



Cognitive Research for Exploratory Search (CRES)

Yuka Egusa (National Institute for Educational Policy Research, Japan),
 Noriko Kando (National Institute of Informatics/The Graduate University for Advanced Studies, Japan),
 Hitomi Saito (Aichi University of Education, Japan),
 Masao Takaku (National Institute for Materials Science, Japan),
 Hitoshi Terai (Nagoya University, Japan),
 Makiko Miwa (Open University of Japan, Japan)

URL: <http://cres.jpn.org/>

Email: cres@nii.ac.jp

CRES project

- Aims to investigate user's behavior and cognitive processes during various information seeking tasks on the Web.

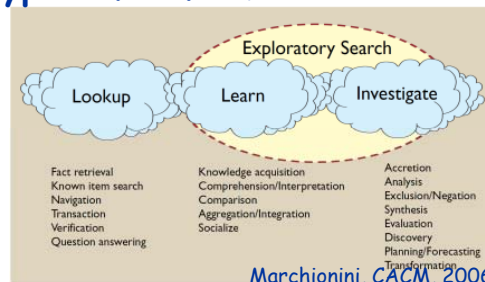
Background

In daily life, users have a lot of things that they want to know, but don't know how to look for them.

- What should I do this coming weekend?
- What is the trial committee system?
- Where can I find a good kindergarten?
- Where can I buy a good car?
- How to write a good project proposal?
- How to plan an enjoyable trip?
- What should be seen at a museum?
- How can I write a good report?
- etc.

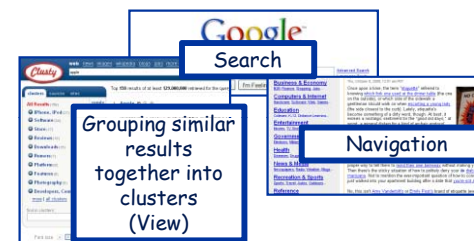


Types of Information Retrieval



Marchionini, *CACM*, 2006

Current Search Engines



Research questions:

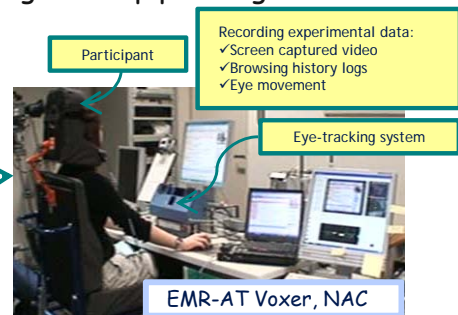
- How users explore the Web for results from search engines
- What users think when they explore the Web.
- > Analysis of server-side logs is insufficient.

In depth analysis of user information seeking behavior is indispensable

- Differences between tasks and information needs:
 - Info. gathering for report writing vs. Info. gathering for trip planning
- Type of users (differences of experience):
 - Undergraduates (11) vs. Graduates (5)

Collected data:

- Browsing history logs
- Screen captured video
- Eye movement
- Thinking aloud
- Interviews, etc...



T60, Tobii

We proposed analytical frameworks:

- "Lookzone": Set of categories indicating which part of resulting pages participants looked at.
- "Web action categories": We defined 10 action categories for analyzing a user's behavior on the Web
- "Link Depth": How far searchers browse into search engine result pages (SERP).
- "Concept map": Measuring the change in the user's knowledge due to the search by comparing these before and after maps.
- "Taxonomy of Knowledge Modification and Knowledge Utilization Patterns": Frameworks for content-analyzing the think-aloud and interview data.

We developed tools for collecting and analyzing data

- "COPATT": Platform for integrating browsing history logs, screen captured video, eye movement, and annotating users' actions.
- "QT-Honey": New client side logging tool based on Lemur Query Log Toolbar (Lemur project).
- "VizCMaps": Visualization tool for pre- and post-concept maps
- "Scanpath2SVG": Visualization tool for eye movement data.

(Updated 2010-08-16)

Procedure

Pre-questionnaires

- ◆ How much do you use Web weekly?
- ◆ What browsers do you use?
- ◆ What search engines do you use?

Repeat twice

Search Task

- Report writing
 - Trip planning
- 15 min.

Post-questionnaire

- ◆ How difficult was task?
- ◆ Satisfied with search results?

Interview

- ◆ Information-seeking processes
 - ◆ Show screen-captured video
- ≒ 30 min.

Instructions

- ✓ You have 15 minutes to collect related information through the Web.
- ✓ Add pages to browser's book marks if useful.

CRES: Cognitive Research for Exploratory Search (2)

"Web action categories"

Group Task

Web action categories		Undergraduates (n=9)		Graduates (n=5)	
		Report Mean(SD)	Trip Mean(SD)	Report Mean(SD)	Trip Mean(SD)
Search	searching using search engine	8.00 (4.37)	6.27 (4.92)	9.20 (2.99)	7.80 (5.27)
Link	clicking on page links	19.36 (6.26)	35.64 (8.65)	28.80 (7.28)	33.20 (8.57)
Next	going to next page	0.45 (0.78)	0.91 (1.08)	0.80 (0.75)	0.20 (0.40)
Back	going back to previous page	17.45 (7.51)	22.27 (13.80)	10.40 (8.11)	10.80 (7.19)
Jump	going to bookmarked or history page	2.64 (1.61)	2.64 (1.92)	2.20 (1.72)	3.40 (2.25)
Browse	browsing new search results	1.82 (2.25)	0.18 (0.57)	0.80 (1.17)	0.60 (1.20)
Submit	clicking submit button	1.27 (2.60)	3.00 (2.80)	7.60 (11.29)	4.60 (4.84)
Bookmark	adding bookmarks	4.55 (2.06)	4.55 (2.31)	8.00 (1.26)	8.00 (5.76)
Change	changing from one tab to another	2.45 (5.37)	3.55 (3.23)	43.60 (23.59)	28.40 (17.85)
Close	closing tabs or windows	0.36 (0.64)	2.36 (1.77)	4.20 (3.54)	6.00 (8.79)

Undergraduates were more likely to click links during the trip task than during the report task.

Graduates tend to use multiple tabs and windows.

Graduates bookmarked more pages than the undergraduates.

"COPATT": analysis platform

Integrating multiple data types

Screen captured video

Eye movement

Interviews

Thinking aloud

Browsing history logs

Lookzones

"Lookzones"

Lookzone	Undergraduates (n=9)		Graduates (n=5)	
	Report Mean(SD)	Trip Mean(SD)	Report Mean(SD)	Trip Mean(SD)
1 Title bar	3.78 (6.81)	1.00 (1.56)	0.40 (0.80)	0.80 (0.98)
2 Menu	0.22 (0.42)	0.11 (0.31)	1.80 (3.12)	0.00 (0.00)
3 Bookmark	4.22 (5.90)	0.00 (0.00)	0.00 (0.00)	0.20 (0.40)
4 Toolbar	1.33 (1.63)	1.22 (1.40)	0.40 (0.80)	0.40 (0.80)
5 URL bar	0.56 (1.07)	0.22 (0.42)	0.40 (0.49)	0.00 (0.00)
6 Search bar	0.00 (0.00)	0.00 (0.00)	6.40 (7.50)	4.00 (7.04)
7 Search bar button	0.00 (0.00)	0.00 (0.00)	0.40 (0.49)	0.20 (0.40)
8 Tab	8.11 (9.81)	9.22 (17.94)	12.00 (14.13)	6.00 (6.63)
12 Scroll bar	0.11 (0.31)	0.00 (0.00)	0.60 (0.80)	0.00 (0.00)
21 Find in a page	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
22 Status bar	1.78 (3.39)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
9 Link for services	17.67 (23.44)	5.11 (9.33)	2.40 (2.06)	2.20 (2.14)
10 Query box	36.89 (36.71)	12.56 (11.93)	5.60 (4.36)	3.00 (4.65)
11 Search button	0.89 (1.10)	0.67 (0.82)	0.00 (0.00)	0.20 (0.40)
13 Number of hits	0.44 (0.96)	0.00 (0.00)	0.00 (0.00)	0.60 (0.80)
14 Sponsor link	6.67 (7.85)	12.44 (9.93)	0.00 (0.00)	11.40 (13.99)
15 Spell check	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.20 (0.40)
16 Title	59.67 (38.92)	42.11 (34.19)	41.20 (26.80)	39.20 (40.82)
17 Snippet	91.11 (55.59)	37.00 (32.34)	74.80 (42.56)	29.40 (28.80)
18 URL	40.89 (34.27)	15.56 (11.35)	18.00 (9.21)	12.40 (11.53)
20 Link for next page	3.00 (4.03)	2.56 (4.11)	1.20 (1.94)	1.20 (1.17)
Misc	52.89 (53.43)	18.89 (14.51)	21.60 (14.47)	17.00 (8.60)
Out of lookzone	83.44 (73.10)	70.78 (101.06)	15.00 (10.94)	7.20 (4.71)

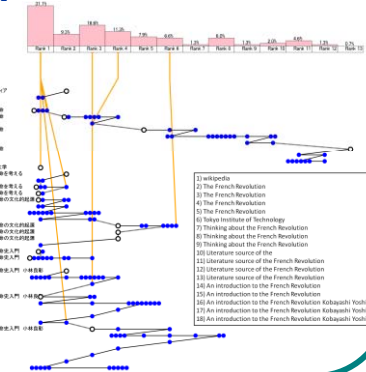


Group Task

Graduates tend to use more advanced web browser features. e.g. search bars and tabs. Snippet areas more attractive in report tasks than trip tasks.

Scanpath2SVG

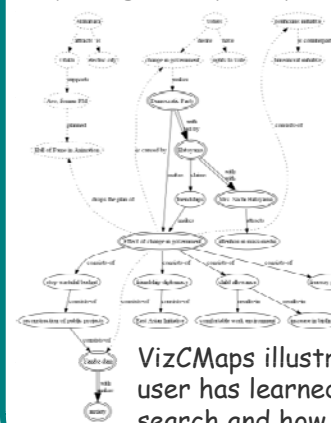
Visualization of viewed page and clickthrough page rankings



A demo version of Scanpath2SVG visualization is available at <http://cres.jpn.org/scanpath2svg/>

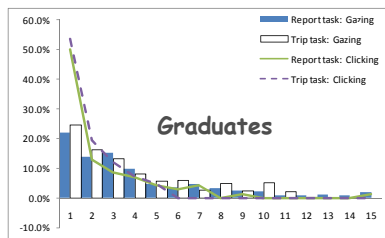
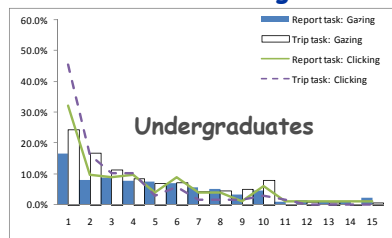
VizCMaps: Combined graph of pre- and post-search concept maps

A new method for evaluating the effectiveness of an exploratory search by using concept maps.



VizCMaps illustrates what a user has learned during the search and how the user's knowledge representations have changed.

Eye movement and click ranking

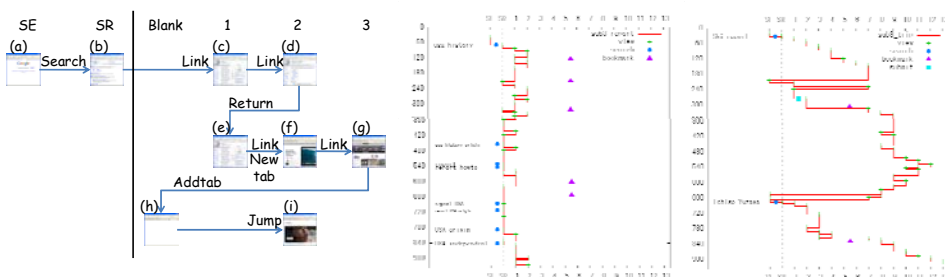


Users viewed more low-ranking pages for report tasks than for trip tasks. Users' viewing behavior was heavily influenced by type of query, i.e. navigational or informational.

Link Depth Overview Examples of Link Depth

How far users explore the Web

Report vs. Trip



In the trip task, most of the participants explored more deeply on the Web than in the report task. This result reflects the relationship between tasks and the physical characteristics of the Web.

Outcomes

(Detailed info is available at <http://cres.jpn.org/>)

- Terai et al., IIX2008 (Oct. '08)
- Kando et al., ASIS&T panel (Oct. '08)
- Egusa et al., EVIA (Dec. '08)
- Kando et al., Dagstuhl Seminar (Mar. '09)
- Saito et al., SIGIR Workshop on UIIR, (Jul. '09)
- Miwa, Organizing a Panel at ASIS&T (Nov. '09)
- Egusa et al., HICSS 2009, (Jan. '10)
- Takaku et al., JSIK Journal (Sep. '10; online: May '10)
- Egusa et al., IIX2010 (Aug. '10)
- Saito et al., AIRS2010 (Dec. '10)