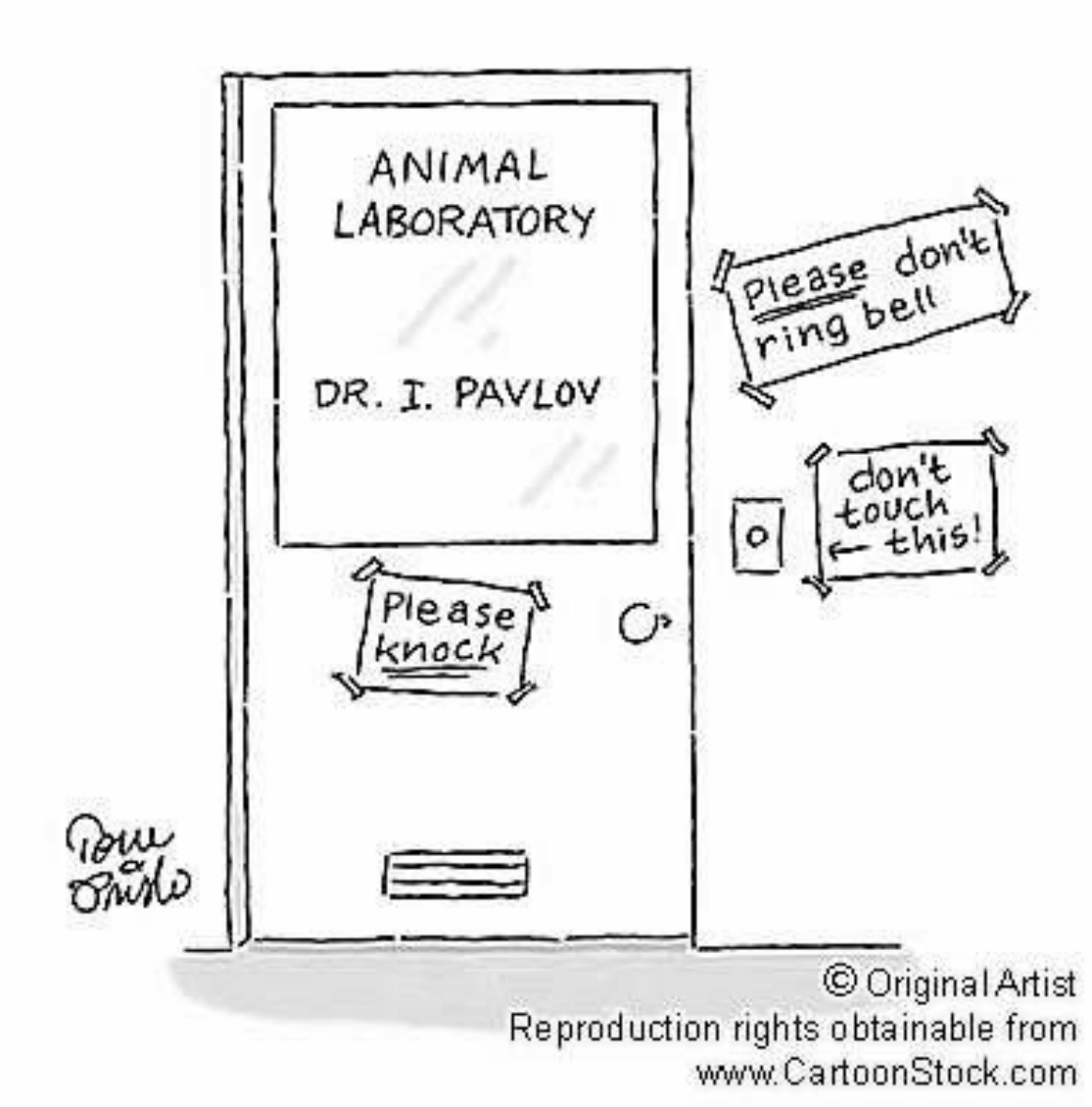
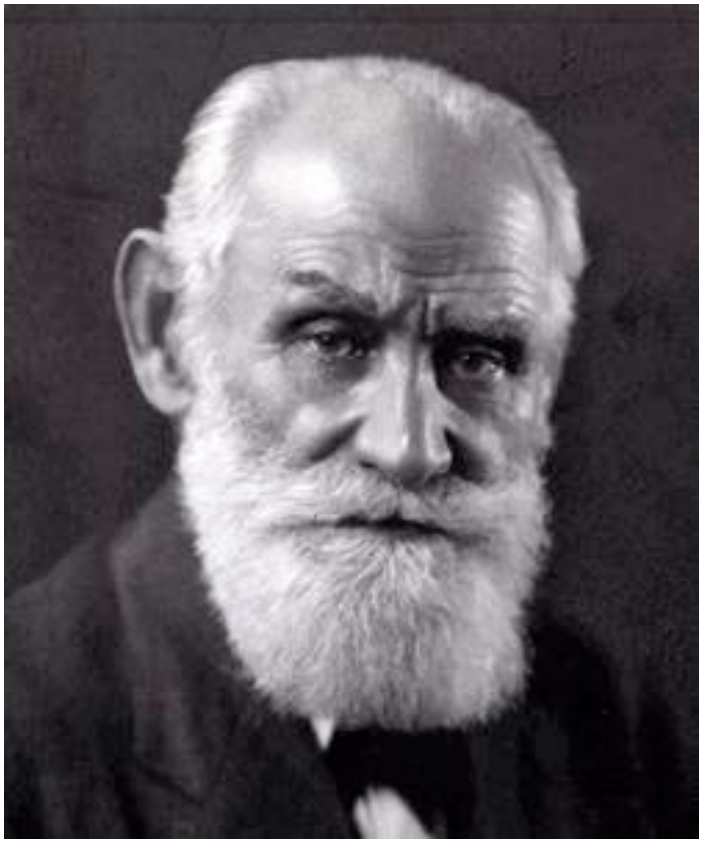
http://www.psywww.com/intropsych/ch05_conditioning/

Classical Conditioning: Ivan Petrovich Pavlov

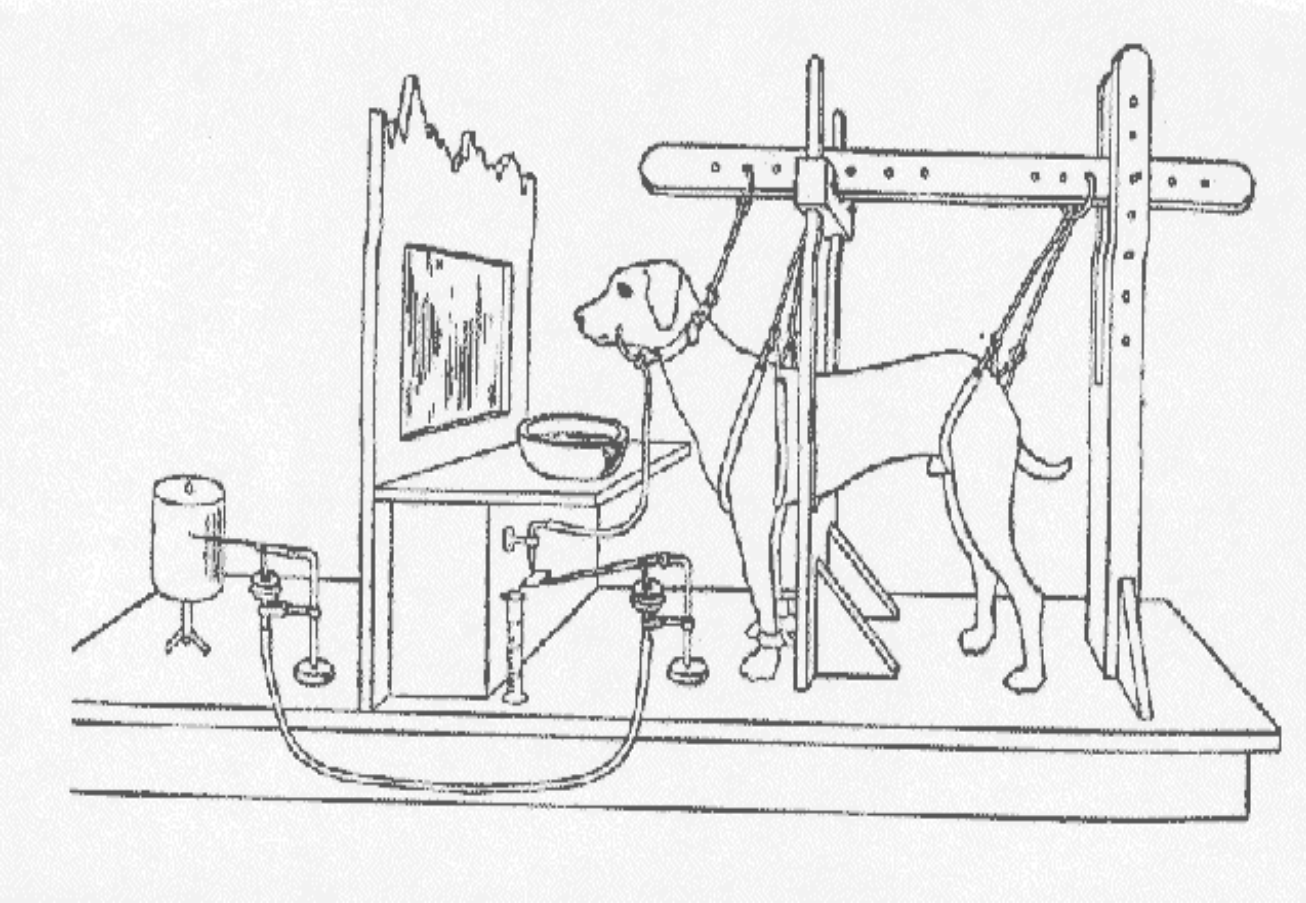




Ivan Pavlov (1849 – 1936)

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



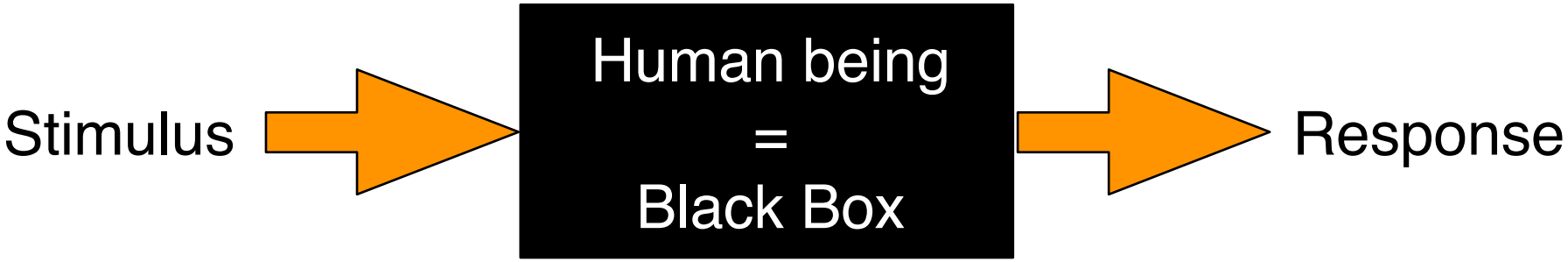
- Unconditioned behavior:
  US $\rightarrow$ UR
- Training:
  US + CS $\rightarrow$ UR
- Conditioned behavior:
  CS $\rightarrow$ CR

Bild: http://www.acs.appstate.edu

Examples of Classical Conditioning

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

Paradigm of Behaviorism



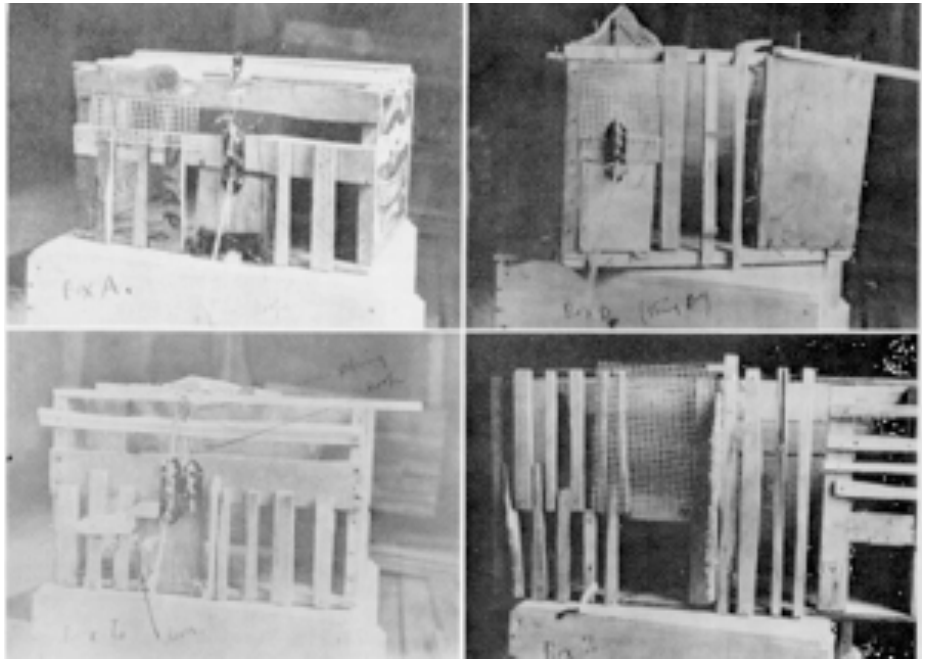
- Elaborate the laws of the relationship between stimulus and response
- ***Learning*** in behaviorism:
  - To condition the responses of the learning subjects to certain stimuli
- Not only Pavlov-like classical conditioning!

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)

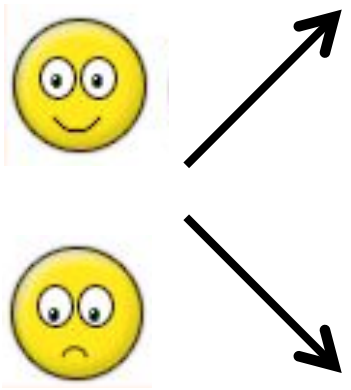
Before the main behavioristic movement!



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



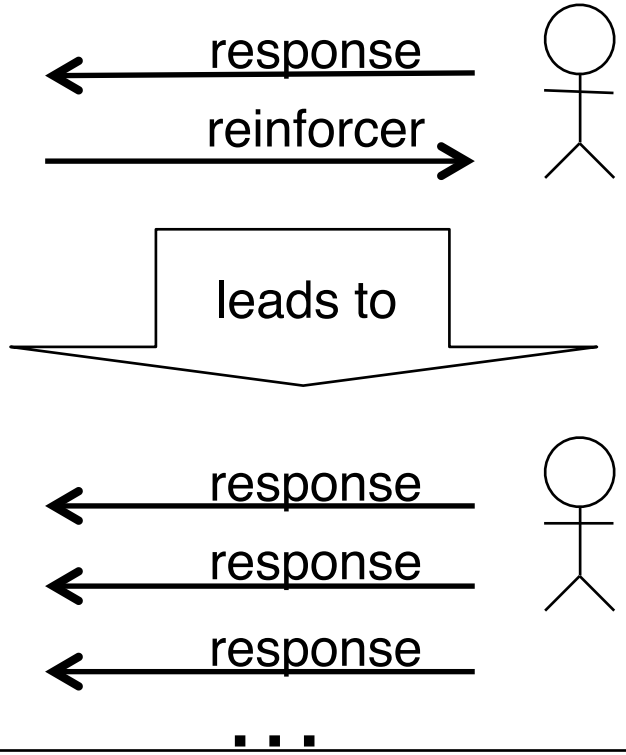
Burrhus Frederic Skinner: Operant Conditioning

- 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.”

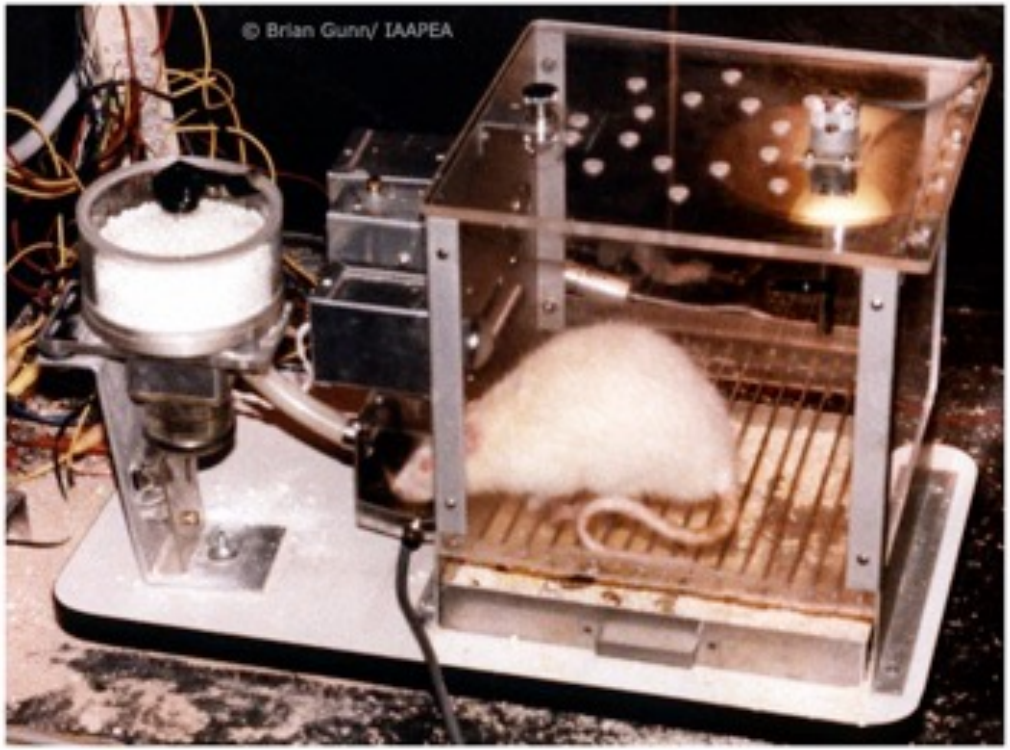


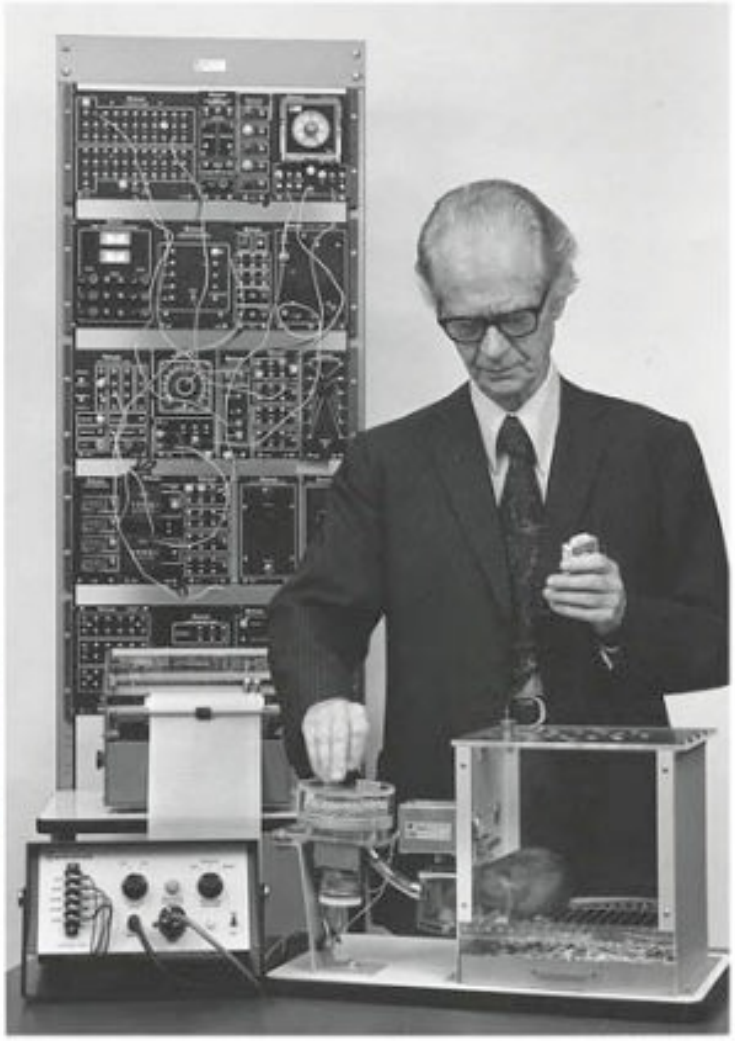
To modify behavior:

- Find something that is reinforcing
- Wait until desired behavior appears
- Immediately reinforce!

The Skinner Box

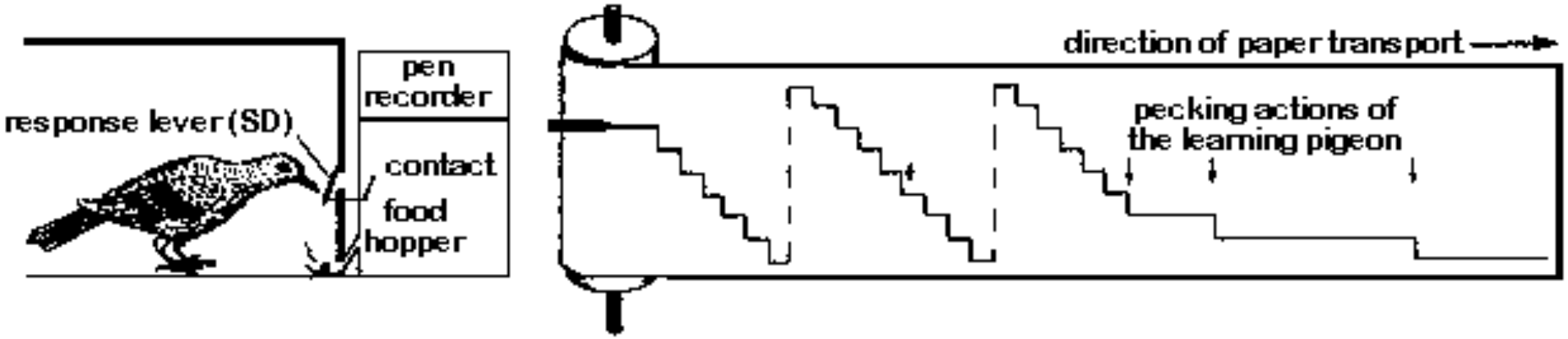
- Grid floor (can be used for electric shocks)
- Light
- Lever
- Food cup (reinforcement)





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^D)	→	(R)	→	(S^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 → orient toward lever → light switched on → presses lever → …

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

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?

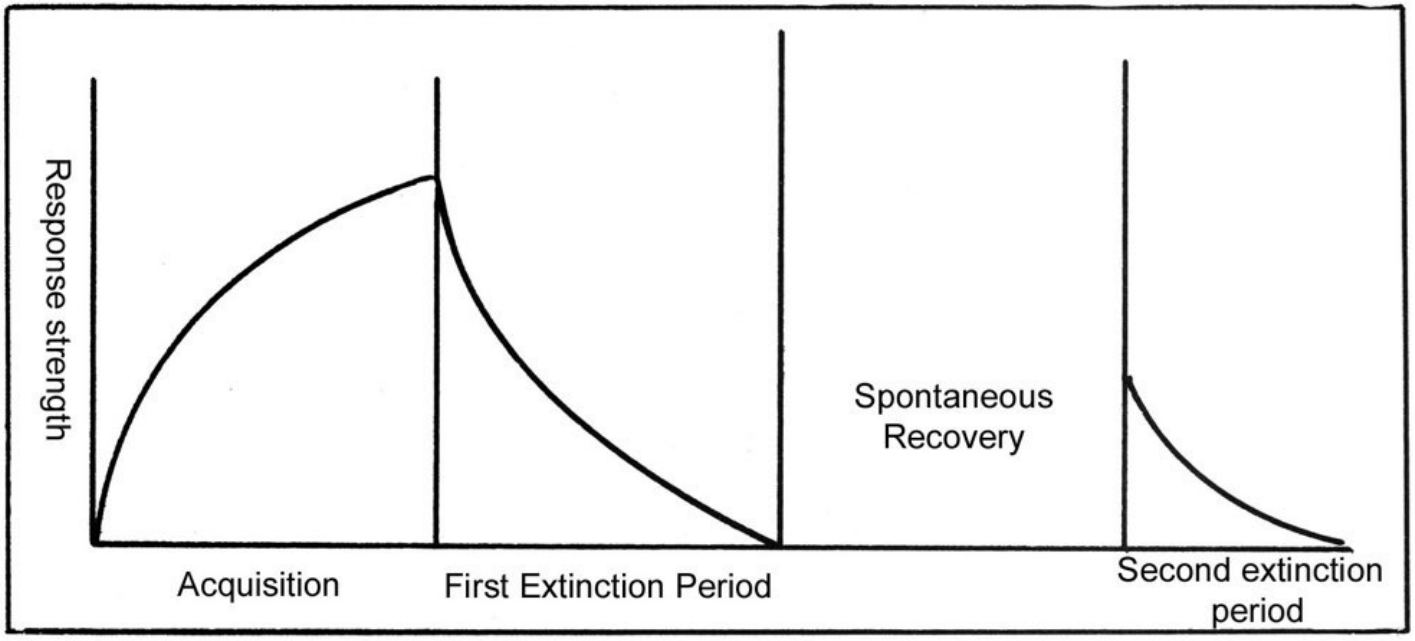
Watch B. F. Skinner with a Conditioned Pigeon

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

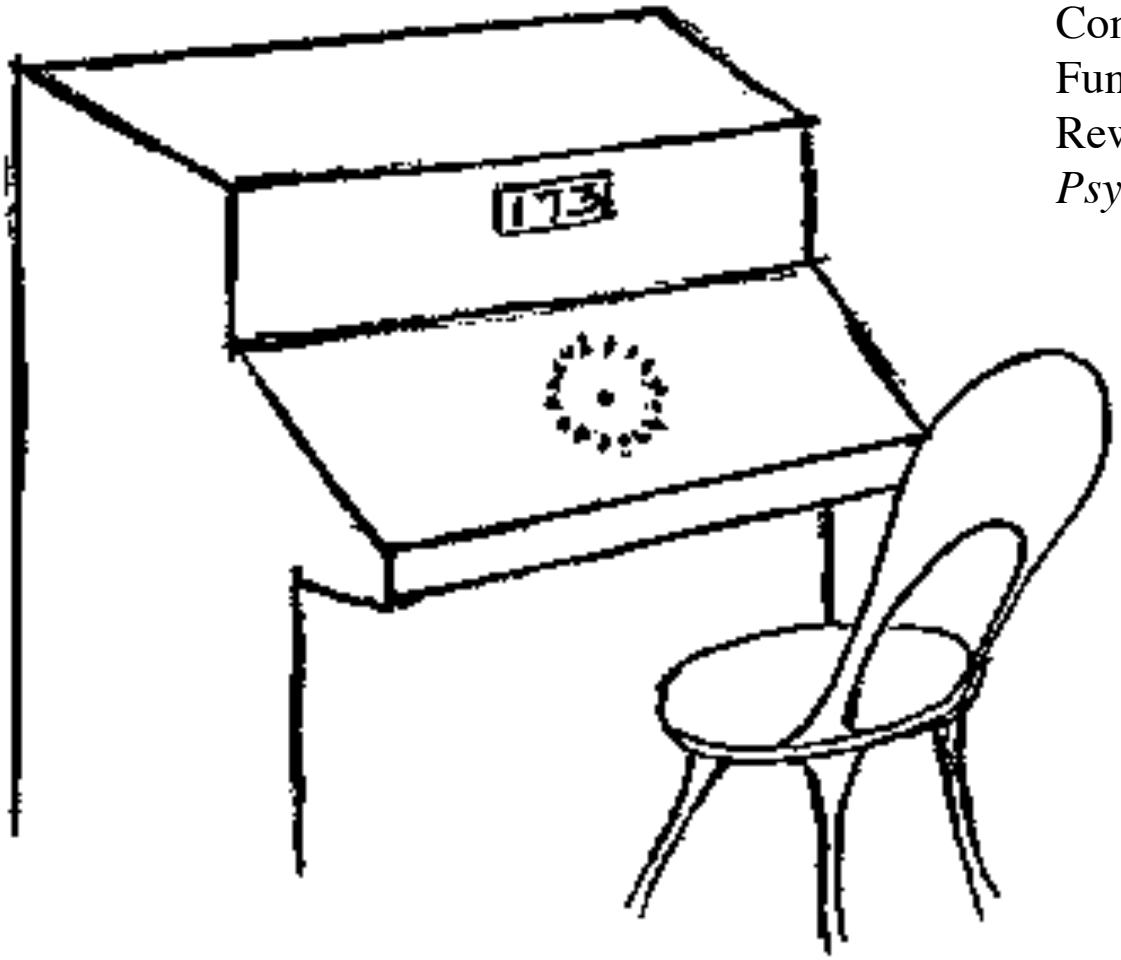


Superstitious Behavior

- ***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



Wright, John C.: »Consistency and Compexity of Response Sequences as a Function of Schedules of Noncontingent Reward« *Journal of Experimental Psychology* 63 : 601-9, 1962.

Read it up in:

Paul Watzlawick. How Real is Real? Confusion, Disinformation, Communication.
New York:Vintage, 1977

(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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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

http://www.doit.gmu.edu/inventio/issues/Spring_2004/Coppola1_print.html

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

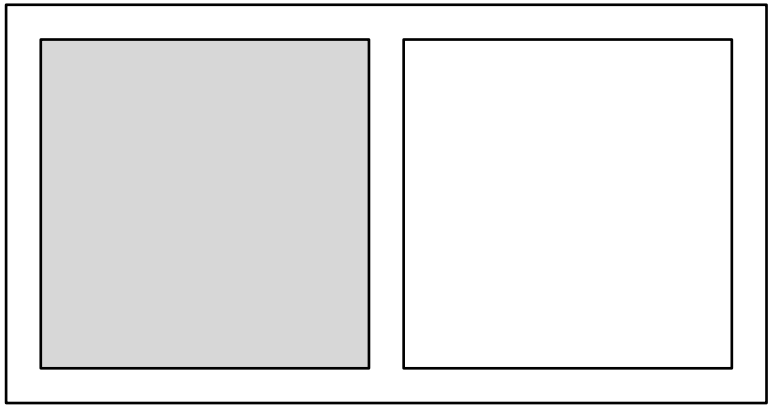
- Experiments with chimpanzees
  - Usage of tools, combinations, …
- Chickens would not be able to do that!
  - „Insightful learning“

Wolfgang Köhler
(1887 – 1967)

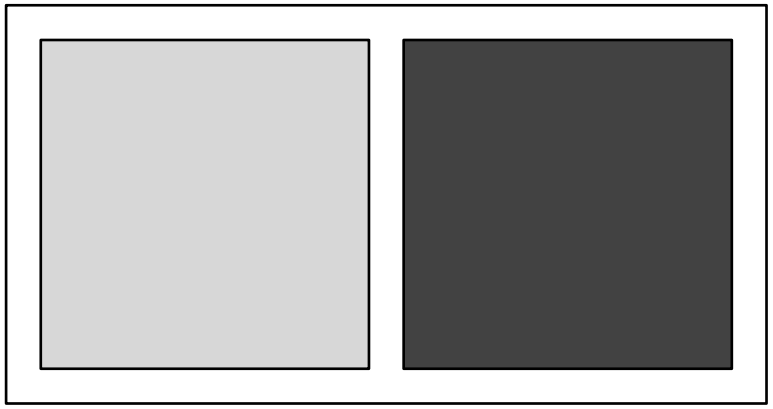
www.youtube.com/watch?
v=FwDhYUlbxiQ

Wolfgang Köhler: Transposition

An experiment beyond stimulus-response connections:



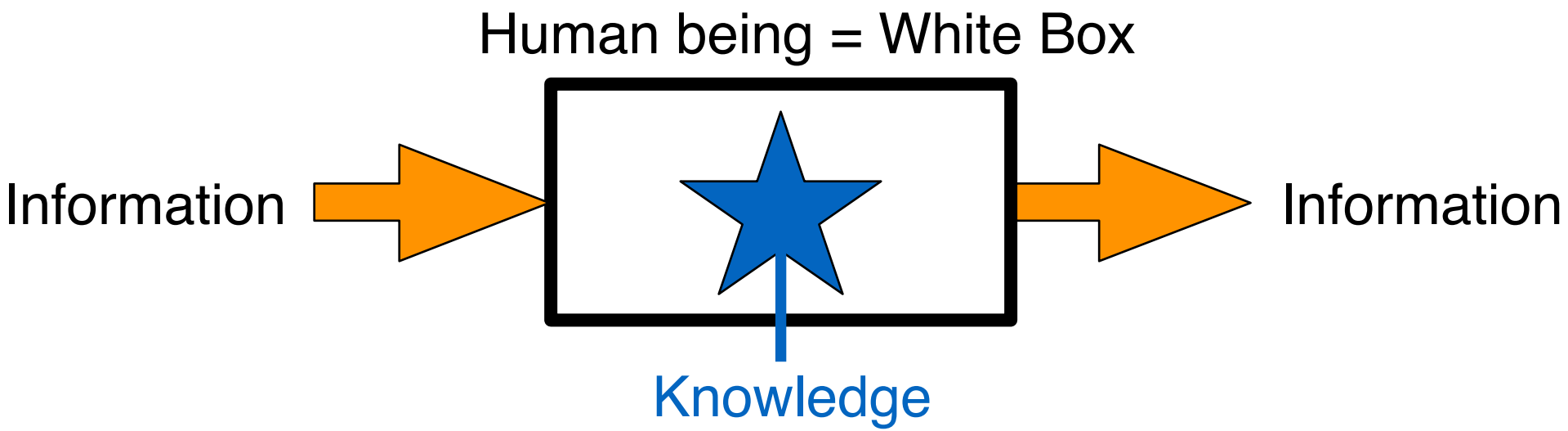
Stimuli during Preliminary Training:
Animal is fed only on light grey surface



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



- C*ognition*:
  - Conception (Begriffsbildung)
  - Perception (Wahrnehmung)
  - Recognition (Wiedererkennen)
  - Reasoning (Schlussfolgern)
- *Learning:*
  - transformation of information to knowledge

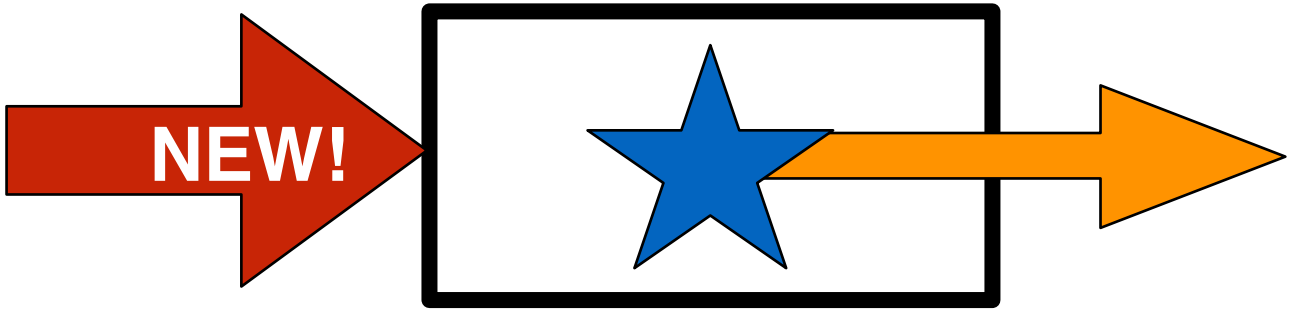
Jean Piaget: Development of Intelligence

- 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)

Jean Piaget
(1896 – 1980)

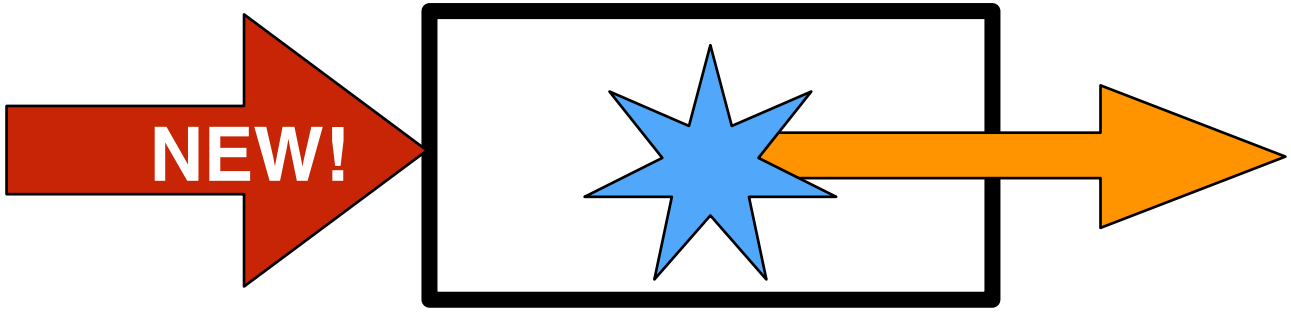
Assimilation and Accommodation

Assimilation (understanding):



Select schema, integrate

Accommodation (learning):



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

Robert M. Gagné (1916 – 2002)