# User Modeling in Exploratory Search

**Ilkka Kiistala**
Department of Computer Science
University of Helsinki
ilkka.kiistala@helsinki.fi

**Tuire Peurala**
Department of Computer Science
University of Helsinki
tuire.peurala@helsinki.fi

### ABSTRACT
Here we'll describe the content of our essay.

### Author Keywords
Exploratory Search; Information Retrieval; User Modeling.

### ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

### General Terms
Human Factors; Design; Measurement.

### INTRODUCTION
Context who needs, what needs, why that is a problem in current situation

We'll describe here the roles of further chapters.

### USER MODELING
Shortish explanation of user modeling key concepts. [17], [5]

To build a good system where machine and a human cooperate to perform a task it is important to take into account some significant characteristics of people [17]. User model is built of these characteristics and traditionally it has been a model of a typical user [17]. In reality often the users vary so much that a traditional user model is insufficient and there is a need for a user model of an individual.

#### Sterotypes
Modeling stereotypes. [3], [16] Traditional user models have been constructed by collecting data on an average user on various tasks and environments [17]. An example of a sterotypical user model is Fitt's law that suggests that the speed on which the user operates the machine can be increased by increasing the size of targets the user must hit. The major weakness of these kind of models is that they assume that all the users constitute a homogenous set. In most cases for the majority of users the system is better adapted to them taht would be without any adaptation, but it isn't likely the best system that could be produced [17].

#### How to Collect and Analyze User Information
[15], [23]

#### Personalization
Individualization of user models, Adaptive/Adaptable User Interfaces, intelligent user interfaces [2], [4], [1]

[21]: "Personalized system's output or appearance differs for every user or user group in every context. The adapted output has the potential to be a great benefit for users; it is geared towards the user's preferences, behaviour or needs and it can make interaction easier and a lot more fruitful." The evaluation of a personalized system is problematic because it is unclear if the results gathered from a few individuals who all used system personalized for them can be generalized to entire population of users.

[21]: The writers are researchers at University of Twente, Netherlands. They took a look at scientific articles about user-centered evaluation (UCE) studies of adaptive and adaptable systems. The articles they reviewed are from 2007 and before. They reviewed 63 studies. Of the systems in the studies, 37 % were adaptive, 27 % adaptable and the rest, 36 %, were both adaptive and adaptable. As a result of their literature review, they have modeled a process that can be used in evaluating a personalized system. The model they present, the iterative design process for a personalized system, has four phases based on how ready the system is. Based on their findings in the studies they reviewed, they connect the most useful methods to use and most appropriate variables to investigate in each phase. Overall, the article notes that the current UCE practice of personalized systems was found to be sloppy at times. They found that some of the questionnaires they reviewed were poorly designed and suggest that all the questionnaire data and log data as well should be made available so that a reader can judge the quality of the study. One reason they mention for low quality evaluations is that most evaluators of personalized systems are computer scientists and not specialized in evaluation.

### EXPLORATORY SEARCH IS A SUBTOPIC OF INFORMATION RETRIEVAL

#### Information retrieval
There are many goals in information retrieval and exploratory search is one of them. [6], [10]

Information seekers often express a desire for a user interface that organizes search results into meaningful groups, in order to help make sense of the results and to help decide what to do next [7]. There two ways of grouping search results; clustering and hierarchical faceted categories. Clustering is

grouping of items based on some similarity and is fully automated process. It is good for clarifying a vague query but the clustering algorithms aren't yet perfect and the clustering can be unpredicted [7]. Category system is a set of labels that are organized to mirror the domain. Hierarchical faceted categories are a set of hierarchical categories that each represent a different dimension. Categories are usually created manually but can be partly automated.

### Exploratory Search

Introduction to exploratory search. [13], [27], [20]

The user interface of an exploratory search system should be designed to fulfill the needs of most of its users. More information on what works and doesn't work can usually be collected from system evaluations.

However, evaluating exploratory search systems is difficult, because users have different starting positions. Their knowledge of the domain varies, they are interested in different aspects of the topic and they have previously encountered different information. [12]

## USER MODELING IN EXPLORATORY SEARCH

Generally [14], [19], [24], [11]

[11]:The writers had done a user experiment to find out what the searchers are looking at in a faceted search UI. The test participants were university students and the system of interest was a library system. As a result of the eyetracker test the writers found out that participants looked a lot at the facets and 47,4% of the eye movement was between facets, breadcrums summarising the selected facets and the result list. In an interview the participants told they used facets to help organize their view on the topic domain and select sub-topics for further investigation. Of these results the researchers deduced that the facets played an important role in the exploratory search process. The article summarizes related study on faceted search and exploratory search and has many interesting leads on articles for our essay topic.

Exploratory search is a complex information seeking task and to support this it has become accepted to use faceted search or categorized overviews [11]. Structured metadata is used to provide the user with an overview of the results and clickable categories. With this UI approach the user doesn't have to reformulate the query to narrow and browse the results. Faceted search is used in practice in library catalogs, web search, online shopping and other domains [11]. Faceted search enables the user to change fluidly between search and browsing and searchers with partially defined or changing information needs can use the overview to understand the knowledge domain and refine their needs. It has been shown that when using faceted search the users explored their results more broadly than without facets and felt more organized about their searches. Still though the faceted search interfaces make the search more efficient the subjects don't always prefer it [11].

Exploratory search tasks can be characterized as either learning oriented or investigative and they have common aspects like uncertainty, ambiguity and discovery distinguishing them from look-up oriented tasks [11].

### User Model Construction Methods

#### Utilizing the User Model

Search interface and search results, how they are affected by User Model?

Stereotypes used? Personalization used?

[21]: In order to accomodate to differing needs of users or usergroups over time, a system may use one of three basic approaches. System is called adaptive if it alters it structure, functionality or interface on the basis of a user model generated from *implicit* user input. Adaptable systems use *explicit user input* and need user's active participation. Personalized system is a hybrid of the two aforementioned.

### Experience

How has user modeling been used in supporting exploratory search, example cases? What challenges have emerged?

- Cases

### Analysis

- Challenges - Success - Failures

### Recommendations, Future improvement needs etc.

See Cases: Conclusions

## CONCLUSION

Goal, solution summary

Our goal was to explore the field of Exploratory Search and User Modeling. We found several articles that have some contribution to the topic.

Summary of results and their reliability

We found that: - Usage - Success - Failures

How much is it used in the real world, really?

Research impact - What has the research brought into software development?

## REFERENCES


1. Brusilovsky, P. Methods and techniques of adaptive hypermedia. *User Modelling and User-Adapted Interaction 6*, 2-3 (1996), 87–129.
2. Bunt, A., Conati, C., and McGrenere, J. What role can adaptive support play in an adaptable system? In *Proceedings of the 9th international conference on Intelligent user interfaces*, ACM (2004), 117–124.
3. Dillon, A., and Watson, C. User analysis in hci the historical lessons from individual differences research. *International Journal of Human-Computer Studies 45*, 6 (12 1996), 619–637.
4. Findlater, L., and McGrenere, J. A comparison of static, adaptive, and adaptable menus. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, ACM (2004), 89–96.

5. Fischer, G. User modeling in human–computer interaction. *User modeling and user-adapted interaction 11*, 1-2 (2001), 65–86.
6. Hearst, M., Elliott, A., English, J., Sinha, R., Swearingen, K., and Yee, K.-P. Finding the flow in website search. *Communications of the ACM 45*, 9 (2002), 42–49.
7. Hearst, M. A. Clustering versus faceted categories for information exploration. *Communications of the ACM 49*, 4 (2006), 59–61.
8. Kobsa, A. Generic user modeling systems. vol. 11 (2001), 49–63.
9. Kobsa, A. *Generic user modeling systems*, vol. 4321 LNCS of *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. 2007.
10. Kuhlthau, C. C. Inside the search process: Information seeking from the user's perspective. *JASIS 42*, 5 (1991), 361–371.
11. Kules, B., Capra, R., Banta, M., and Sierra, T. What do exploratory searchers look at in a faceted search interface? In *Proceedings of the ACM/IEEE Joint Conference on Digital Libraries* (2009), 313–322.
12. Kules, B., and Shneiderman, B. Users can change their web search tactics: Design guidelines for categorized overviews. *Information Processing and Management 44*, 2 (2008), 463–484.
13. Marchionini, G. Exploratory search: From finding to understanding. vol. 49 (2006), 41–46.
14. O'Connor, B., Krieger, M., and Ahn, D. Tweetmotif: Exploratory search and topic summarization for twitter. *Proceedings of ICWSM* (2010), 2–3.
15. Pazzani, M., and Billsus, D. Learning and revising user profiles: The identification of interesting web sites. *Machine Learning 27*, 3 (1997), 313–331.
16. Pu, H. ., Chuang, S. ., and Yang, C. Subject categorization of query terms for exploring web users' search interests. *Journal of the American Society for Information Science and Technology 53*, 8 (2002), 617–630.
17. Rich, E. Users are individuals: individualizing user models. *International Journal of Human-Computer Studies 51*, 2 (8 1999), 323–338.
18. Shen, X., Tan, B., and Zhai, C. Implicit user modeling for personalized search (2005). 824–831.
19. Sugiyama, K., Hatano, K., and Yoshikawa, M. Adaptive web search based on user profile constructed without any effort from users (2004). 675–684.
20. Tvarožek, M. Exploratory search in the adaptive social semantic web. *Information Sciences and Technologies Bulletin of the ACM Slovakia 3*, 1 (2011), 42–51.
21. Van Velsen, L., Van Der Geest, T., Klaassen, R., and Steehouder, M. User-centered evaluation of adaptive and adaptable systems: a literature review. *Knowledge Engineering Review 23*, 3 (2008), 261.
22. Wei, B., Liu, J., Zheng, Q., Zhang, W., Fu, X., and Feng, B. A survey of faceted search. *Journal of Web Engineering 12*, 1-2 (2013), 041–064.
23. White, R. W., Bennett, P. N., and Dumais, S. T. Predicting short-term interests using activity-based search context. In *Proceedings of the 19th ACM international conference on Information and knowledge management*, ACM (2010), 1009–1018.
24. White, R. W., Drucker, S. M., Marchionini, G., Hearst, M., and Schraefel, M. C. Exploratory search and hci: Designing and evaluating interfaces to support exploratory search interaction. In *Conference on Human Factors in Computing Systems - Proceedings* (2007), 2877–2880.
25. White, R. W., Kules, B., and Drucker, S. M. Supporting exploratory search, introduction, special issue, communications of the acm. *Communications of the ACM 49*, 4 (2006), 36–39.
26. White, R. W., Marchionini, G., and Muresan, G. Evaluating exploratory search systems. introduction to special topic issue of information processing and management. *Information Processing and Management 44*, 2 (2008), 433–436.
27. White, R. W., and Roth, R. A. Exploratory search: Beyond the query-response paradigm. *Synthesis Lectures on Information Concepts, Retrieval, and Services 1*, 1 (2009), 1–98.