

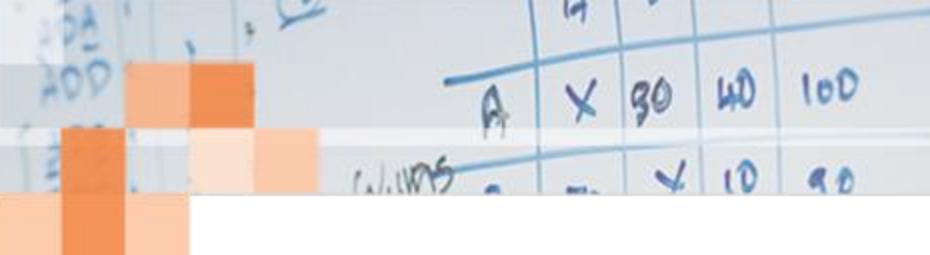
Investigating Behavioral Variability in Web Search

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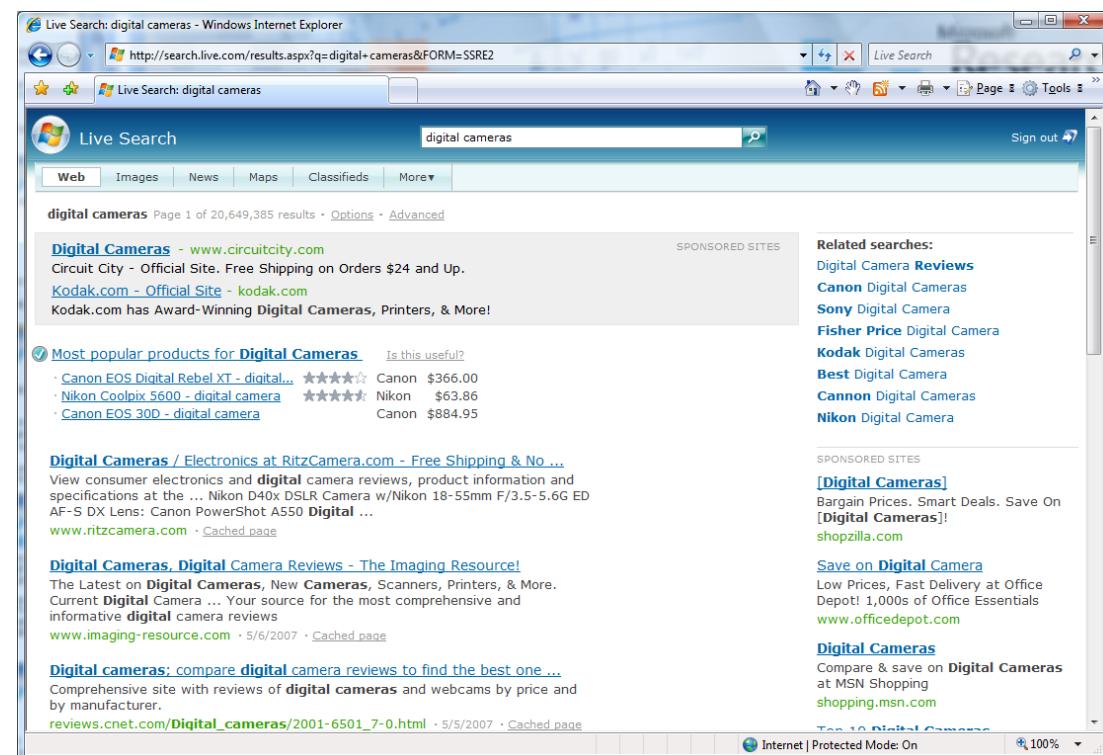
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Example to start

- Jack searches for “digital cameras”. He knows what he wants (he’s did this before) and goes straight to a particular page.
- Jill searches for “digital cameras”. She is unsure of what she’s looking for, and wants to explore the options.
- Both type “digital cameras” into a search engine...



Jill sees:



Live Search: digital cameras - Windows Internet Explorer

http://search.live.com/results.aspx?q=digital+cameras&FORM=SSRE2

Live Search: digital cameras

digital cameras Page 1 of 20,649,385 results • Options • Advanced

Digital Cameras - www.circuitcity.com
Circuit City - Official Site. Free Shipping on Orders \$24 and Up.

Kodak.com - Official Site - kodak.com
Kodak.com has Award-Winning Digital Cameras, Printers, & More!

Most popular products for Digital Cameras [Is this useful?](#)

- Canon EOS Digital Rebel XT - digital... ★★★★☆ Canon \$366.00
- Nikon Coolpix 5600 - digital camera ★★★★☆ Nikon \$63.86
- Canon EOS 30D - digital camera Canon \$884.95

Related searches:

- Digital Camera Reviews
- Canon Digital Cameras
- Sony Digital Camera
- Fisher Price Digital Camera
- Kodak Digital Cameras
- Best Digital Camera
- Cannon Digital Cameras
- Nikon Digital Camera

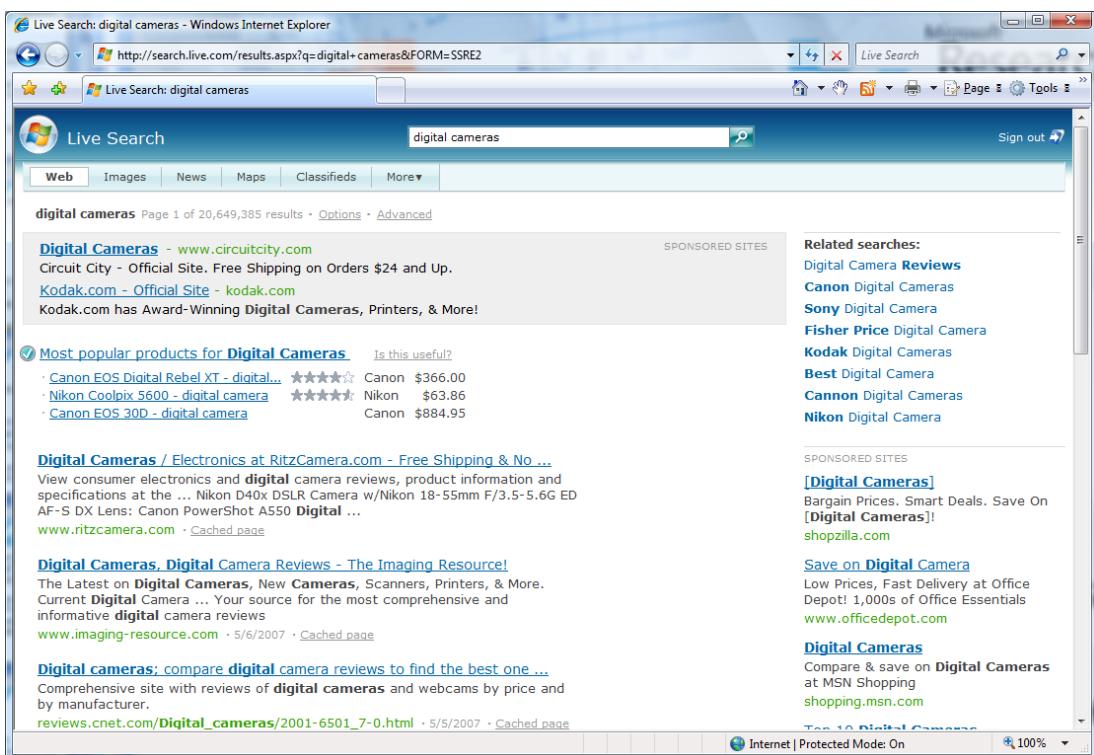
Digital Cameras / Electronics at RitzCamera.com - Free Shipping & No ...
View consumer electronics and **digital** camera reviews, product information and specifications at the ... Nikon D40x DSLR Camera w/Nikon 18-55mm F/3.5-5.6G ED AF-S DX Lens: Canon PowerShot A550 Digital ...
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Digital Cameras, Digital Camera Reviews - The Imaging Resource!
The Latest on **Digital Cameras**, New **Cameras**, Scanners, Printers, & More. Current **Digital Camera** ... Your source for the most comprehensive and informative **digital** camera reviews
[www.imaging-resource.com](#) • 5/6/2007 • [Cached page](#)

Digital cameras: compare digital camera reviews to find the best one ...
Comprehensive site with reviews of **digital cameras** and webcams by price and by manufacturer.
[reviews.cnet.com/Digital_cameras/2001-6501_7-0.html](#) • 5/5/2007 • [Cached page](#)

Internet | Protected Mode: On 100%

Jack sees:



Live Search: digital cameras - Windows Internet Explorer

http://search.live.com/results.aspx?q=digital+cameras&FORM=SSRE2

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Internet | Protected Mode: On 100%

- Same interface support for Jack and Jill regardless of prior experience or task
- No support for decisions beyond this page

One-Size-Fits-All

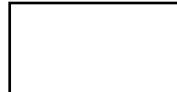
- Search engines adopt a “one-size-fits-all” approach to interface design
 - Users benefit from familiarity
 - Cost to user-interface designers minimized
 - Limited support for next steps
- Important to understand what users are doing beyond the result page, and in what ways “one-size-fits-all” can be enhanced

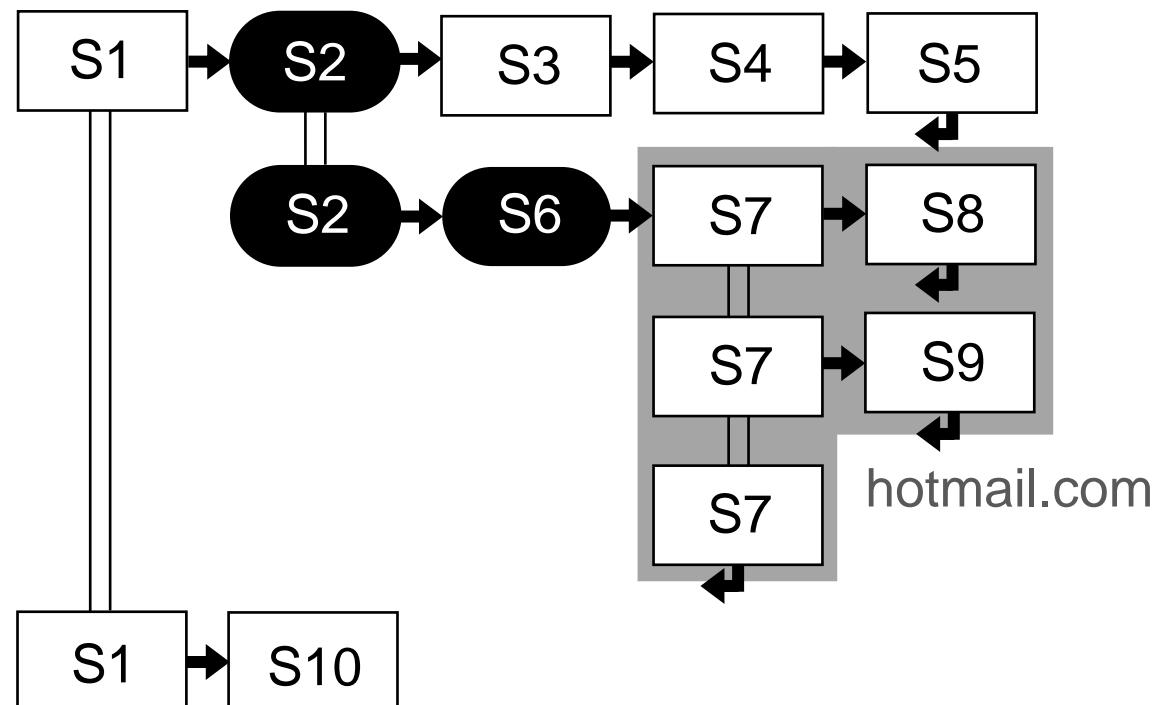
Log-based Study

- Approx. 2500 consenting users
- Instrumented client-side logging of URLs visited, timestamps, referral information, etc.
- 20 weeks (Dec 05 – April 06)
- Analysis focused on:
 - Interaction patterns (e.g., *SBBBSBSbBbBBB*)
 - Features of interaction (e.g., time spent)
 - Domains visited

Browser Trails

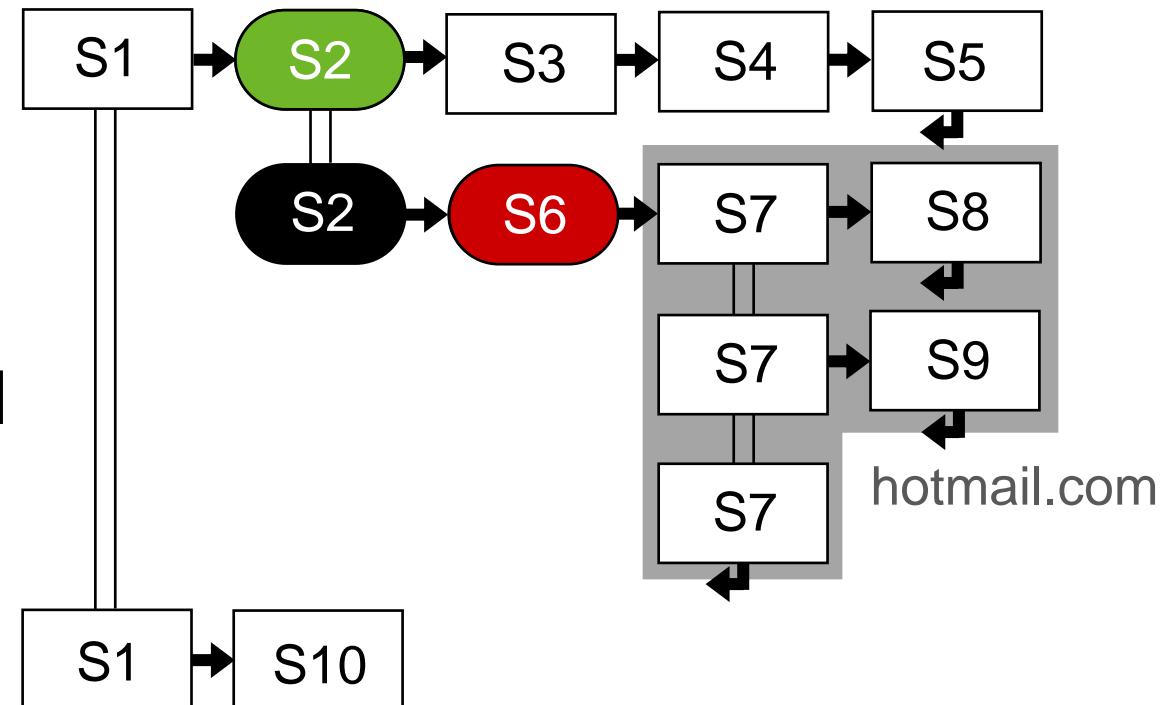
- Our analysis based on browse trails
- Ordered series of page views from opening Internet Explorer until closing browser
- Example trail as Web Behavior Graph:

 Search engine result page
 Non-result page

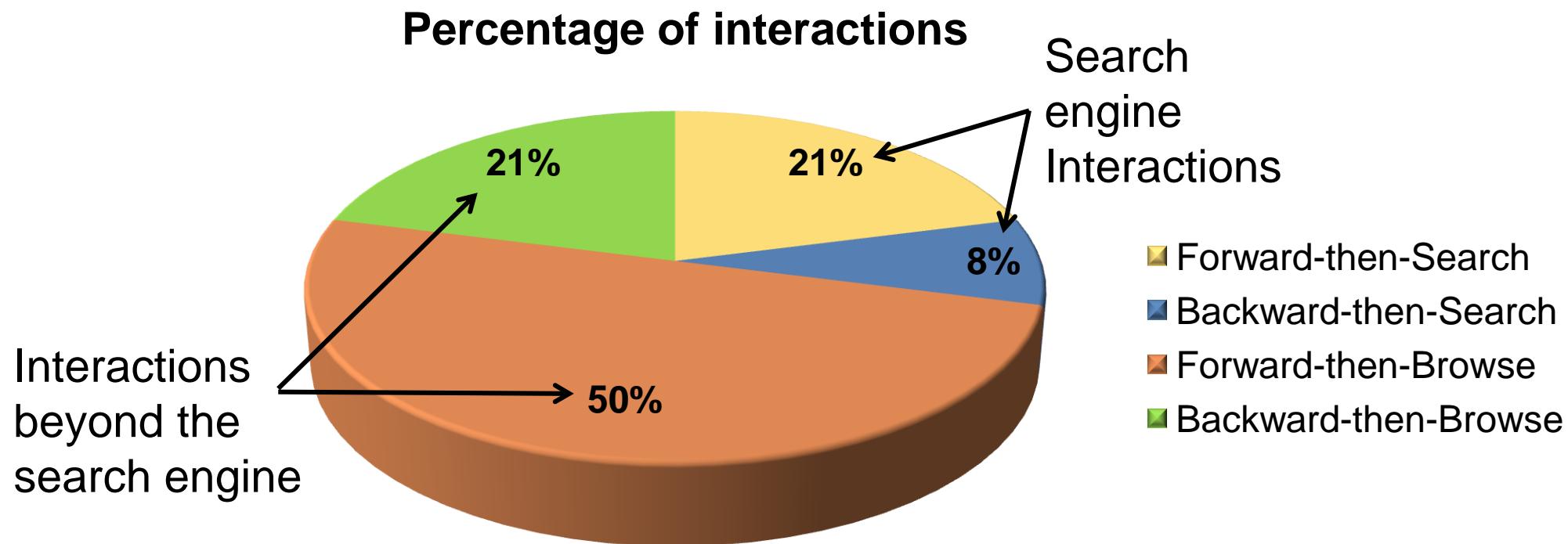


Search Trails

- Search trails situated within browse trails:
 - Initiated with a query to top-5 search engine
 - Can contain multiple queries
- Terminate with:
 - Session timeout
 - Visit homepage
 - Type URL
 - Check Web-based email or logon to online service



All Search Trails, All Users



- < 30% of interaction with search engines
- > 70% of interaction is forward motion
- Takeaway: Post SE interaction important

What we investigated

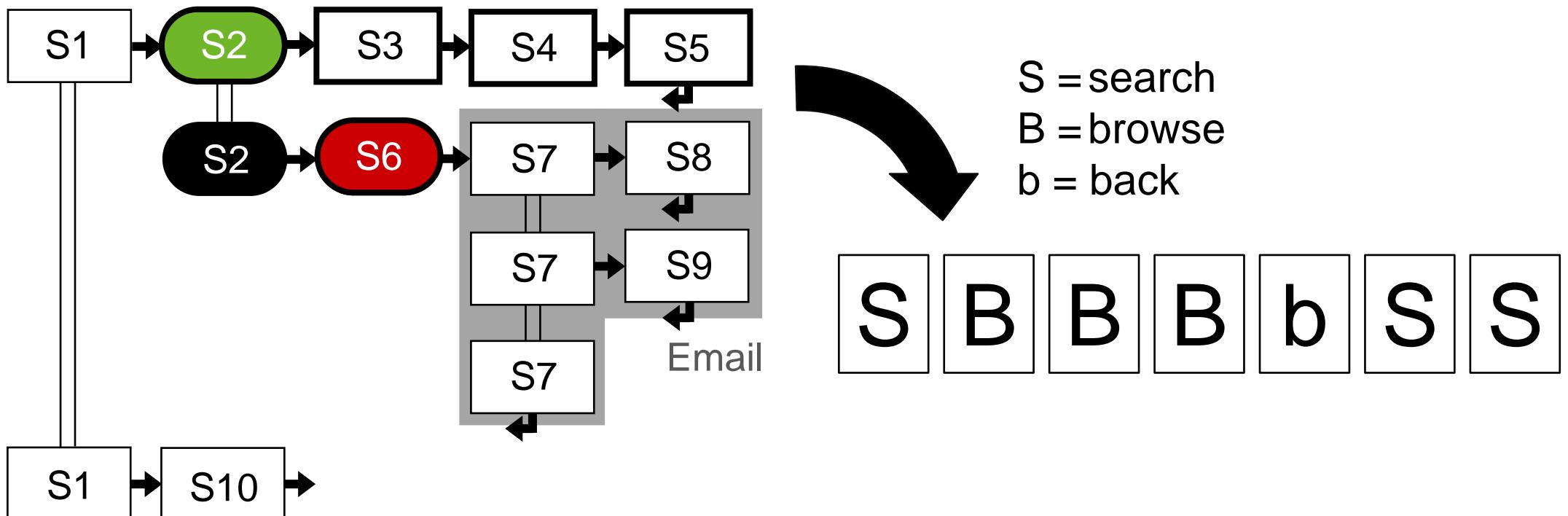
- We studied all search interactions (w/ search engine and post-engine) to better understand:
 - User Interaction Variability
 - Extent of differences within and between users
 - Query Interaction Variability
 - Extent of differences within and between queries

User Variability

- Differences in:
 - Interaction patterns
 - Features of the interaction
 - Domains visited
- Within each user
 - How consistent is user X?
- Between all users
 - How consistent are all users together?

Interaction Pattern Variance

1. Represent all users' trails as strings



2. For each user compute Edit Distance
from each trail to every other trail

Interaction Pattern Variance (2)

3. Average Edit Distance from each trail to other trails, e.g.,

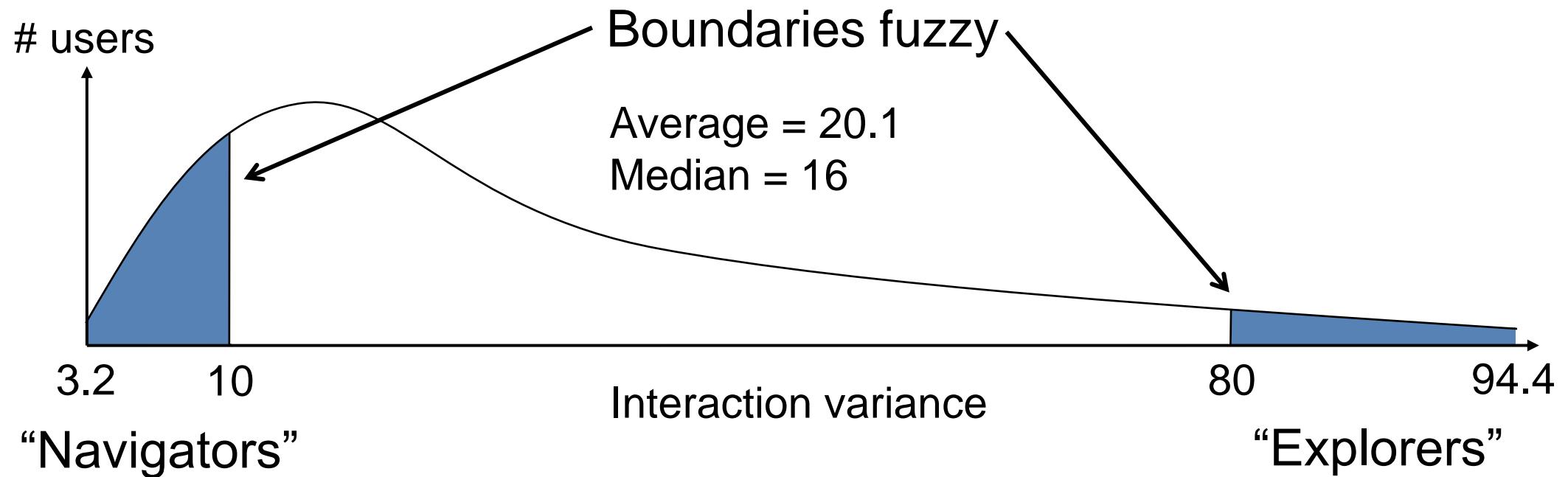
									Average	
Trail 1	S	S	B	b	S	B	S		$ED(1,2) = 4$	4
Trail 2	S	B	B	b	B	S	b	S	$ED(2,1) = 4$	4.5
Trail 3	S	B	B	B	B				$ED(3,1) = 4$	4.5

4. Trail with smallest avg. distance most representative of user interaction patterns

Interaction Pattern Variance (3)

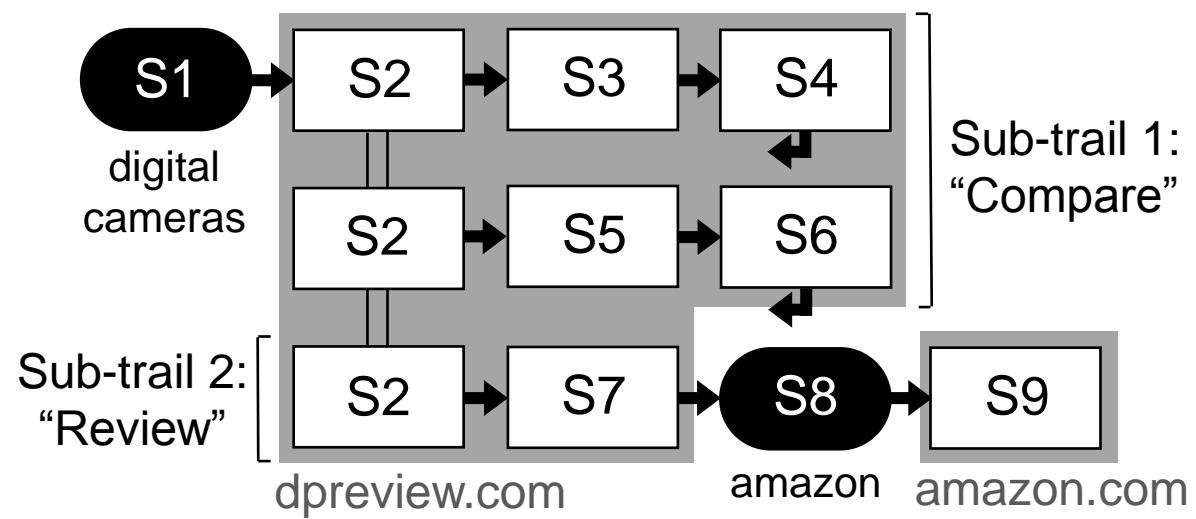
5. Avg. Edit Distance of representative trail:

- Low = user interaction patterns consistent
- High = user interaction patterns variable



Navigators

- Consistent patterns (most trails same), e.g.,

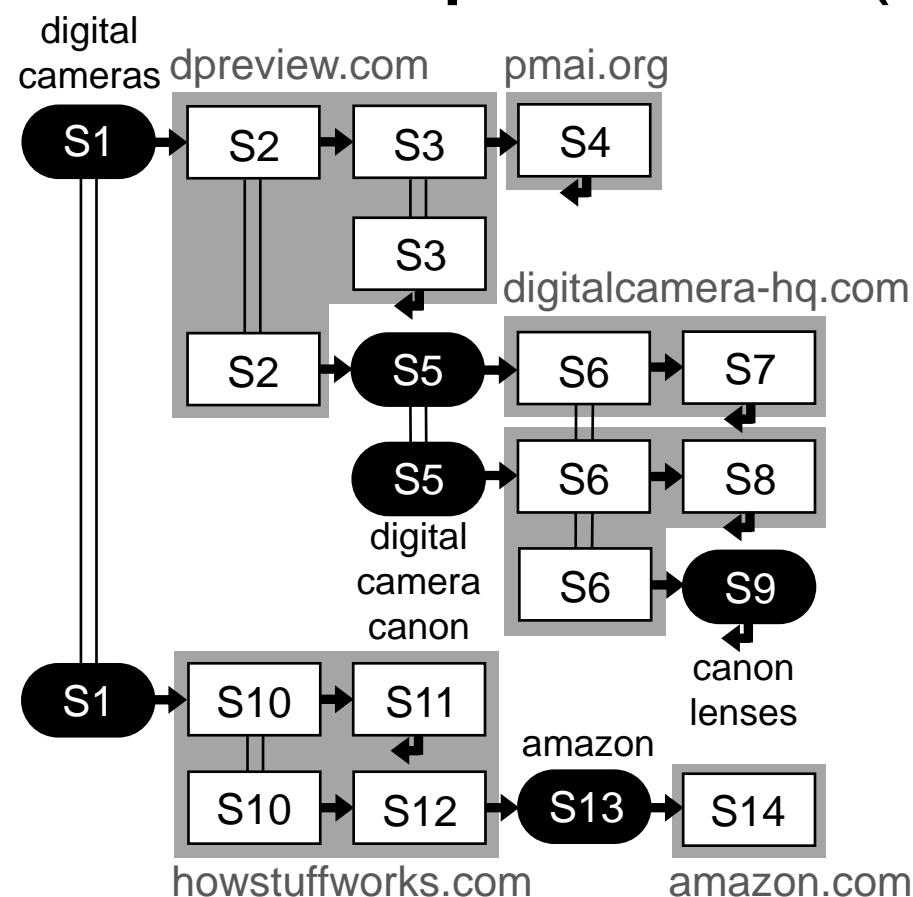


- Few deviations/regressions
- Searched sequentially
- Likely to revisit domains
- Clearly defined subtasks
 - e.g.,
 1. Comparison
 2. Review

- Most users interact like this sometimes – Navigators interact like this most of the time

Explorers

- Variable patterns (most trails different), e.g.,



Explorers:

- Trails branched frequently
- Submitted many queries
- Visited many new domains

- Almost all of their trails different

Trail Features

- Studied features of the trails
 - Time spent, Num. queries, Num. steps, Branchiness, Num. revisits, Avg. branch len.
- Factor analysis revealed three factors that captured 80.6% of variance between users
 - Forward and backward motion (52.5%)
 - “Branchiness” (i.e., how many sub-trails?) (17.4%)
 - Time (10.7%)
- Factors can be used to differentiate users

Domain Variance

- Proportion of domains visited that were unique, computed as:

Num unique domains / Num of domains

- 17% had variance of .1 or less
 - Most of the domains visited were revisits
- 2% had variance of .9 or more
 - Most of the domains visited were unique
- Roughly same users at extremities as with interaction variance ($\geq 86\%$ overlap)

Design Rationale

- “Navigators” and “Explorers” extreme cases
- All users exhibit extreme behavior at times
- Learn from Navigators and Explorers
- Decide what interface support they need
- Offer this support as optional functionality to all users in a search “toolkit”
- Default search interface does not change
- More on this later...

Query Variability

- Focus on queries rather than users
- If interaction variable we may need:
 - Tailored search interfaces for different queries
 - Query segmentation and tailored ranking
- 385 queries with sufficient interaction data
 - Submitted at least 15 times by at least 15 unique participants
 - Distribution of informational / navigational matched that of much larger query logs

Interaction Patterns for Queries

- Same analysis as earlier, but with queries
- Low variance (based on ED):
 - Queries generally navigational (e.g., “msn”)
- High variance:
 - Undirected, exploratory searches
 - Searches where people’s tastes differ (e.g., travel, art)
- Nav. and Explor. query behavior similar to Nav. and Explor. user behavior

Help Navigators / Nav. Queries

- **Teleportation**

- They follow short directed search trails
 - Jump users direct to targets, offer shortcuts

- **Personal Search Histories**

- They conduct the same search repeatedly
 - Present previous searches on search engine

- **Interaction Hubs**

- They rely on important pages within domains
 - Surface these domains as branching points

Help Explorers / Explor. Queries

- **Guided Tours and Domain Indices**
 - They visit multiple domains
 - Offer list of “must see” domains for query topic
- **Predictive Retrieval**
 - They want serendipity
 - Automatically retrieve novel information
- **Support for Rapid Revisitation**
 - They use “back” and visit previous pages a lot
 - Mechanisms to return them to branching points

Conclusions

- **Conducted** a longitudinal study of Web search behavior involving 2500 users
- **Found** differences in interaction flow within and between users and within and between queries
- **Identified** two types of user with extremely consistent / variable interaction patterns
- **Learned** how to support these users that can be used to help everyone