



# Predicting Outcomes of Web Navigation



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## Introduction

### Motivation & Goals

Despite many research efforts in the area of hypertext and web navigation, the problem of users becoming "lost in hyperspace" is still with us. And relatively little is known about the relationship between web navigation strategies and success on information seeking tasks.

The goal of this research is to review metrics that characterize user navigation strategies in information seeking tasks on websites. The metrics are evaluated on their ability to predict navigation task outcomes.

## Web Navigation Studies

### Two Experiments

**TL Study** – time limit on each information finding task;  
**TA Study** – users were asked to talk aloud while navigating website.

**Task:** Question-driven information seeking on complex websites. Find **one** web page containing information specified in each question.  
**Task constraints:** Navigate to the page, do not use search.  
**Participants:** **TL:** 48 adults (29M+19F); **TA:** 14 adults (8M+6F).  
**Sample question:** "Find passport offices in Ontario."

## Definitions of Metrics

### Simple Metrics

use the **visited** and **unique** node counts and their ratios:

**Revisits** =  $1 - U/N$  (Herder & an Dijk, 2004)  
where:  $N$  = # nodes visited;  $U$  = # unique nodes visited;

### Graph-Based Metrics

use two formal properties of the user navigation path graph:

**Stratum** = a measure of linearity (Botafofo et al. 1992)  
**Compactness** = a measure of connectedness

### Navigation Path Similarity Metrics

measure **similarity** between user path and the optimal path:

- Existence of optimal path assumed
- The navigation path is a sequence of nodes:  $\langle n_0, n_1, \dots, n_l \rangle$
- Each node is a URL treated as a 3-tuple:  $\langle \text{host}, \text{path}, \text{query} \rangle$

Calculated using Needleman-Wunsch (1970) longest common sequence (LCS). This is a global sequence alignment algorithm with a non-zero gap cost and an arbitrary distance function (calculated between URLs treated as 3-tuples).

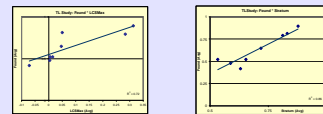
### Subjective Evaluation of Lostness

In the **TA Study**, participants were asked to talk aloud while engaged in the search task—they were asked to report on how well they felt they were doing. Later, a trained human rater watched an audio-video record of the usability session and assessed how lost the participant appeared to be, every 30 seconds. Lostness was rated on a scale: 1-"Definitely Not Lost", 2-"Probably Not Lost", 3-"Probably Lost", 4-"Definitely Lost".

## Metrics and Task Outcomes

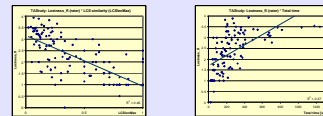
### TL Study

**Task success: LCS similarity & Stratum**  
Successful users' paths tended to be similar to the optimal path and close to linear shape.



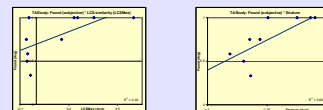
### TA Study

**Lostness: LCS similarity & total time**  
Subjective lostness best predicted by LCS Similarity and total time.



### TA Study

**Subjective Task Success: LCS similarity & Stratum**  
When participants felt that they had been successful, their navigation paths were similar to the optimal path close to linear.



## Characterizing One Task

**User Task, Q8:** "Find page describing how to deal with stress for women"

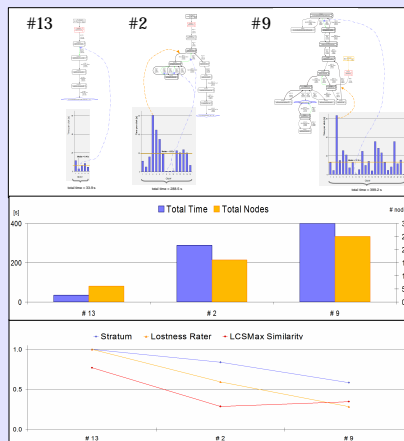
### Subject Number

**User Navigation Path**  
from linear to "bushy"

### Time per Click

slowest & fastest clicks  
linked to steps on path

### Total Time & Total Nodes



**Stratum, Subjective Lostness & Similarity**  
to facilitate comparisons  
Lostness & Similarity were rescaled to [0, 1]

## Summary

### Key Findings

- Similarity to optimal path was a good predictor of task success and lostness
- Higher values of stratum (typically along with lower values of compactness) were associated with a higher probability of task success
- Best predictors of information finding success were different depending on the specific question
- Association between stratum and task success was opposite to found in previous research (McEneaney, 2001)

### Summary and Future Work

Appropriate metrics provide useful characterizations of user web navigation behaviour and can help to diagnose a variety of problems. This diagnostic capability could be used to build adaptive web solutions.

Extensions of this research will study:

- Different information finding tasks (e.g. broad browsing)
- Factors that encourage deviation from the optimal or intended path;
- Automatic detection of lostness and provision of an adaptive interface;
- Individual differences such as level of web familiarity, domain knowledge, gender, verbal ability, etc.

The ultimate goal is to inform web design and to improve the information architecture and design of large, complex websites and hypertext documents.