

## Lecture 2

### Educational Software IN4145

### Educational principles

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1



## Today

- Announcements
- Last Lecture
- Behavioural psychology principles
- Cognitive psychology principles
- Constructivist psychology principles

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2



## Announcements

### Guest Speakers:

- eCoaching by Oliveir Blanson Henkemans (TNO) 26 April 2010
- Evaluating children's interactive products by Panos Markopoulos (TU/e) 10 May 2010



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3



## Announcements

- Next week group have to present an outline of their project in the lecture.
- 5 min talk

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4



## Last lecture

By Siadis and Vogelij

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5



## Learning outcomes of lecture 2

After today's first hour lecture you should:

- Be able to describe major learning principles, theories, and approaches

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6



## Psychology principles

- Behavioural psychology
  - To be scientific, only deal with observable elements i.e. behaviour and the environment
- Cognitive psychology
  - Include elements that are not directly observable such as memory, and mental constructs, motivations
- Constructivist psychology
  - People have their own truth, and knowledge is constructed by the learner

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7



## Pre-Behaviourism

- End 1800, psychology starts as a discipline
- First study focused on introspection (observations and reporting of one's own mental processes)
- Critic of introspection
  - Very subjective
  - Could not be verified



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8



## Behaviourism

- Focus on objectivity
- Aim is to predict and control behaviour
- Experimental as branch of natural sciences
- To change behaviour, need to provide people with relevant learning experiences.

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9



## Behaviourism - assumptions

- Psychology should study behaviour, because it is objective and observable
- The unit of analysis is stimulus-response
- Behaviour is determined by the environment rather than by heredity
- Understand Learning in term of conditioning principles
- The brain is not of central importance

(Eysenck, 2000)



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10



## Behaviourism – Classical conditioning

- Neutral stimulus (a bell) becomes paired with unconditioned stimulus (food) to elicit a response (drooling) which was before only elicited by the unconditioned stimulus.
- By repeated pairing, the neutral stimulus on its own will also result in the response



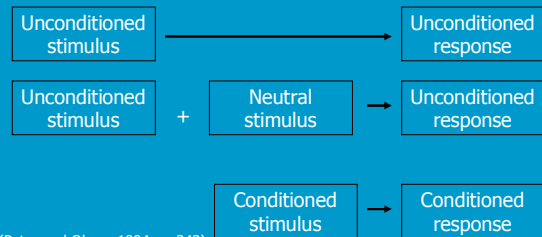
Ivan Pavlov

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11



## Behaviourism – Classical conditioning



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12



Unbeknownst to most students of psychology, Pavlov's first experiment was to ring a bell and cause his dog to attack Freud's cat.

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## Behaviourism – Operant conditioning

- A form of learning in which behaviour is controlled by the giving of reward or reinforcement

B.F. Skinner

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## Behaviourism – Operant conditioning

Operation performed after behaviour	Name	Effect
Present positive consequences	Positive reinforcement	Increase the probability of behaviour
Remove aversive consequences	Negative reinforcement	Increase the probability of behaviour
Present aversive consequence	Positive Punishment	Decrease the probability of behaviour
Remove favourable consequence	Negative Punishment	Decrease the probability of behaviour
Neutral consequence occur (after being previously reinforced)	Extinction	Decrease the probability of behaviour

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## Behaviourism – Pattern of reinforcing

- Behaviour that is always rewarded increases rapidly in frequency, but after reward ceases the behaviour also extinguishes rapidly.
- Behaviour that is rewarded intermittently increase in frequency more slowly, but is more long lasting or resistant to extinction.

(Alessie and Trollip, 2001).

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## Example Behaviourism Activities

- Drill and practice
  - Math tables;  $2+2 =$
  - Country Capitals
- Touch Typing
- Shoot-them-up computer games
- Spelling

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## Behaviourism – Programmed Learning

Skinner idea resulted in **programmed learning**

- The learning material is presented in a series of small steps
- Students are asked questions at each step to ensure that they understood it.
- Students are provided with immediate feedback
- Learning Programmes are linear or branching

(Eysenck, 2000)

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## Behaviourism – Criticism

- The Control of Experiment situations might result in artificial results
- Ignore internal factors such as past knowledge and experiences
- Assumption that behaviour is not determined by heredity is not true (for example personality and intelligence).

(Eysenck, 2000)

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19



## Cognitive psychology principles

- Discontent with Behaviourism
- The arrival of the Computer has as metaphor – the human as information processor
- Also include a focus on internal processes (e.g. memory, attention, attitude, motivation)

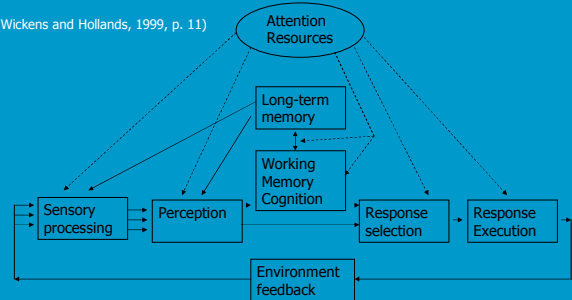
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20



## Human information processing model

(Wickens and Hollands, 1999, p. 11)



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21



## Cognitive psychology - assumptions

- Information made available by the environment is processed in a series of processing systems
- These processing systems transform or alter the information in various ways
- The aim of research is to specify the processes and structures that underlie cognitive performance
- Information processing in people resembles that in a computer, in that both can be regarded as having information-processing systems
- There is bottom-up and top-down processing

(Eysenck, 2000)

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22



## Cognitive psychology – Schema theory

- Schemas: organised packets of information stored in long-term memory
- "Remembering is...an imaginative reconstruction, or construction, built out of the relation of our attitude towards a whole active mass of organised past reactions or experience"



Frederic Bartlett

(Eysenck, 2000)

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23



## Cognitive psychology – Schema theory

Schema learning occurs in 3 ways (Rumelhart and Norman, 1981 in Eysenck, 2000):

- **Accretion:** A new example of an existing schema is recorded and added to the relevant schematic information in LTM
- **Tuning:** Concepts in a schema are elaborated and refined through experiences indicating that the existing schema is not adequate
- **Restructuring:** A new schema is created, often with reference to a similar, pre-existing schema.

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24



## Cognitive psychology – Schema theory – The war of the Ghosts

### The War of the Ghosts

One night two young men from Egulac went down to the river to hunt seals and while they were there it became foggy and calm. Then they heard war-cries, and they thought: "Maybe this is a war-party". They escaped to the shore, and hid behind a log. Now canoes came up, and they heard the noise of paddles, and saw one canoe coming up to them. There were five men in the canoe, and they said:

"What do you think? We wish to take you along. We are going up the river to make war on the people." One of the young men said, "I have no arrows." "Arrows are in the canoe," they said. "I will not go along. I might be killed. My relatives do not know where I have gone. But you," he said, turning to the other, "may go with them." So one of the young men went, but the other returned home. And the warriors went on up the river to a town on the other side of Kalama.

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25



## Cognitive psychology – Schema theory

The people came down to the water and they began to fight, and many were killed. But presently the young man heard one of the warriors say, "Quick, let us go home: that Indian has been hit." Now he thought: "Oh, they are ghosts." He did not feel sick, but they said he had been shot.

So the canoes went back to Egulac and the young man went ashore to his house and made a fire. And he told everybody and said: "Behold I accompanied the ghosts, and we went to fight.

Many of our fellows were killed, and many of those who attacked us were killed. They said I was hit, and I did not feel sick."

He told it all, and then he became quiet. When the sun rose he fell down. Something black came out of his mouth. His face became contorted. The people jumped up and cried.

He was dead

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26



## Cognitive psychology – Schema theory – The war of the Ghosts

- Story of Indians on the west coast of Canada
- Bartlett gave it to participants before WOI in UK
- How would people remember the story if it fit poorly into their cultural schemas?
- Subject omitted much of the story, changed many facts, and imported new information
- People use schemas to aid their inferential recall of studies material

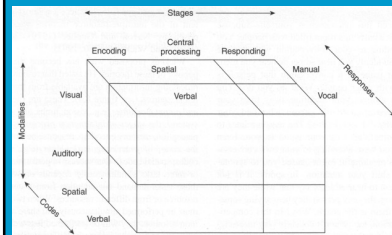
(Anderson, 1995)

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27



## Cognitive psychology - Resources



Multimedia principle: People learn better from words and pictures than from words alone (Mayer, 2005).

Multiple Resources

(Wickens and Hollands, 1999, p. 449)

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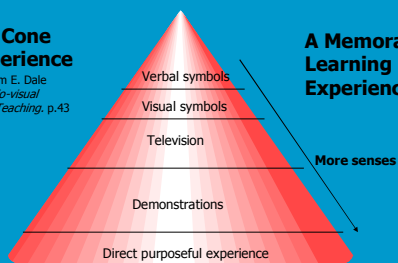
28



## Multi-sensory Learning

### Dale's Cone Of Experience

Redrawn from E. Dale (1955), *Audio-visual Methods in Teaching*, p.43



A Memorable Learning Experience?

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29



## Cognitive psychology - Memory

Working memory

- Limited capacity (7 +/- 2 chunks)
- Chunking: Integrated unit of information (NSAFBICIANASA vs. NSA FBI CIA NASA)

Long-Term Memory

- **Episodic Memory:** memory for autobiographical or personal events
- **Semantic memory:** organised knowledge about the world and about language store in LTM
- **Explicit memory:** memory based on conscious recollection
- **Implicit memory:** memory not based on conscious recollection
- **Declarative memory:** knowledge relating to "knowing that"
- **Procedural memory:** knowledge relating to "knowing how"

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30



## Cognitive psychology - Memory

Ericsson (1988) requirements for very high level of memory performance:

1. Meaningful encoding: the information should be processed meaningfully, relating it to pre-existing knowledge
2. Retrieval structure: cues should be stored with the information to aid later retrieval
3. Speed-up: there is extensive practice so that the processes involved in encoding and retrieval occur rapidly.

(Eysenck, 2000)

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31



## Cognitive psychology - Motivation

### Malone and Lepper

Intrinsic motivators

- Challenge
- Curiosity
- Control
- Fantasy

Extrinsic motivators

### Keller ARCS

- Attention
- Relevance
- Confidence
- Satisfaction

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## Cognitive psychology – Techniques to enhance intrinsic motivation

- Use game techniques
- Use embellishment to increase learner intensity of work and attention and to encourage deeper cognitive processing
- Use exploratory environments
- Give the learner personal control
- Challenge the learner
- Arouse the learner's curiosity
- Give encouragement, even when errors are made

(Alessie and Trollip, 2001).

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## Cognitive psychology – Mental Models

- Mental model: a representation in working memory that can be "run" by the learner to understand a system, solve problems, or predict events.
- Another view on mental models (Eysenck, 2000): representations of the state of affairs described in the premises of a problem or other statements

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34



## Cognitive psychology – Individual difference – Cognitive Style

- "cognitive styles are the preferred, consistent, individual characteristics in organizing and processing information" (Chen and Rada, 1996).
  - **Field dependent** learners rely on the external world to structure their information processing
  - **Field independent** learners are more autonomous thinkers relying more on an internal frame of reference.
- "Individual difference in cognition alone do not have significant effects on the use of hypertext" (Chen and Rada, 1996).
- "hypermedia case studies provide an equally effective learning environment for students regardless of learner differences" (Fitzgerald, and Semrau, 1998)

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## Cognitive psychology - Learning

- **Facilitated**
    - By structure & organization
    - By similar knowledge, as in consistency in UI design
    - By analogy
    - If presented in incremental units
    - Repetition
  - **Hindered**
    - By previous knowledge
      - Try moving from Mac to Windows
- => Use user's previous knowledge in user interface

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## Cognitive psychology - Criticism

- Experimental cognitive psychology – limited ecological validity
- Limitation of the computer metaphor

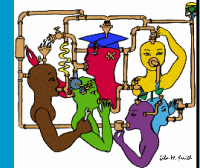
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37



## Constructivist psychology - assumptions

- Only reality is our individual interpretation of what we perceive
- Knowledge is not received from outside, but constructed in head
- **Social constructivism:** learning is inherently social
- **Modern constructivism:** there is a real world, but our understanding is very individual and changing. (Alessie and Trollip, 2001).



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38



## Example Constructivist psychology Activities...

- Build bridge from toothpicks
- Egg-dropping contest
- Solar car contest
- Learn accounting to run a business
- Create simulation



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## Example Non- Constructivist psychology Activities...

- Drill and practice
- Reading and re-reading and re-reading....



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## Constructivist psychology - Learning

- Emphasize learning rather than teaching
- Emphasize the actions and thinking of learners rather than of teachers
- Emphasize active learning
- Use discover or guided discovery approaches
- Encourage learner construction of information and projects
- Have a foundation in situated cognition
- Use cooperative or collaborative learning activities

(Alessie and Trollip, 2001).

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41



## Constructivist psychology - Learning

- Use purposeful or authentic learning activities
- Emphasize learner choice and negotiation of goals, strategies, and evaluation methods
- Encourage personal autonomy on the part of learners
- Support learner reflection
- Support learner ownership of learning and activates
- Encourage learners to accept and reflect on the complexity of the real world

(Alessie and Trollip, 2001).

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42



## Constructivist psychology – Situated Learning

Learning is set in a context:

- Activity
- Culture
- Goals

For example

Learn mathematics not in math class, but as part of business case.

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43



## Constructivist psychology – Education Software

Instead of tutorial and drill instruction, education software such as:

Simulations, virtual reality, open-ended learning environment, discussion board, email

Are more effective lifelong learners as they allow learners to explore information freely, apply their own learning styles, communicate with other learners

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44



## Constructivist psychology - Criticism

- Might not be applicable to all types of learning (some drill instruction is needed before something becomes internalised)
- What is the role of the teacher, only facilitator?

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45



## Summary

- Behaviourism: to change behaviour need to provide people with relevant learning experiences
  - Classical conditioning
  - Operant conditioning
- Cognitive approach: focus on internal information processes
  - Schemata, memory, multiple resources, motivation
- Constructivism: People have their own truth, and knowledge needs to be actively constructed by the learner

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46



## Next time

### Computer Assisted Personalised System of Instruction

#### Topics

- Case study of computer-aided personalised system of Instruction
- Student groups present an outline of their project in the lecture

#### Literature

- Brinkman, W.-P., Rae, A., & Dwivedi, Y.K., (2009) "Computer-Aided Personalised System of Instruction for Teaching Mathematics in an Online Learning Environment", Solutions and Innovations in Web-Based Technologies for Augmented Learning: Improved Platforms, Tools and Applications, pp. 271-299, IGI Global, Hershey, NY.

Summary of lecture 2 by ??

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47



## Reference

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48

