

SIGIR 2012 Portland



SIGIR 2012 Portland, Oregon, USA August 12–16, 2012

# PUTTING CONTEXT INTO SEARCH AND SEARCH INTO CONTEXT

Susan Dumais, Microsoft Research

# Overview

- Importance of context in IR
- Potential for personalization framework
- Examples
  - ▣ Personal navigation
  - ▣ Client-side personalization
  - ▣ Short- and long-term models
  - ▣ Time as metadata
- Challenges and new directions

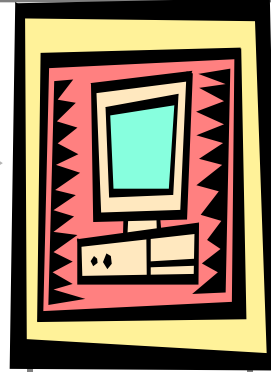
# Search for **Context**

User  
Context



Query Words

Query Words

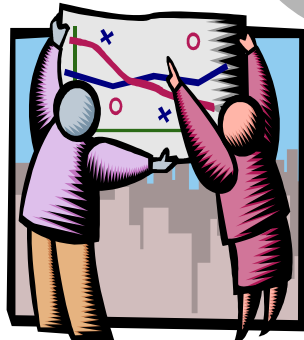


Ranked List

Document  
Context



Task  
Context



# Context Improves Query Understanding

- Queries are difficult to interpret in isolation



- Easier if we can model: who is asking, what they have done in the past, where they are, when it is, etc.

**Searcher:** (*SIGIR* | Susan Dumais ... an information retrieval researcher)

vs. (*SIGIR* | Stuart Bowen Jr. ... the Special Inspector General for Iraq Reconstruction)

**Previous actions:** (*SIGIR* | information retrieval)

vs. (*SIGIR* | U.S. coalitional provisional authority)

**Location:** (*SIGIR* | at SIGIR conference) vs. (*SIGIR* | in Washington DC)

**Time:** (*SIGIR* | Jan. submission) vs. (*SIGIR* | Aug. conference)

- Using a single ranking for everyone, in every context, at every point in time, limits how well a search engine can do



# SIGIR 2012?

- Have you searched for SIGIR 2012 recently?
- What were you looking for?

[SIGIR Quarterly Report: July 2012 « The Currency Newshound](#)

[thecurrencynewshound.com/2012/08/02/sigir-quarterly-report-july-2012](http://thecurrencynewshound.com/2012/08/02/sigir-quarterly-report-july-2012)

I am pleased  
Secretaries of

[SIGIR Portland Oregon 2012 - ACM SIGIR Special Interest Group ...](#)

[www.sigir.org/sigir2012](http://www.sigir.org/sigir2012)

SIGIR 2012. Online registration for SIGIR 2012 is now closed. On-site registration will be  
2, the 35th Annual ...

[SIGIR 2012 Workshop on Open Source Information Retrieval](#)

[opensearchlab.otago.ac.nz](http://opensearchlab.otago.ac.nz)

Introduction. The open source IR community has been  
search engines (such as MG) continue to be used in

[SIGIR 2012 Workshop on Time-aware Information Access ...](#)

[research.microsoft.com/en-us/people/milads/taia2012.aspx](http://research.microsoft.com/en-us/people/milads/taia2012.aspx)

SIGIR 2012 Workshop on Time-aware Information Access (#TAIA2012). Web content  
physical and social world, ...

[SIGIR 2012 : The 35th International ACM SIGIR Conference on ...](#)

[www.wikicfp.com/cfp/servlet/event\\_showcfp?eventid=18172&conowner](http://www.wikicfp.com/cfp/servlet/event_showcfp?eventid=18172&conowner)

SIGIR 2012 : The 35th International  
Development in Information Retrieval

[ACM SIGIR Special Interest Group on Information Retrieval ...](#)

[www.sigir.org](http://www.sigir.org)

SIGIR invites applications for student travel grants to help cover the cost of travel, living

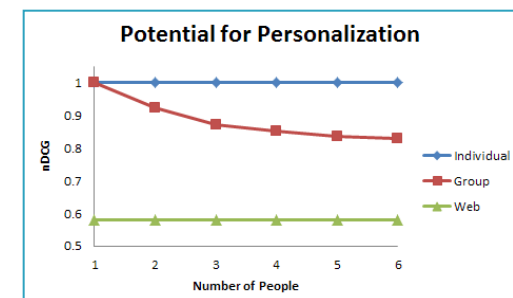
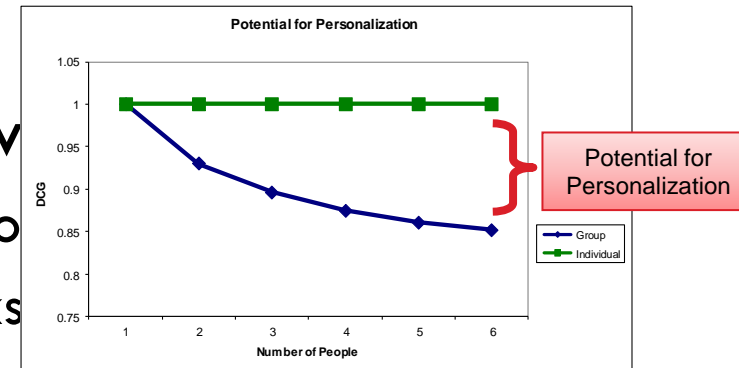
[SIGIR 2012](#)

[sigir2012.confmaster.net](http://sigir2012.confmaster.net)

Welcome to the paper submission and reviewing site for the SIGIR2012 conference! The  
abstract submission deadline is 6 February, 2012. If you submitted an abstract ...

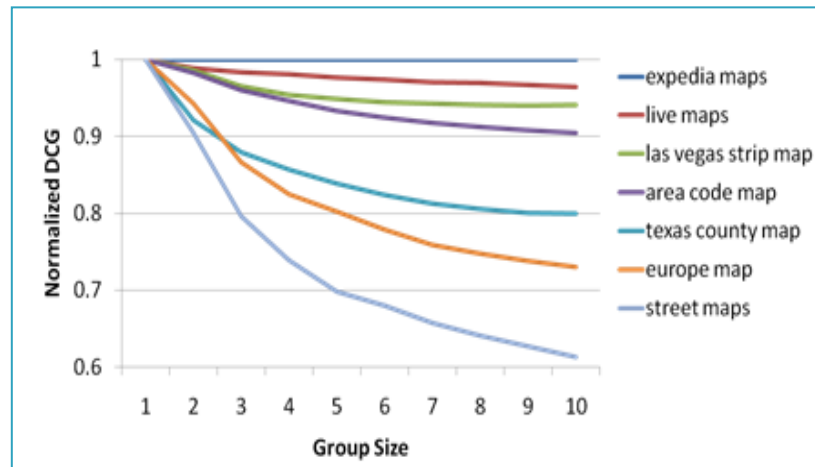
# Potential For Personalization

- A single ranking for everyone limits search quality
- Quantify the variation in individual relevance for the same query
- Different ways to measure individual relevance
  - ▣ Explicit judgments from different people
  - ▣ Implicit judgments (search result clicks)
- Personalization can lead to large improvements
  - ▣ Small study with explicit judgments
  - ▣ 46% improvements for core ranking
  - ▣ 70% improvements with personalization

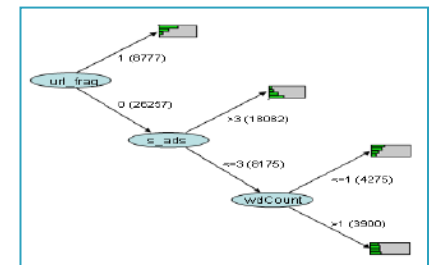


# Potential For Personalization

- Not all queries have high potential for personalization
  - ▣ E.g., facebook vs. sigir
  - ▣ E.g., \* maps



- Learn when to personalize



# User Models

- Constructing user models
  - ▣ Sources of evidence
    - Content: Queries, content of web pages, desktop index, etc.
    - Behavior: Visited web pages, explicit feedback, implicit feedback
    - Context: Location, time (of day/week/year), device, etc.
  - ▣ Time frames: Short-term, long-term
  - ▣ Who: Individual, group
- Using user models
  - ▣ Where resides: Client, server
  - ▣ How used: Ranking, query support, presentation
  - ▣ When used: Always, sometimes, context learned



# User Models

## □ Constructing user models

### ▣ Sources of evidence

- Content: Queries, content of web pages, desktop index, etc.
- Behavior: Visited web pages, explicit feedback, implicit feedback
- Context: Location, time (of day/week/year), device, etc.

### ▣ Time frames: Short-term, long-term

### ▣ Who: Individual, group

PNav

## □ Using user models

### ▣ Where resides: Client, server

### ▣ How used: Ranking, query support, presentation

### ▣ When used: Always, sometimes, context learned

PSearch

Short/Long

Time

# Example 1: Personal Navigation

- Re-finding is common in Web search
  - ▣ 33% of queries are repeat queries
  - ▣ 39% of clicks are repeat clicks
- Many of these are navigational queries
  - ▣ E.g., *microsoft* -> [www.microsoft.com](http://www.microsoft.com)
  - ▣ Consistent intent across individuals
  - ▣ Identified via low click entropy
- “Personal navigational” queries
  - ▣ Different intents across individuals, but consistently the same intent for an individual
    - SIGIR (for Dumais) -> [www.sigir.org/sigir2012](http://www.sigir.org/sigir2012)
    - SIGIR (for Bowen Jr.) -> [www.sigir.mil](http://www.sigir.mil)

|              |     | Repeat Click | New Click |
|--------------|-----|--------------|-----------|
| Repeat Query | 33% | 29%          | 4%        |
| New Query    | 67% | 10%          | 57%       |
|              |     | 39%          | 61%       |

bing  
165 beta

sigir

446,000 RESULTS

SIGIR Conference is on Sunday, Aug tomorrow.

ACM SIGIR Special Interest Group on Information Retrieval ...  
www.sigir.org -  
Welcome to the ACM SIGIR Web site. ACM SIGIR addresses issues ranging from theoretical to user demands in the application of computers to the acquisition, organization ...

Welcome to SIGIR Home  
www.sigir.mil -  
An Iraq fisherman pushes his boat off-shore to depart on his daily fishing trip. View the Report.

home [ACM SIGIR 2010]  
www.sigir2010.org -  
ACM-SIGIR 2010 was held at UniMail, Geneva, Switzerland between 18th and 23rd of July 2010. Thanks to all the participants!! The story continues with ACM-SIGIR 2011.

SIGIR Portland Oregon 2012 - ACM SIGIR Special Interest Group  
www.sigir.org/sigir2012 -  
SIGIR 2012. Online registration for SIGIR 2012 is now closed. On-site registration will be available at the conference venue. Welcome to SIGIR 2012, the SIGIR Special Interest Group.

Welcome to The 34th Annual ACM SIGIR  
sigir2011.org -  
ACM-SIGIR 2011 successfully completed in Beijing. Thanks to all the speakers and participants!! See you next year.

Related searches for sigir  
SIGIR Iraq SIGIR Forum  
SIGIR 12 SIGIR 2011 Accepted  
CIKM WSDM

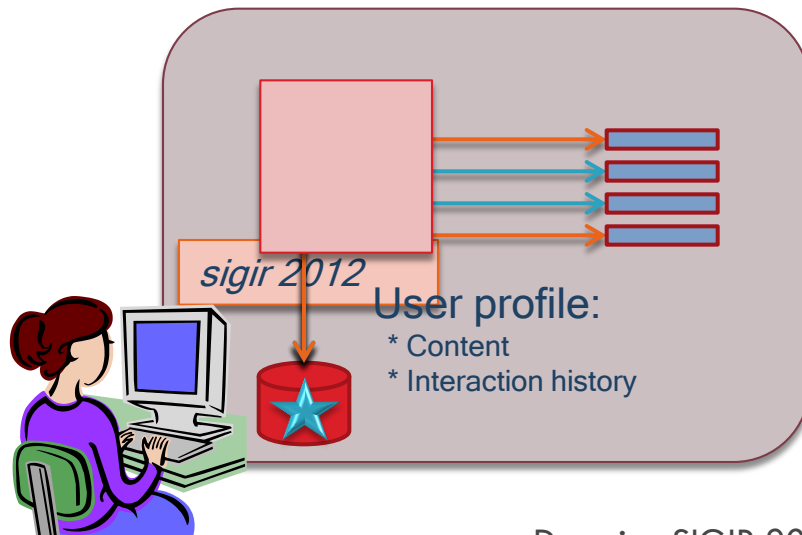
Special Inspector General for Iraq Reconstruction - Wikipedia  
en.wikipedia.org/wiki/Special\_Inspector\_General\_for\_Iraq\_Reconstruction -  
The Office of the Special Inspector General for Iraq Reconstruction (SIGIR) was created in October 2004 as the successor to the Coalition Provisional Authority Office.

# Personal Navigation Details

- Large-scale log analysis
- Identifying personal navigation queries
  - ▣ Use consistency of clicks within an individual
  - ▣ Specifically, the last two times a person issued the query, did they have a unique click on same result?
- Coverage and prediction
  - ▣ Many such queries: ~15% of queries
  - ▣ Prediction accuracy high: ~95% accuracy
  - ▣ High coverage, low risk type of personalization
- Predictions consistent over time
- Can be used to re-rank, or augment presentation

# Example 2: PSearch

- Rich client-side model of a user's interests
  - ▣ Model: Content from desktop search index & Interaction history
    - Rich and constantly evolving user model
  - ▣ Client-side re-ranking of (lots of) web search results using model
  - ▣ Good privacy (only the query is sent to server)
    - But, limited portability, and use of community



# PSearch Details

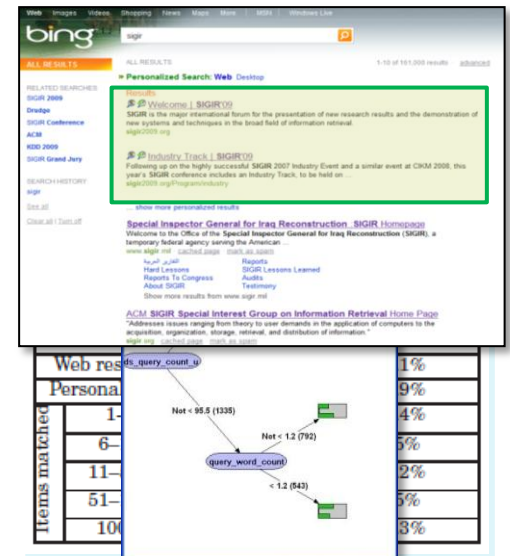
## □ Ranking Model

- Score: Weighted combination of personal and global web features
  - $Score(result_i) = \alpha PersonalScore(result_i) + (1 - \alpha) WebScore(result_i)$
- Personal score: Content and interaction history features
  - Content score - log odds of term in personal vs. web content
  - Interaction history score - visits to the specific URL, and backoff to site

## □ Evaluation

- Offline evaluation, using explicit judgments
- In situ evaluation, using PSearch prototype
  - Internal deployment; 225+ people for several months
  - Coverage: Results personalized for 64% of queries
  - Effectiveness:
    - CTR 28% higher, for personalized results
    - CTR 74% higher, when personal evidence is strong
  - Learned model for when to personalize

Dumais - SIGIR 2012 Industry Keynote



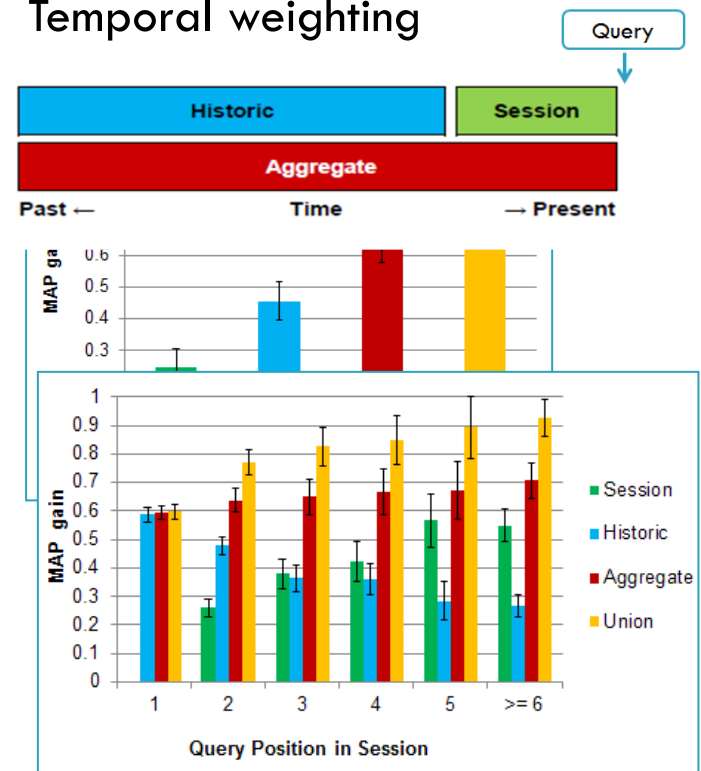
# Example 3: Short + Long

- Short-term context
  - ▣ Previous actions (queries, clicks) within current session
    - (Q=*sigir* | *information retrieval vs. iraq reconstruction*)
    - (Q=*ego* | *id*)
    - (Q=*acl* | *computational linguistics*)
- Long-term preferences and interests
  - ▣ Behavior: Specific queries/URLs
    - (Q=*weather*) -> *weather.com vs. weather.gov vs. intellicast.com*
  - ▣ Content: Language models, topic models, etc.
- Develop unified model for both

# Short + Long Details

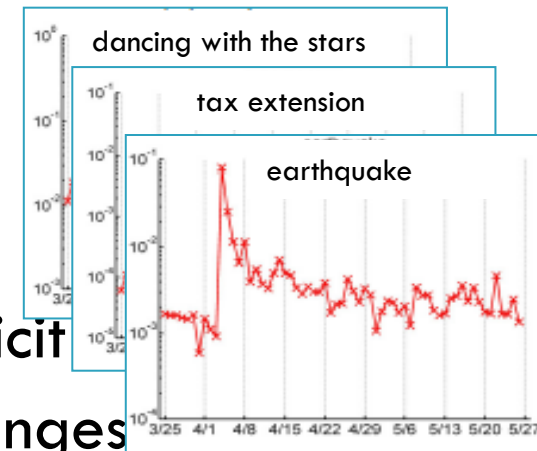
- User model (content)
  - ▣ Specific queries/URLs
  - ▣ Topic distributions, using ODP
- Log-based evaluation, MAP
- Which sources are important?
  - ▣ Session (short-term): +25%
  - ▣ Historic (long-term): +45%
  - ▣ Combinations: +65-75%
- What happens within a session?
  - ▣ 60% of sessions involve multiple queries
    - By 3<sup>rd</sup> query in session, short-term features more important than long-term
    - First queries in session are different

- User model (temporal extent)
  - ▣ Session, Historical, Combinations
  - ▣ Temporal weighting



# Example 4: Temporal Dynamics

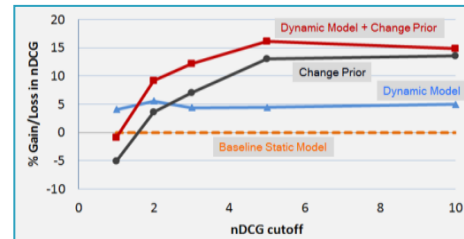
- Queries are not uniformly distributed over time
  - ▣ Often triggered by events in the world
- Relevance is influenced by time
  - ▣ Explicit time (e.g., *US Open 2012*)
  - ▣ Implicit time (e.g., *Olympic results*; implicit)
  - ▣ What's relevant to the same query changes
    - E.g., *US Open ...* in 2012 vs. in 2011
    - E.g., *US Open 2012 ...* in May (golf) vs. in Sept (tennis)
    - E.g., *US Tennis Open 2012 ...*
      - Before event: Schedules and tickets, e.g., stubhub
      - During event: Real-time scores or broadcast, e.g., espn, cbssports
      - After event: General sites, e.g., wikipedia, usta



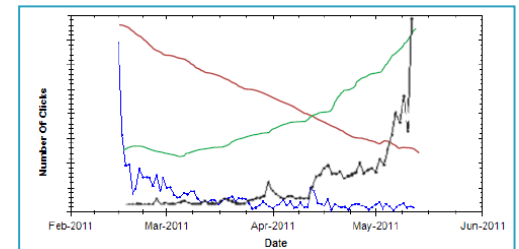


# Temporal Dynamics Details

- Develop time-aware retrieval models
- Leverage content change on a page
  - ▣ Pages have different *rates of change* (influences document priors,  $P(D)$ )
  - ▣ Terms have different *longevity* on a page (influences term weights,  $P(Q/D)$ )
  - ▣ 15% improvement vs. LM baseline



- Leverage time-series modeling of user interactions
  - ▣ Model Query and URL clicks as time-series
  - ▣ Enables appropriate weighting of historical interaction data
  - ▣ Useful for queries with local or global trends



# Challenges in Personalization

- User-centered
  - ▣ Privacy
  - ▣ Transparency and control
  - ▣ Consistency
  - ▣ Serendipity
  
- Systems-centered
  - ▣ System optimization
    - Storage, run-time, caching, etc.
  - ▣ Evaluation

# Privacy

- Need user profile and content to be in the same place
- Profile on client (e.g., PSearch)
  - ▣ Profile is private
  - ▣ Query to server, many documents returned, local computations
- Profile in cloud
  - ▣ Transparency about what's stored
  - ▣ Control over what's stored ... including nothing
- Other possible approaches
  - ▣ Light weight profiles (e.g., queries in a session)
  - ▣ Public or semi-public profiles (e.g., Tweets, Facebook status)
  - ▣ Matching an individual to group

# Serendipity

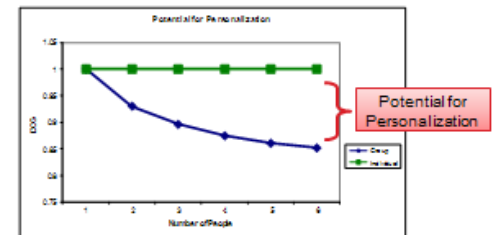
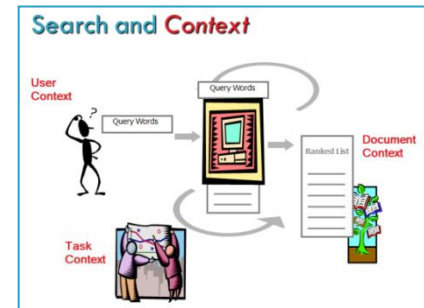
- Does personalization mean the end of serendipity?
- Actually ... it can improve it!
- Judgments of Relevance vs. Interestingness
  - ▣ Personalization finds more relevant results
  - ▣ Personalization finds more interesting results
  - ▣ Even when interesting results were not relevant
- Need to be ready for serendipity
  - ▣ Zone of proximal learning
  - ▣ Walpole's *Three Princes of Serendip* – heroes made discoveries by accident and sagacity, of things they were not in quest of

# Evaluation

- External judges
  - ▣ Query – Lack diversity of intents and backgrounds
  - ▣ Query + user profile (e.g., session data) – Better, but where do the profiles come from and how do we summarize them?
- Actual searchers
  - ▣ Offline
    - Allows exploration of many different alternatives
    - But ... Difficult to collect at scale
  - ▣ Online (*In Situ*)
    - Explicit judgments – Great, but annoying and may change behavior
    - Implicit judgments – Nice, but can be noisy
    - But ... Limited set of alternatives; presentation and relevance coupled
- Diversity of methods: User studies; user panels; large-scale log analysis and A/B testing

# Summary

- Queries difficult to interpret in isolation
- Augmenting query with context can help
  - ▣ Who, what, where, when?
- Potential for improving search using context is large
- Examples
- Challenges and new directions



# Thanks!

- Questions?

- More info:

<http://research.microsoft.com/~sdumais>

- Collaborators:

- ▣ Eric Horvitz, Jaime Teevan, Paul Bennett, Ryen White, Kevyn Collins-Thompson, Peter Bailey, Eugene Agichtein, Krysta Svore, Kira Radinski, Jon Elsas, Sarah Tyler, Alex Kotov, Anagha Kulkarni

# References

## □ Short-term models

- White et al., CIKM 2010. *Predicting short-term interests using activity based contexts.*
- Kotov et al., SIGIR 2011. *Models and analyses of multi-session search tasks.*
- Agichtein et al., SIGIR 2012. *Search interrupted: Understanding and predicting search task continuation.*

## □ Long-term models

- Teevan et al., SIGIR 2005. *Personalizing search via automated analysis of interests and activities.* \*
- Teevan et al. SIGIR 2008. \*
- Teevan et al., TOCHI 2010. *Potential for personalization.* \*
- Bennett et al., SIGIR 2012. *Modeling the impact of short- and long-term behavior on search personalization.* \*
- Tyler et al., WSDM 2010. *Large Scale Query Log Analysis of Re-Finding.*
- Teevan et al., WSDM 2011. *Understanding and Predicting Personal Navigation.* \*

## □ Time

- Elsas and Dumais, WSDM 2010. *Leveraging temporal dynamics of document content in relevance ranking.* \*
- Kulkarni et al., WSDM 2011. *Understanding temporal query dynamics.*
- Radinsky et al., WWW 2012. *Modeling and predicting behavioral dynamics on the Web.* \*