



Evaluating information retrieval in complex tasks

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Introduction

- In (social) research it is typical to test whether the dependence observed is valid also in sub-groups
 - a way of controlling spurious correlations
- Topic variation affects much more than system variation on retrieval performance (Alemayehu 2003)
- Not all web searches are short and simple (Kellar & al 2007)
 - fertile to categorize topics (information needs) for developing more appropriate retrieval methods
 - explore semantic properties of documents matching differing topics



Point of departure

- A task is complex to the extent one knows in advance information inputs, processing and outputs of the task (Byström & Järvelin 1995)
- A person does not have sufficient knowledge to accomplish a (work) task
 - ASK (Belkin), Sense making (Dervin), Uncertainty (Kuhlthau)
- Lack of understanding generates information searching for solving the problematic situation in order to proceed in the task



Mental models and IR

- Subjects form mental models representing their task
 - A mental model consists of concepts and their relations
- An insufficient model lacks necessary concepts and relations (Vakkari 1999)
- Insufficient knowledge refers to the degree a person is able in connecting (relating) a task/problem into his prior knowledge structures (conceptual construct)
 - Insufficient concepts and insufficient relations
- Subjects search information for obtaining concepts and their relations to bridge a gap in their knowledge
- This bridge is build on the foundations of their prior knowledge (representation of the task)

Cf. Heit 1997, S.I.Robertson 2001, Patel & Ramoni 1997, Vakkari 2001



Main hypotheses

- The degree of prior knowledge of a task (topic) is connected
 - to the types of information (and sources) people are looking for and using in their tasks
 - to the patterning of search tactics and term choices in querying
 - to the patterns of relevance assessments in choosing and using retrieved documents
 - to the ways tools for supporting searching are used



Some goals of IR systems

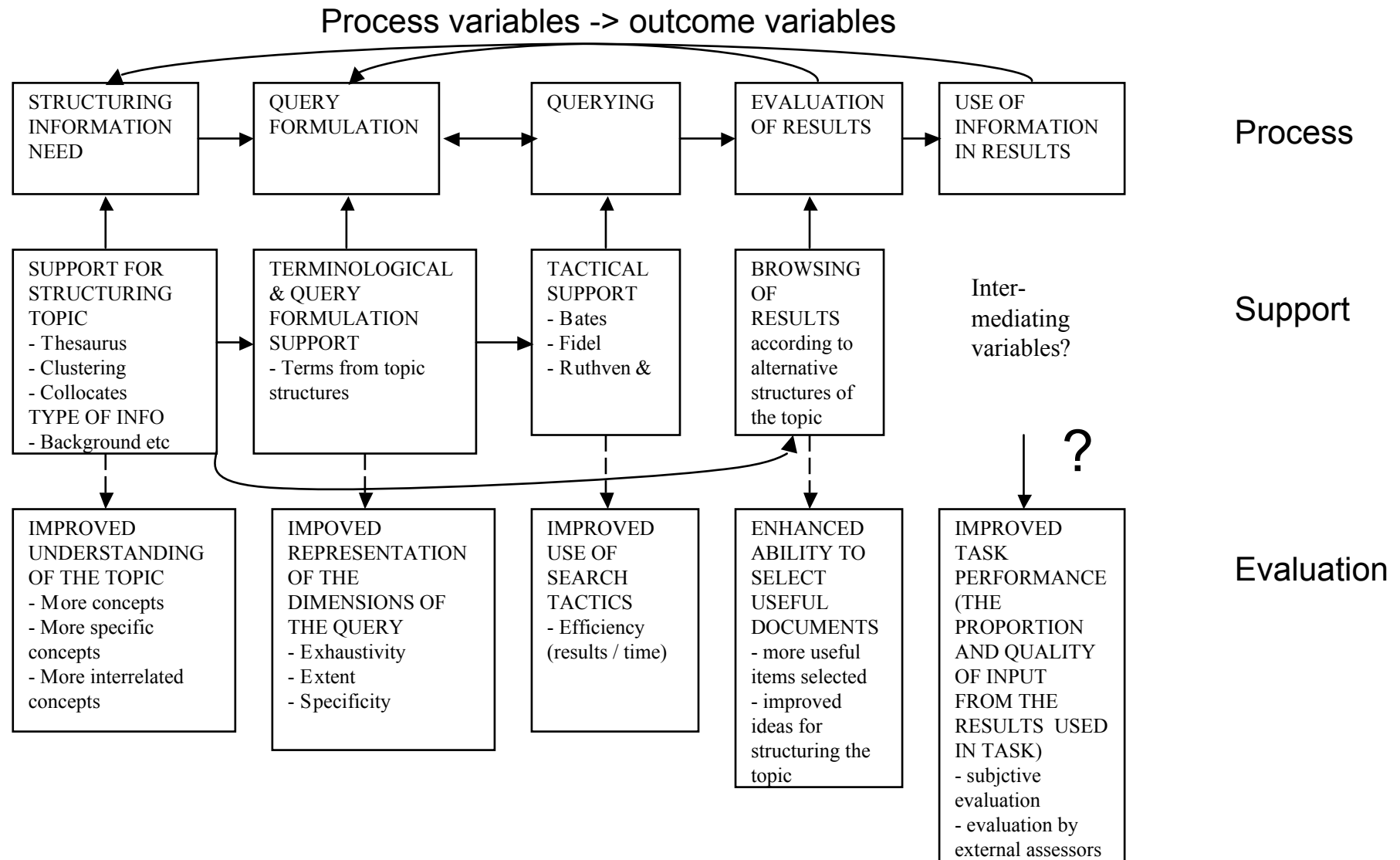
- The goal of information searching is to support actor's task performance
- Information searching consists of search goals and actions for accomplishing these goals
- The goals of IR systems are to support actors:
 - *proceeding in task performance*
 - *finding useful information for the task*
 - *support in structuring the topic*
 - *supporting search process*
 - *support in the evaluation of search results*
- A search goal refers to specific search results a user hopes to obtain (Xie 2000), but what about other search goals?



Evaluating IR systems

- Do we evaluate outputs or outcomes of IR systems (cf. Rossi & al. 2007)?
- Outputs are products delivered by a system
 - typically relevant information items
- Outcomes are the benefits a system produces for the users
 - Improved attainment of search goals? (search level)
 - Changes in the understanding of the user for proceeding in the task (cf. Hersh 1994) (task level)
 - System output and outcome do not correlate (Hersh & al. 2002, Huuskonen & Vakkari 2008)

SEARCH PROCESS, SUPPORT TOOLS AND EVALUATION





What to evaluate?

- Evaluate how a system reaches its goals
 - structuring the topic
 - supporting search process
 - supporting evaluation of search results
 - provision of info items contributing task performance
 - improving task performance
 - How process variables influence outcome variables?
- Criteria of success on these dimensions?
- These goals change during task performance
 - Different goals require different evaluation criteria
 - Categorizing goals - tuning evaluation methods and criteria



Models for representing IIR

- Theories necessary for a more accurate understanding of IIR (Vakkari & Järvelin 2005)
 - interconnections between information needs (tasks), retrieval methods and tools, search process, results and outcome
 - For systematizing existing scattered results and inferring fertile research questions
- Without models it is difficult to say how retrieval methods and tools are related to search process, results, and outcome
 - Understanding immediate and long-term impacts of using IR systems in task performance

References

- Alemayehu, N. (2003). Analysing performance variation using query expansion. *Journal of the American Society for Information Science & Technology* 54(5): 379-391.
- Bates, M.J. (1979) Information search tactics. *Journal of the American Society for Information Science* 30(4): 205-214.
- Belkin, N. J. (1980). Anomalous states of knowledge as basis for information retrieval. *Canadian Journal of Information Science*, 5, 133-143.
- Byström, K., & Järvelin, K. (1995). Task complexity affects information seeking and use. *Information Processing & Management*, 31: 191-213.
- Dervin, B. (1992). *From the mind's eye of the user: the sense-making qualitative methodology*. In J.D. Glazier and R.R. Powell (Eds.), *Qualitative Research in Information Management* (pp. 61-84). Englewood, CO: Libraries Unlimited.
- Fidel, R. (1991). Searchers' selection of search keys: III searching styles. *Journal of the American Society for Information Science*, 42, 515-527.
- Heit, E. (1997). Knowledge and concept learning. In K. Lamberts, & D. Shanks (Eds.), *Knowledge, Concepts and Categories* (pp. 7-41). Hove: Psychology Press.
- Hersh, W.R. (1994) Relevance and retrieval evaluation: perspectives from medicine. *Journal of the American Society for Information Science* (45)3: 201-206.
- Hersh, W.R., Crabtree, M.K., Hickam, D.H., Sacherek, L., Friedman, C.P., Tidmarsh, P., Mosbaek, C. & Kraemer, D. (2002) Factors associated with success in searching MEDLINE and applying evidence to answer clinical questions. *Journal of the American Medical Informatics Association* 9(3): 283-293.
- Huuskonen, S. & Vakkari, P. (2008) Students' search process and outcome in Medline in writing an essay for a class on evidence based medicine. *Journal of Documentation* 64(2): 287-303.
- Kellar, M, Watters, K., & Shepherd, M. (2007). A field study characterizing web-based information seeking tasks. *Journal of the American Society for Information Science and Technology* 58(7): 999-1018.
- Kuhlthau, C. C. (1993). *Seeking Meaning*. Norwood, N.J.: Ablex.
- Patel, V. & Ramoni, M. (1997). Cognitive models of directional inference in expert medical reasoning. In P. Feltovich, & al. (Eds.), *Expertise in context: human and machine* (pp. 67-99). Menlo Park: AAAI Press.
- Robertson, S.I. (2001), *Problem solving*. Hove: Psychology Press.
- Rossi, P., Lipsey, M. & Freeman, H. (2007) *Evaluation: A Systematic Approach*. 7th ed. Thousand Oaks: Sage.
- Ruthven, I., Lalmas, M., van Rijsbergen, K. (2003). Incorporating user search behavior into relevance feedback. *Journal of the American Society for Information Science and Technology* 54(6): 529-549.
- Vakkari, P. (1999) Task complexity, problem structure and information actions. *Information Processing & Management* 35 (6): 819-837.
- Vakkari, P. (2001) A Theory of the Task-based Information Retrieval Process. *Journal of Documentation* 57 (1): 44-60.
- Vakkari, P. & Järvelin, K. (2005) Explanation in Information Seeking and Retrieval. In: Spink, A. & Cole, C. (ed.), *New Directions in Cognitive Information Retrieval*. Berlin: Springer, The Information Retrieval Series, Vol. 19, 113-138.
- Vakkari, P. & Pennanen, M. & Serola, S. (2003) Changes of search terms and tactics while writing a research proposal. *Information Processing & Management* 39: 445-463.
- Xie, H. (2000). Shifts of interactive intentions and information-seeking strategies in interactive information retrieval. *Journal of the American Society for Information Science*, 51, 841-857.