Cognitive load theory and theories of human-computer interaction

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Research questions

- Can Cognitive Load Theory (CLT) research and research in Human-Computer Interaction (HCI) benefit from each other?
  - Are concepts of Cognitive Load Theory (CLT) and concepts of Human-Computer Interaction (HCI) compatible?
  - How far have CLT concepts been assimilated by HCI?
  - How could both fields connected further / potential areas of joint research?
Human-Computer Interaction

...deals with:

- Theories and models of human behaviour when interacting with information and communication technology (ICT)

- General or more specific guidelines or heuristics for the design and evaluation of ICT

- Methods for the user-centred design of ICT

- Development of new interaction paradigms and technologies
Human-Computer Interaction

- Usability:

The extent to which a specific USER can solve a certain TASK effectively, efficiently and with satisfaction, by using a specific TOOL.
Contrasting CLT and HCI concepts

Models of human cognition:

- 1970s and 1980s: Similar theoretical backgrounds of CLT and HCI
  - Component model of working memory (Baddeley)
  - Limited working memory capacity (Miller, Baddeley)

- Mid-90s:
  - CLT: Concept of germane cognitive load

- HCI: User experience goals

Reducing extraneous cognitive load

Fostering germane cognitive load

Fostering motivation, joy, interest…
Literature review

- Literature database “Guide to Computing Literature”
  - Provided by the Association of Computing Machinery (ACM)

- Search for „cognitive load theory“ and „Sweller“
  - 230 search results
  - 39 publications contained „cognitive load“ in their title or abstract

- What are common topics covered by the publications?
- Are the three types of cognitive load described?
- What does the research try to achieve by applying CLT?
## Literature review: Results (1/2)

<table>
<thead>
<tr>
<th>Topics:</th>
<th>N (of 39)</th>
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<tbody>
<tr>
<td>Designing computer-based instruction</td>
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<tr>
<td>Designing hypermedia / information search environments</td>
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<td>Game design</td>
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<td>Cognitive load measurement</td>
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<td>Modelling of distributed cognitive load in groups</td>
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<td>Formal simulation model of CLT</td>
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<td>Design of multi-modal interfaces</td>
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Literature review: Results (2/2)

- Naming and description of cognitive load types:
  - Intrinsic cognitive load (ICL): 23
  - Extraneous cognitive load (ECL): 34
  - Germane cognitive load (GCL): 18

- 6 of the 18 publications that name GCL aim at fostering GCL or at managing ICL and GCL

- Oviatt (2006), Sawicka et al. (2008): usability principles in order to reduce extraneous cognitive load
Usability model according to CLT

- **USER**
  - Learner
    - Expertise, cognitive capabilities, motivation

- **TASK**
  - Learning
    - Construction and automation of schemas

- **TOOL**
  - Learning Environment
    - Foster germane CL
    - Decrease extraneous CL
    - Adapt intrinsic CL
Cognitive load model in ICT supported learning

- Germane Cognitive Load (GCL)
- Extraneous Cognitive Load (ECL)
- Intrinsic Cognitive Load (ICL)

Application of CLT instructional design principles
Application of traditional HCI design principles
Discussion (1/2)

- CLT and HCI share part of theoretical background: Reducing extraneous cognitive load
- Germane cognitive load is foreign to basic cognitive models in HCI
- All three types of cognitive load have found their way into HCI literature

- Usability model according to CLT:
  - Helps to understand the particularites of software design for learning purposes
    - Increasing GCL (within working memory capacity) is appreciable

- Modeling software use as component of ECL:
  - Clarifies roles of usability principles and instructional design principles
  - Points out the importance of software training
Discussion (2/2)

- Areas for joint research
  - Adaptive systems: e.g. task allocation, amount of user control
  - User experience: principles that influence mediating factors such as motivation and interest
Thank you very much for your attention!
## Literature review: Results

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