

# Information problem solving and mental effort

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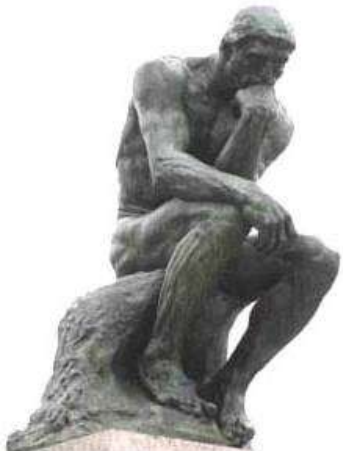
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# Information problem solving

- Skills, knowledge and attitude to
  - define the information need;
  - identify sources;
  - judge and select relevant information from the sources;
  - organize the information found;
  - present the information into a coherent product;
  - construct knowledge.

*(Brand-Gruwel & Stadtler, 2011; Brand-Gruwel & Gerjets, 2008; Brand-Gruwel, Wopereis, & Vermetten, 2005).*



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# Research in IPS

- The process of IPS.
- Instructional design to foster IPS.



# The process of IPS



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# Unraveling the IPS-process

- Feddes, R., Vermetten, Y., Brand-Gruwel, S., & Wopereis, I. (2003). Strategische kennis over het oplossen van informatieproblemen: een exploratief onderzoek [Strategic knowledge about information problem solving: an explorative study]. *Pedagogische Studiën*, 80, 210-225.
- Brand-Gruwel, S., Wopereis, I., & Vermetten, Y. (2005). Information problem solving by experts and novices: analysis of a complex cognitive skill. *Computers in Human Behaviour*, 21, 487-508.
- Brand-Gruwel, S., Wopereis, I., & Walraven, A. (2009). A descriptive model of Information Problem Solving while using Internet. *Computers & Education*, 53, 1207-1217.
- Argelagos, E., Brand-Gruwel, S., Jardozi, H., & Pifarre, M. (2012). *Web search processes: how to measure them? An exploratory study comparing methods*. Manuscript in submitted.

## 2005: the Expert-Novice study



# Participants: expert-novice study

- Experts:
  - 5 PhD students in the field of Educational Technology in their final year
- Novices:
  - 5 Psychology freshmen from the University of Maastricht



# Set up: expert-novice study

## Task:

- write in 90 minutes an article for a consumers magazine ( $\pm$  400 words) about food that is out of date and use MS Word and Internet

## Instrument to analyze the thinking aloud protocols:

- for development a inductive-deductive method was used
- three columns were scored simultaneously
  - main skills
  - sub skills
  - regulation

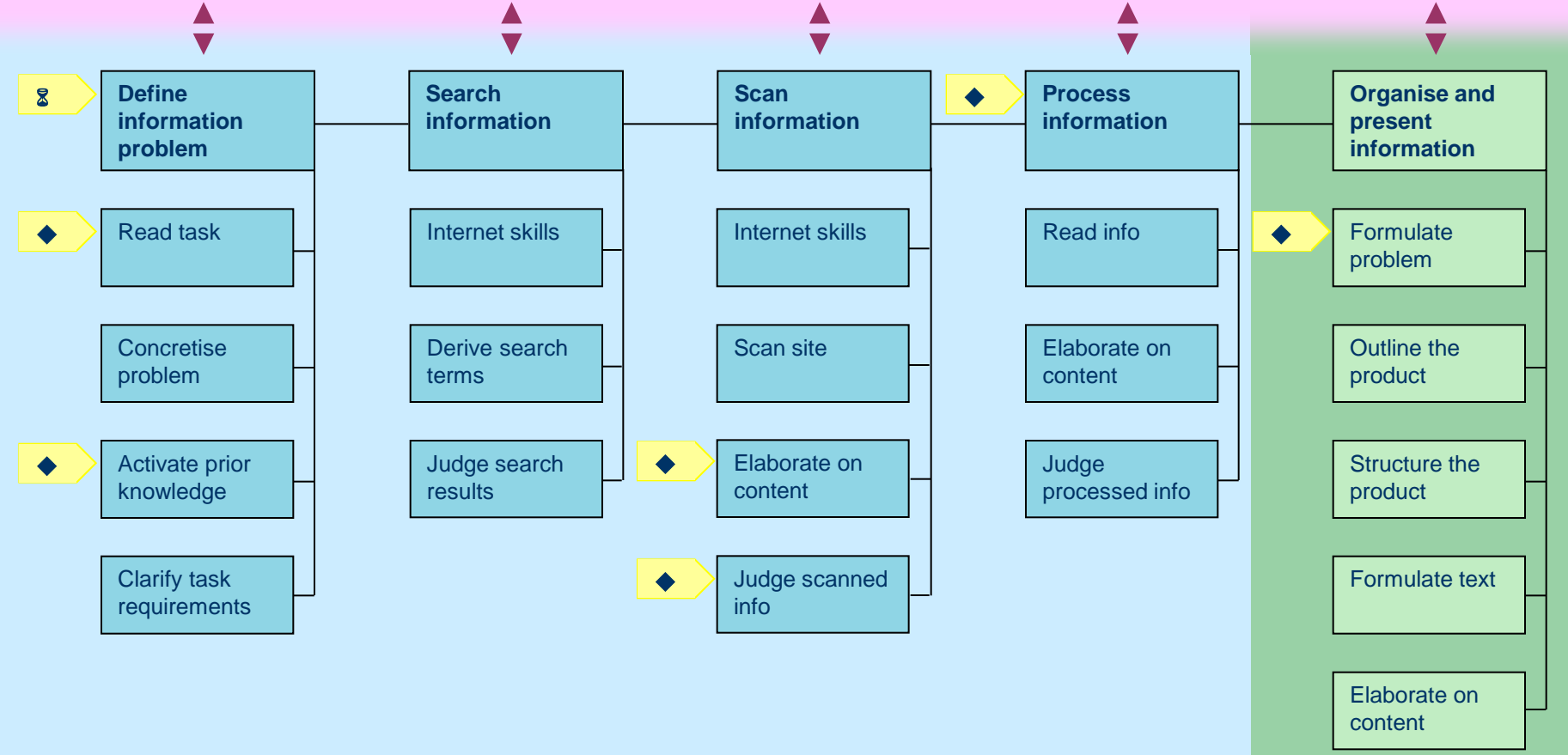
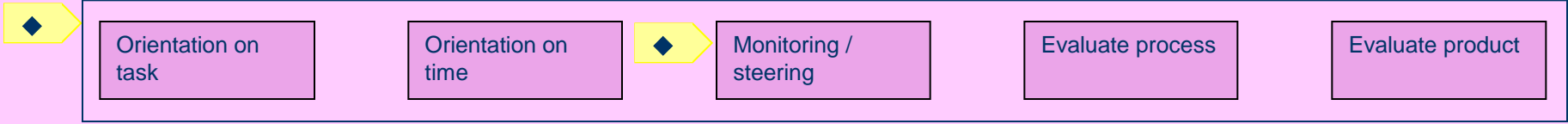


# Information Problem Solving

## a skill decomposition

Regulation

Regulation



Analysis

Synthesis

⌚ Significant difference: experts spend more time on this sub skill

◆ Significant difference: experts do this more often



# Process of evaluating sources and information

- Walraven, A., Brand-Gruwel, S., & Boshuizen, H.P.A. (2009). How students evaluate information and sources when searching the World Wide Web for information. *Computers and Education*, 52(1), 234-246.
- Walraven, A., Brand-Gruwel, S., & Boshuizen, H.P.A. (2011). *Teachers and the World Wide Web: How teachers evaluate search results, information and source*. Manuscript submitted for publication.
- Brand-Gruwel, S., & Stadtler, M. (2011). Solving Information-based Problems: Searching, Selecting and Evaluating Information. *Learning and Instruction*, 21, 175-179.

2009: Students' evaluation behavior  
(secondary education)



# Set up: evaluation behavior study

- Participants: 23 students from secondary education
- Tasks: 12 tasks: 4 science / 4 geo. / 4 language
  - example: Young people use MSN and SMS a lot. Does this have an influence on their language proficiency?
- Procedure: each student accomplished 2 tasks while thinking aloud (30 per task)



# Results: evaluation behavior study

- Students do not evaluate in a sophisticated way
  - Sources are hardly evaluated on usability and reliability
  - Information is being judged on the connection to the task, the amount of information and the language



# Process of evaluation and role of prior knowledge

Brand-Gruwel, S., Kammerer, Y., Van Meeuwen, L., & Van Gog, T. (2011). The use of evaluation criteria when searching the WWW. Manuscript submitted for publication.

2011: evaluation behavior of novices and experts in a domain

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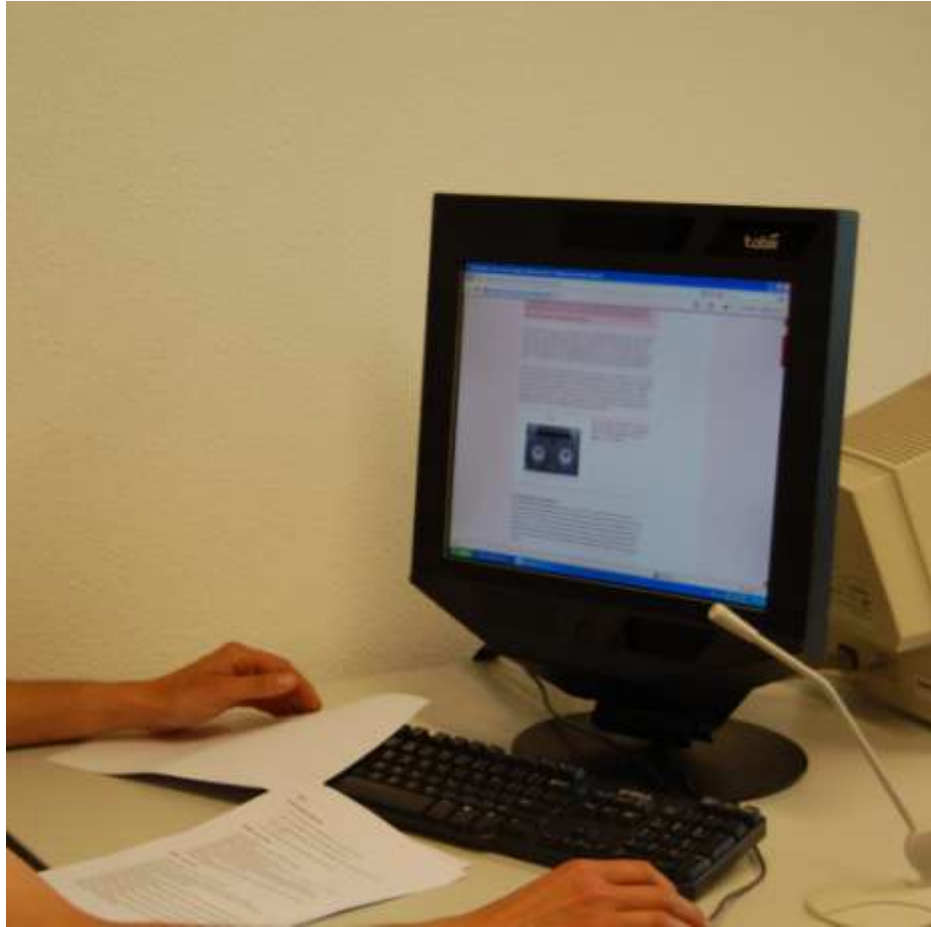


# Set up: evaluation and prior knowledge

- Participants:
  - 20 psychology students (freshmen) (12 men and 8 women; age  $M = 20.2$ ,  $SD = 4.07$ )
  - 17 psychology teachers (University) (7 men and 10 women; age  $M = 39.5$ ,  $SD = 12.33$ )
- Task:
  - Two tasks (reliability of human memory and altruism)
  - Each task had a Google-like result page (SERP) with 17 links
  - select and prioritize information and finally rank the best five sites in 10 minutes



# Procedure: evaluation and prior knowledge



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# Eye-movements

Het Internet [Afbeeldingen](#) [Maps](#) [Nieuws](#) [Video](#) [Gmail](#) [meer ▾](#) [Aanme](#)

**Google**   [Geavanceerd zoeken](#)  
[Voorkeuren](#)

Doorzoek:  het Internet  pagina's in het Nederlands  pagina's uit Nederland

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**Het Internet** Resultaten 1 - 10 van circa 1.900.000 voor **klimaat nederland** (0,25 second

**Nederland - Wikipedia**  
Nederland heeft een gematigd zeeklimaat met milde winters en koele zomers. Het klimaat wordt beïnvloed door de aanliggende Noordzee die het gehele jaar de ...  
nl.wikipedia.org - 137k - [In cache](#) - [Gelijkwaardige pagina's](#)

**Klimaat van Nederland**  
KNMI Klimaat van Nederland - NLweer.com het dagelijks weer en het klimaat in Nederland van 1901 - Klimaatportaal van het PCCC - KNMI - Klimaat ...  
nl.wikipedia.org - 37k - [In cache](#) - [Gelijkwaardige pagina's](#)

**Het weer in klimaat in Nederland**  
concrete klimaatgegevens voor Nederland, El Niño & La Niña, Extreem weer, ijsheiligen, klimaat, midden van het land, neerslag in Nederland, noordkust, ...  
home.planet.nl - 92k - [In cache](#) - [Gelijkwaardige pagina's](#)

**Het klimaat van Nederland**  
Het klimaat in Nederland valt onder het Cf klimaat wat inhoud dat het een gematigd regenrijk klimaat is, zonder een uitgesproken droge tijd. ...  
home.hetnet.nl - 17k - [In cache](#) - [Gelijkwaardige pagina's](#)

**KNMI: Klimaat van Nederland**  
Klimaat van Nederland. Het weer is in Nederland vaak onderwerp van gesprek. Dat is niet verwonderlijk, immers in Nederland is het weer bijzonder ...  
www.knmi.nl - 19k - [In cache](#) - [Gelijkwaardige pagina's](#)

**De website van het KNMI**  
Weer, klimaat en seismologie. Nieuws, vragen, webcams, verwachtingen en waarschuwingen.  
www.knmi.nl - 34k - [In cache](#) - [Gelijkwaardige pagina's](#)  
[ [Meer resultaten van www.knmi.nl](#) ]

**Deltawerken - Het klimaat in Nederland**  
Nederland bezit een gematigd regenklimaat, Cfb volgens de indeling van Köppen. Het klimaat in Nederland wordt vooral bepaald door de ligging aan zee. ...  
www.deltawerken.com - 7k - [In cache](#) - [Gelijkwaardige pagina's](#)


Gesponsorde Koppelingen

**Weer Nederland**  
Selecteer het land of de stad en bekijk gratis het weerbericht.  
[www.google.nl](#)

**Klimaat Nederland**  
Nu: **Klimaat Nederland**  
Inclusief Montage & BTW v.a. € 10!  
[www.Airco-Unie.nl](#)

**Klimaat nederland**  
Aanbiedingen, reiservaringen, info. Alles over Nederland. Ontdek zelf [www.pagango.nl/Nederland](#)

[Uw bericht hier?](#)



# Results: evaluation and prior knowledge

- The domain experts do evaluate the reliability of the sites significantly more often than the novices
- The novices used more superficial criteria for evaluation (statements like: this seems ok, or that may be useful)
- The selected sites of the experts were of a higher quality and a relation with the use of sophisticated criteria
- *Data of the eye-movements will be analyzed together with Yvonne Kammerer (KMRC-Tübingen)*





# Future research: PhD-students

Milou de Smet: Students' use of electronic outline tools for writing and learning.

Johan van Strien: Multiple document comprehension: impact of epistemic beliefs and attitude on intergrating information from different (conflicting) sources

Jaap Walhout (RdMC): Adaptive Instruction to foster students' information problem solving skills: learning to organize digital information.

Jimmy Frèrejean: The integration of the lifelong learning skill 'Information problem solving' into higher education: Effects of different types of feedback and guidance on IPS and mental effort.



# Project Jimmy Frerejean: evaluating instruction

Effect of different kind of support (prompts, worked examples or a combination) on

- learning performance
  - Information problem-solving skill
- mental effort



# Measuring mental effort

- self-rating scales
- dual-task methodology
- physiological measures



# Self-rating scales

## pro's:

- easy to administer
- easy to analyze

## cons:

- subjective
- *after* learning phase



# Dual-task methodology

## pro's:

- real-time measure
- objective measurement

## cons:

- difficult to design:
  - same modality, but not disruptive
- *Is it possible to combine a dual-task approach with eyetracking?*



# Physiological measures

## pro's:

- real-time measure
- objective measurement

## cons:

- difficult to implement (equipment needed)
- difficult to analyze
- disruptive



# Eye tracking parameters

pupil dilation

fixation duration

number of fixations

saccadic amplitude

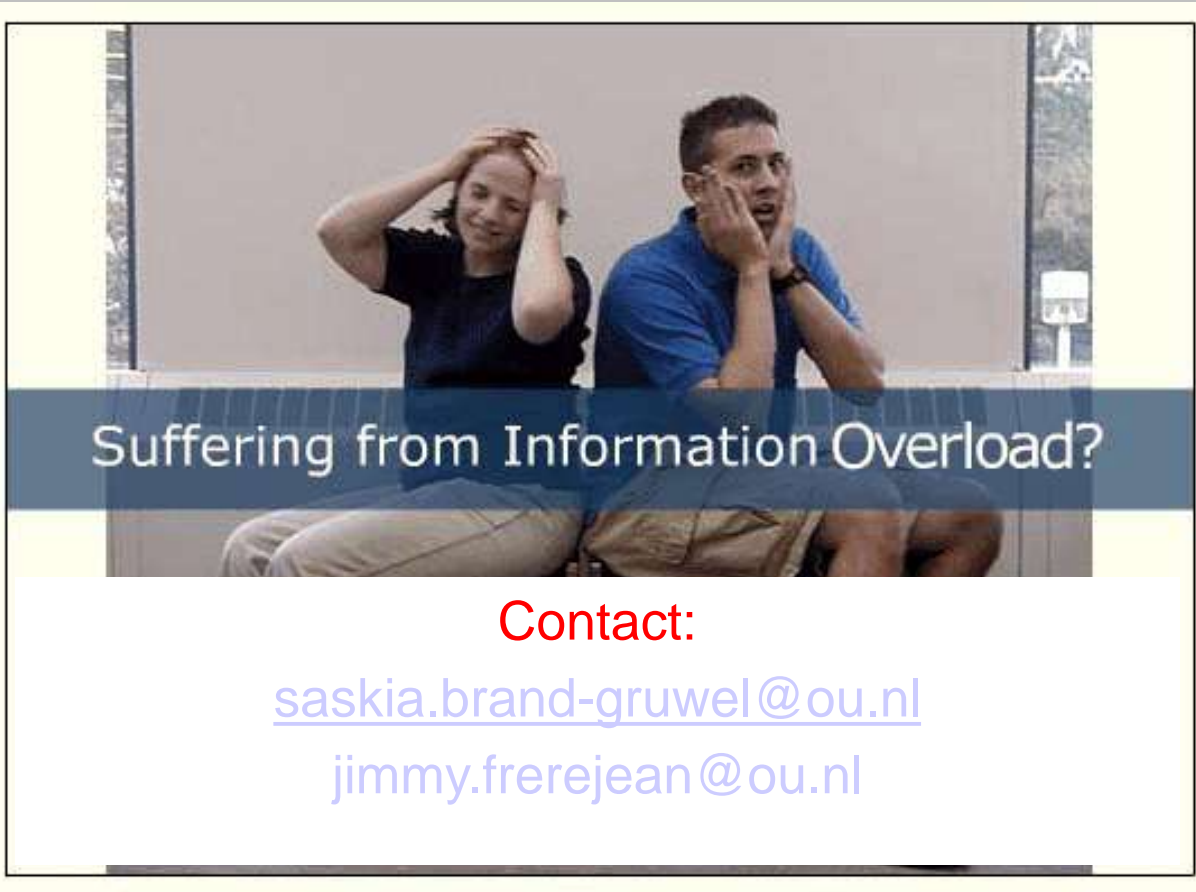
blinking

scanpath (area's of interest)

*Are these parameters (or others) related to mental effort?*

*Do they correlate with other measures of mental effort?*





Suffering from Information Overload?

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[jimmy.frerejean@ou.nl](mailto:jimmy.frerejean@ou.nl)

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