

The Effect of Aggregated Search Coherence on Search Behavior

Jaime Arguello and Robert Capra

School of Information and Library Science
University of North Carolina at Chapel Hill



web 1-3

mont blanc

🔍

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Mont Blanc or **Monte Bianco** (Italian), meaning "White Mountain", is the highest mountain in the Alps, Western Europe, and the European Union. It rises 4,810.45 m ...

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Meisterstuc...
\$320.00

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Generation ...
\$265.98

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Presence fo...
\$9.49

Mont Blanc 's
Eyeglas...
\$268.99

Mont Blanc
MB 247
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\$330.00

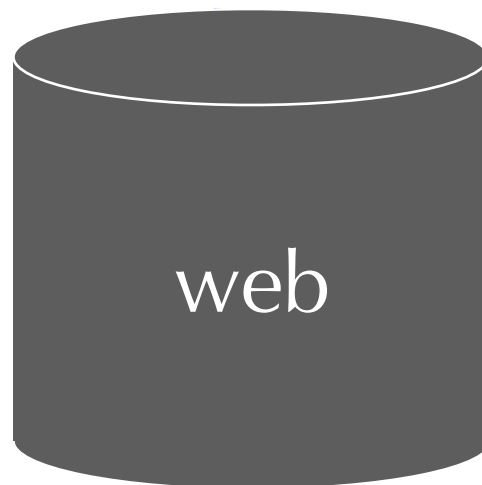
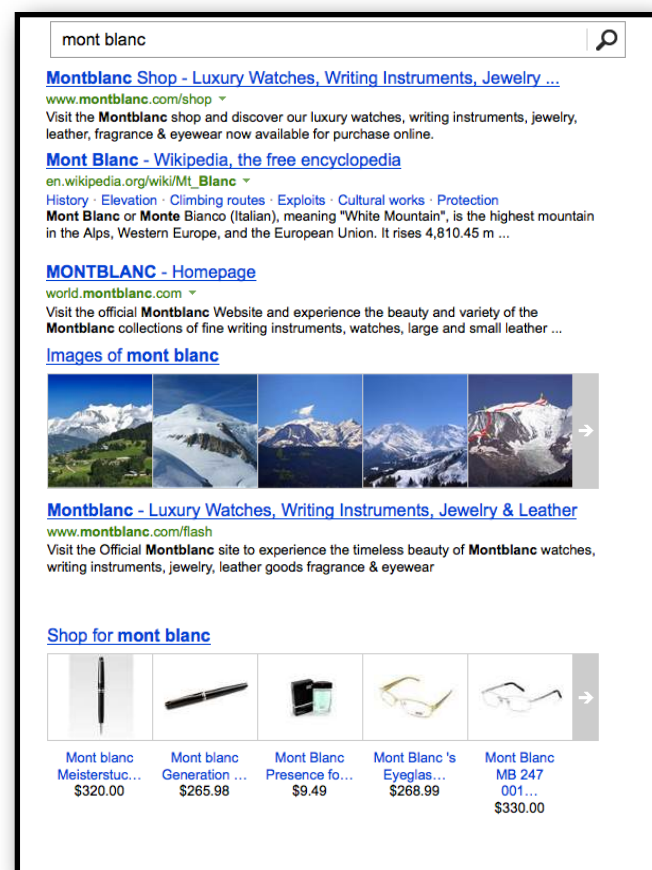
images

web 4-10

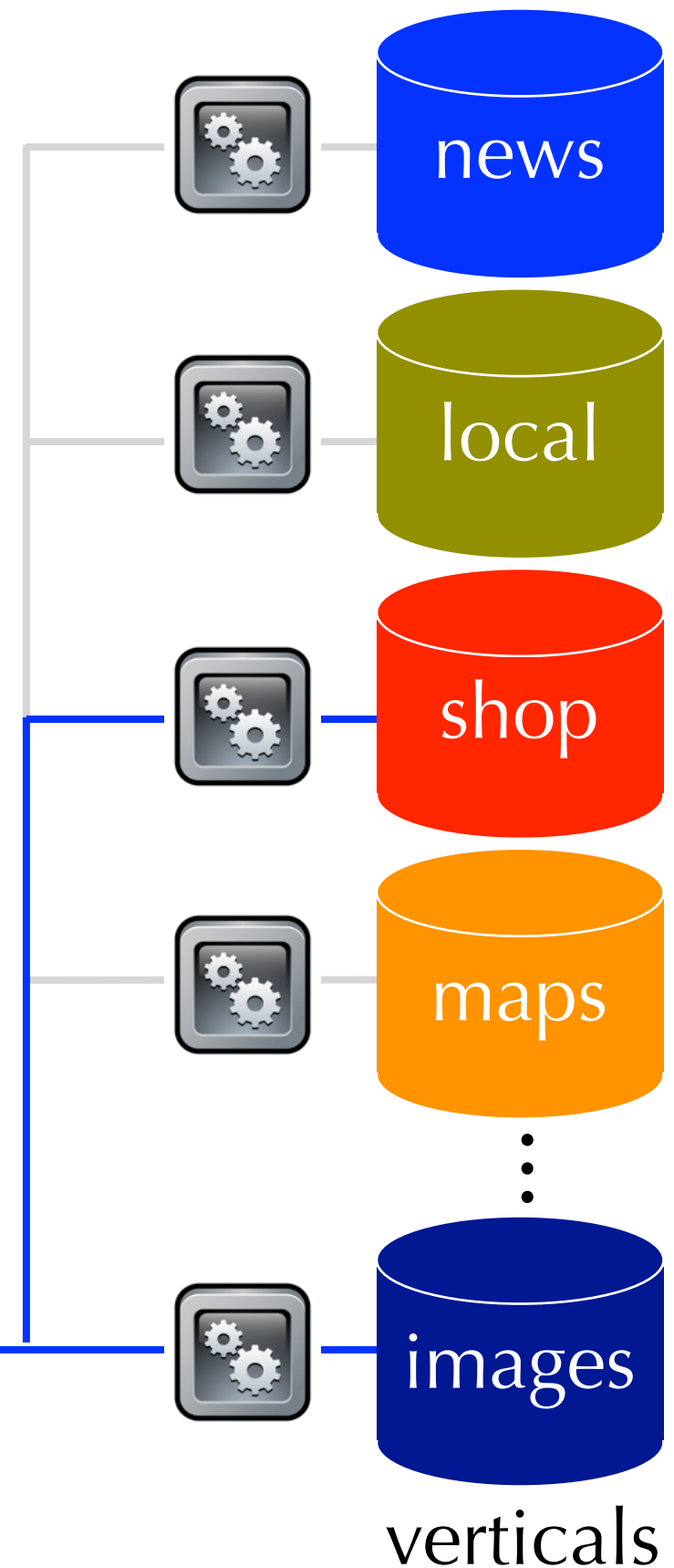
shopping

Aggregated Search

- Predicting which verticals to present and where to present them



aggregated search system



Motivation



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[Mont Blanc - Wikipedia, the free encyclopedia](#)

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Welcome to our **Montblanc** Pen online store, we sell different kinds of **Montblanc** Pens, here must be your best choice. Buy now!



[Amazon.com: mont blanc - Accessories / Clothing & Accessories](#)

[www.amazon.com/s?ie=UTF8&page=1&rh=n%3A1036700%2Ck%3Amont%20blanc](#) ▾

mont blanc sunglasses designer fashion authentic mens frame color - black |lens color - dark grey mb174 b5



[Chamonix Mont Blanc - Chamonix ski holidays, french Alps – Ski ...](#)

[www.chamonix.com](#) ▾

Chamonix **Mont Blanc** : ski holidays in Chamonix **Mont Blanc**, located at the heart of the french Alps. Book online your holiday accommodation, apartment chalet or hotel ...



[Climb Mont Blanc with a Mountain Guides from the Chamonix ...](#)

[montblancguides.com](#) ▾

Climb **Mont Blanc** with **Mont Blanc** Guides, the 100% Specialist **Mont Blanc** Guiding Company . Welcome to **Mont Blanc** Guides. By focusing exclusively on helping our ...



ambiguous query

mont blanc



web 1-3

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images



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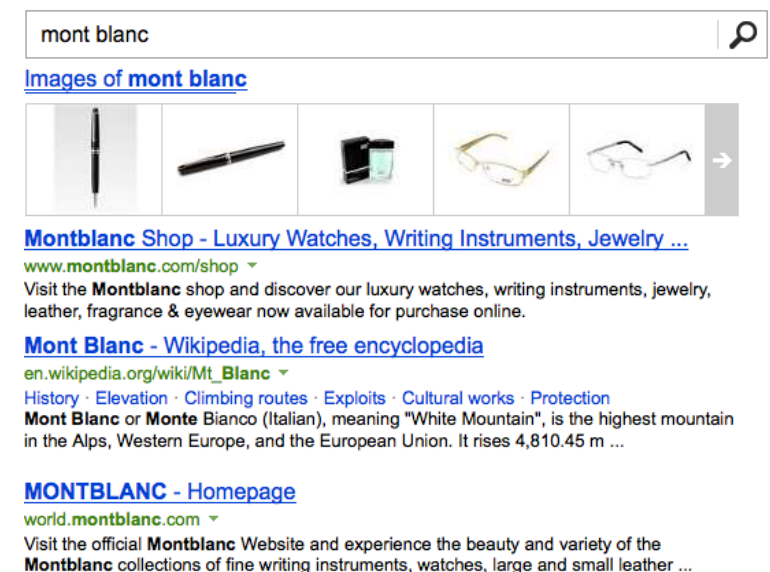
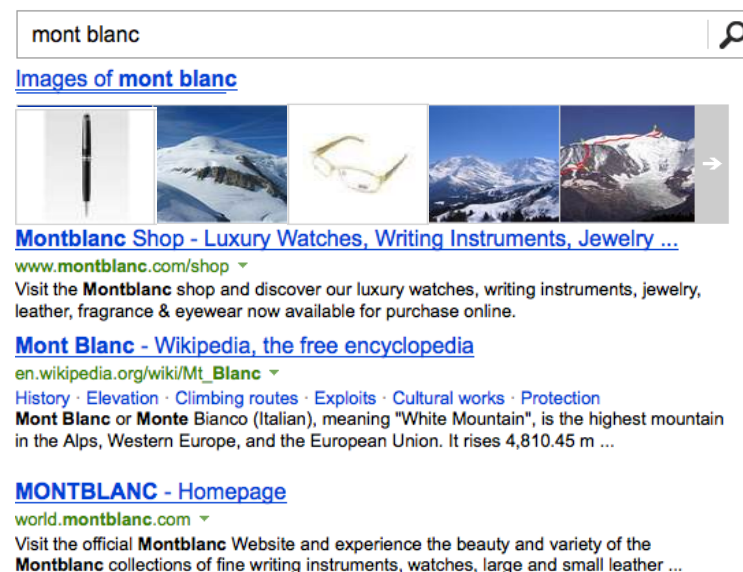
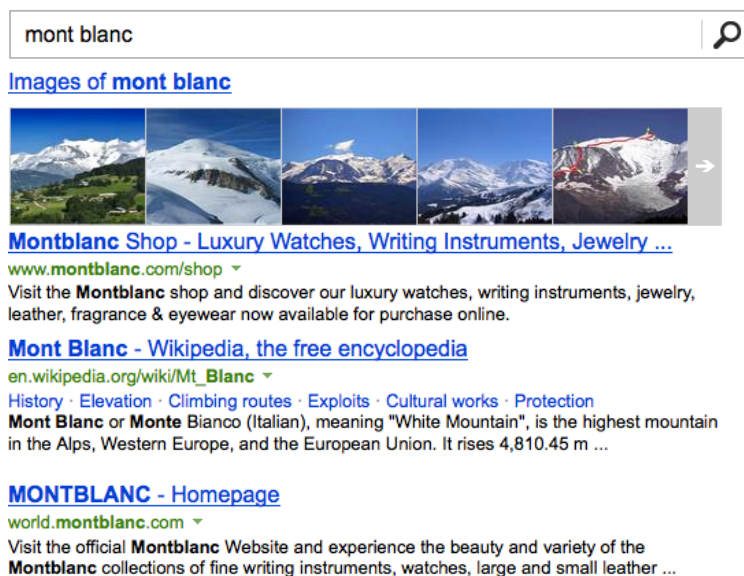
Mont Blanc
Presence fo...
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Mont Blanc
MB 247
001...
\$330.00

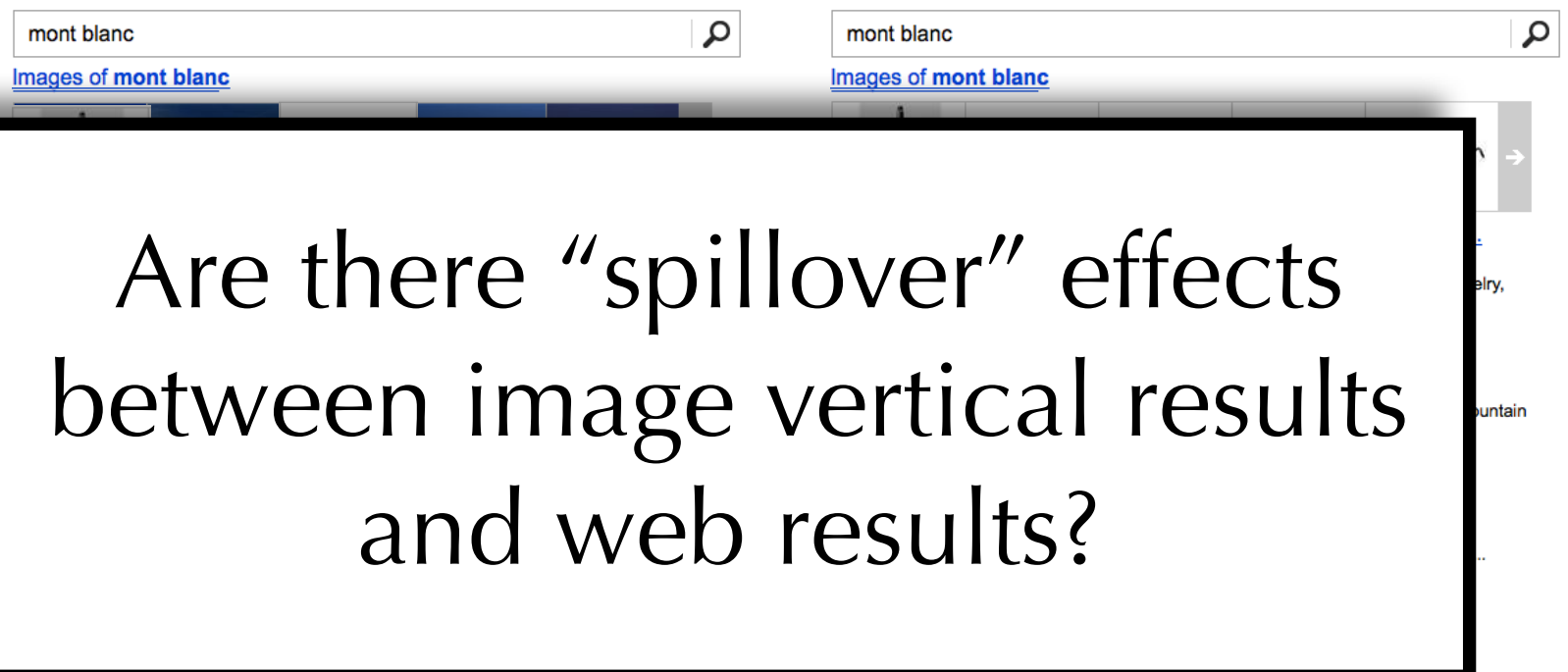
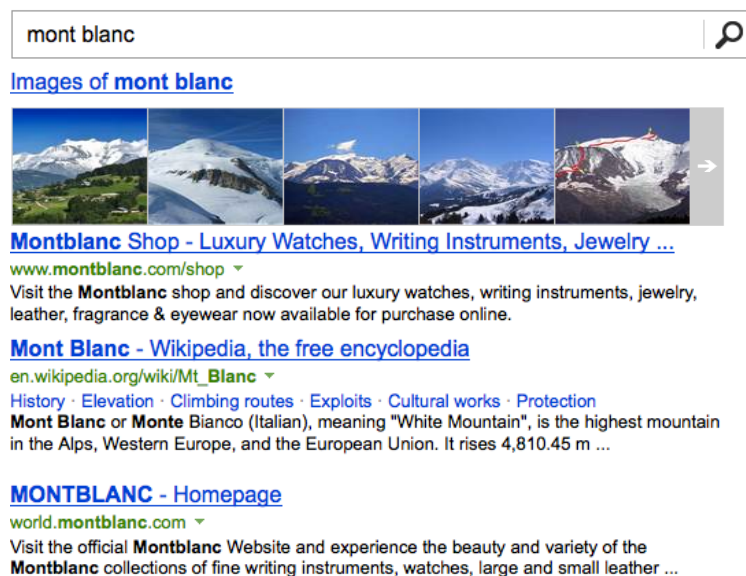
Research Question

- If a user wants web results on a particular query-sense, e.g.
 - ▶ planning a ski trip to **mont blanc** ...
- Can their interaction with the web results be affected by the query-sense distribution in the vertical results?
- **This study:** Do the query-senses in the image results affect user interaction with the web results?



Research Question

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- **This study:** Do the query-senses in the image results affect user interaction with the web results?



Research Questions

RQ1

How do the query-senses in the web results affect user interaction with the web results?

RQ2

How do the query-senses in the image results affect user interaction with the web results?

RQ3

Is there an interaction between the query-senses in web results and the image results?

RQ4

Can the images affect user interaction with the kinds of web results retrieved by a competitive commercial system?

Outline

Motivation and Research Questions

Methodology

Results

Discussion

Conclusion

Study Overview

- User Study 1 (RQ1-3) and User Study 2 (RQ1-4)
- Both studies run on Amazon's Mechanical Turk (AMT)
- Participants were given a search task and a search interface and asked to find a webpage containing the requested information
- Search tasks were unambiguous, but associated with an **ambiguous entity**
- Example: Find a website that contains information about what causes a snow **avalanche**.



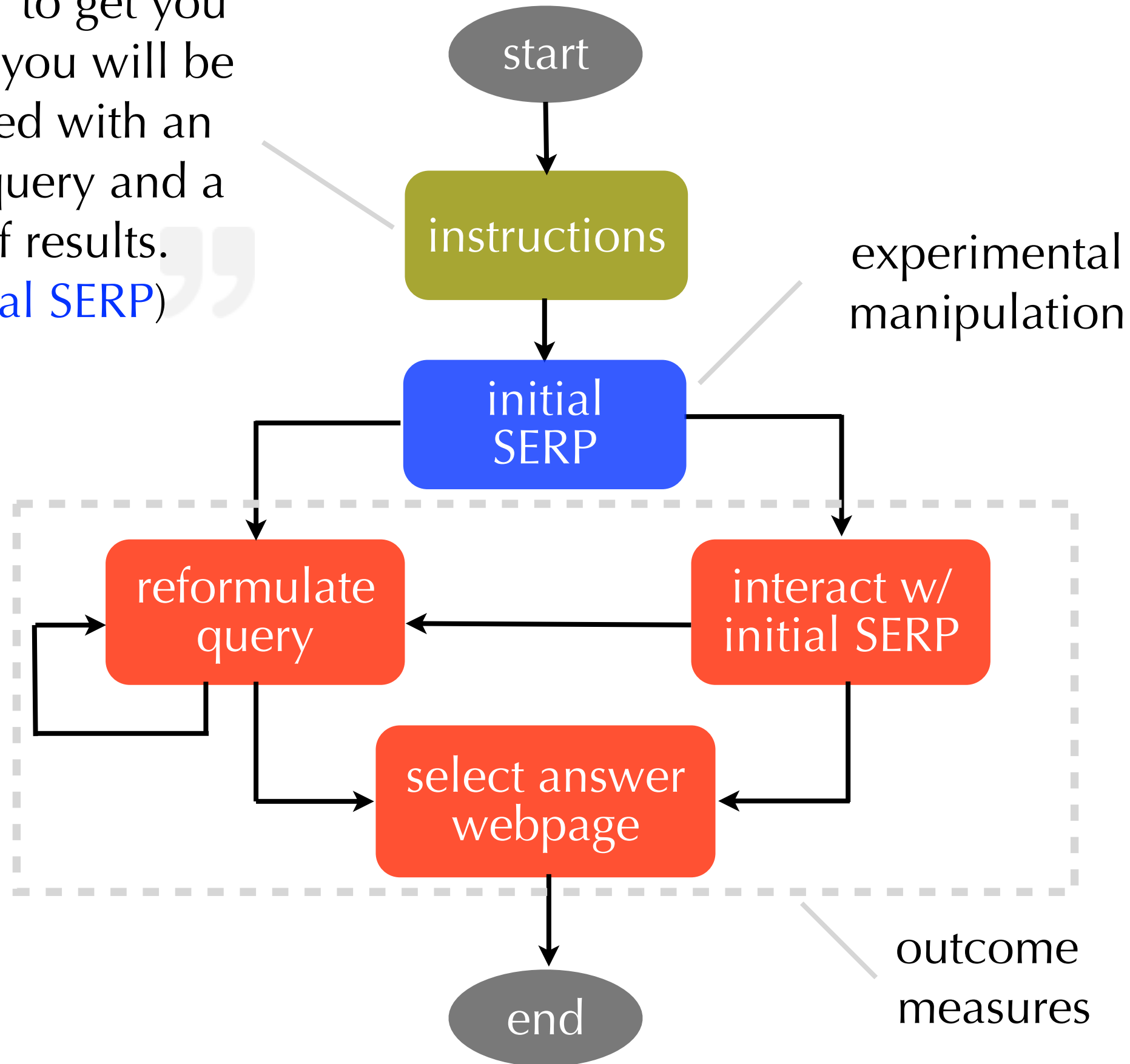
snow
avalanche



chevy
avalanche

Study Protocol

“In order to get you started, you will be provided with an initial query and a set of results.
(initial SERP)”



Experimental Variables

- **Image results:** manipulated the display of image results and their query-sense distribution in the initial SERP
 - ▶ **no images:** no blended image results
 - ▶ **on-target:** 6 images on the same query-sense as the task
 - ▶ **off-target:** 6 images on a different query-sense than the task
 - ▶ **mixed:** 3 on-target and 3 off-target
 - ▶ always presented between web ranks 3 and 4
- **Web results:** manipulated the query-sense distribution of the web results (more on this later)

Initial SERP example

Task: Find a website that contains information about what causes a snow avalanche.

WEB RESULTS: 1-10 of 50

[The Official Web Site - Colorado Avalanche](#)

The Official Site of the Colorado **Avalanche** ... Twitter Fan Video Promotion A Lucky Fan Will Receive A Team-Signed Camouflage Jersey.
avalanche.nhl.com/

[Avalanche - The Game Homepage](#)

Games played today! play: discuss. game finder; search
www.thegamehomepage.com/play/avalanche/

[Avalanche - Free Online Action Games from AddictingGames](#)

Avalanche : Are you a towelette, or maybe a marshmallow? Whatever the case, there are huge, square bolts to dodge. Can you avoid this **avalanche**? Free Online ...
www.addictinggames.com/action-games/avalanche.jsp

[Image Results](#)



[Name of man killed in avalanche released | ksl.com](#)

The death of one person in an **avalanche** has been confirmed by local officials.
www.ksl.com/?nid=148&sid=19040802

[Avalanche](#)

An **avalanche** is a sudden, drastic flow of snow down a slope, occurring when either natural triggers, such as loading from new snow or rain, or artificial triggers ...
en.wikipedia.org/wiki/Avalanche

[2012 Chevy Avalanche | SUV Truck | Chevrolet](#)

Explore the fuel efficient 2012 Chevy **Avalanche**, a new Chevy SUV truck with unrivaled versatility. Discover the Chevy **Avalanche** here.
www.chevrolet.com/avalanche-suv-truck/

[Avalanche: Definition from Answers.com](#)

Headlines Sea to Sky Highway Closed by Landslide Landslide Affords Tycoon an Even Better View Illegal Digging Causes Landslide, Five Dead An **avalanche** is a massive ...
www.answers.com/topic/avalanche

search task

initial query
(ambiguous)

mixed images

Search Task Design

- **Objective:** design unambiguous tasks associated with an ambiguous entity (the initial query)
- **Entity inclusion criteria**
 - ▶ has wikipedia disambiguation page
 - ▶ appears in the AOL query log (exact match)
 - ▶ triggers the image vertical in a commercial system (Bing)
 - ▶ retrieves vertical image results associated with two senses
- **Search task construction**
 - ▶ 80 manually-constructed search tasks
 - ▶ each search task was associated with one sense
 - ▶ target sense: the sense associated with the search task
 - ▶ off-target sense: the other sense

Search Task Design example

Yukon (disambiguation)

From Wikipedia, the free encyclopedia

The **Yukon** is a territory in the northwest of Canada.

Yukon may also refer to:

- [Yukon \(electoral district\)](#), a federal electoral district of Canada, corresponding to the territory
- The [Yukon River](#), a river of Alaska and the Yukon Territory, for which the territory was named

Other places

[\[edit\]](#)

- [Yukon, Missouri](#), a town in the United States
- [Yukon, Oklahoma](#), a town in the United States
- [Yukon, West Virginia](#), a town in the United States
- [Yukon, Florida](#), a ghost town in the United States
- [Yukon, Pennsylvania](#), a town in the United States

•
•
•

Vehicles

[\[edit\]](#)

- [GMC Yukon \(disambiguation\)](#), various full-size sport utility vehicles made by General Motors
- The Giant Yukon and Giant Yukon DISC, mountain bicycles made by [Giant Manufacturing](#)

See also

[\[edit\]](#)

- The [Klondike Gold Rush](#), sometimes referred to as the Yukon Gold Rush
- The [University of Connecticut](#), often referred to as UConn, a homophone of "Yukon"

Search Task Design example

WEB IMAGES VIDEOS MAPS NEWS MORE

yukon

90,900,000 RESULTS Any time ▾

GMC® Yukon SUV | gmc.com Ads

www.gmc.com/GMC-Yukon

Learn About the Features of the 2013 GMC® Yukon on Official Site.

[Current Offers](#) · [Request a Quote](#) · [Download a Brochure](#) · [Locate a Dealer](#)

2013 GMC Yukon Prices | CarPriceSecrets.com

GMCYukon.CarPriceSecrets.com

Find our Low Price on a 2013 GMC Yukon. Don't Pay MSRP of \$40,435!

Gmc Yukon Sale 2012 - GMC Dealers are Cutting Prices.


GMC-Yukon.Auto-Price-Finder.com

See GMC Yukon Deals Now.

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Images of yukon

bing.com/images



Government of Yukon - Government of Yukon - Government of Yukon

www.gov.yk.ca ▾

Government of Yukon - The official home page of the Government of Yukon.

Yukon - Wikipedia, the free encyclopedia

en.wikipedia.org/wiki/Yukon ▾

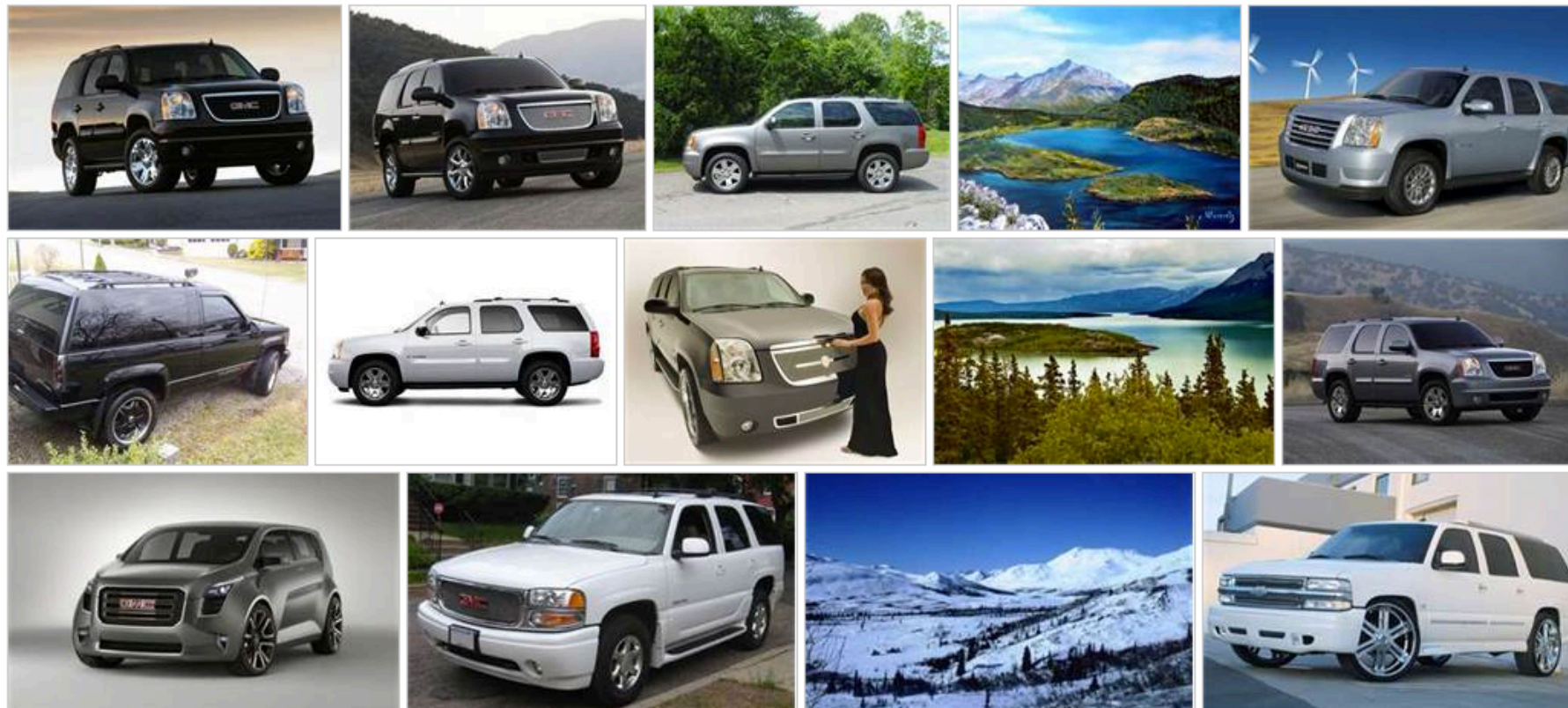
[Etymology](#) · [Geography](#) · [History](#) · [Demography](#) · [Economy](#) · [Government and politics](#)

Yukon is the westernmost and smallest of Canada's three federal territories. The territory was created from the rump of the Hudson's Bay Company's North-Western ...

Search Task Design example

WEB IMAGES VIDEOS MAPS NEWS MORE

yukon



- **Two senses:** Yukon the Canadian province and the GMC truck

Search Task Design example

- Initial Query: Yukon
- Search task: Find a website that contains tourism information about the Canadian province of Yukon.
- Target sense: Yukon, the Canadian province
- Off-target sense: Yukon, the GMC truck
- On-target and off-target images cached using Bing's Image Search API and then curated to ensure equal image quality

Image Results examples

Task: Find a website that contains tourism information about the Canadian province of Yukon.

WEB RESULTS: 1-10 of 50

[Yukon](#)

Yukon is the westernmost and smallest of Canada's provinces. It is named after the **Yukon River**. The word **Yukon** means "Great River".
en.wikipedia.org/wiki/Yukon

[Government of Yukon - Government of Yukon](#) - The official home page of the Government of Yukon.
www.gov.yk.ca/

[2012 GMC Yukon | Full Size SUVs | GMC - New](#)
Explore 2012 GMC Yukon Full Size SUV photos, features and specifications. The Yukon is a sport utility vehicle with customized configurations.
www.gmc.com/yukon-full-size-suv.html

[Yukon: Larger Than Life - Yukon, Canada Vacation](#)
Plan your visit to the Yukon with help from the Yukon Travel Guide. Discover scenic drives, travel packages, accommodations and more.
www.travel.yukon.com/

[Whitehorse, Yukon](#)

Whitehorse / ʔ h w a ʔ t . h ʔ r s / is Yukon's capital city (as of 2010). It was incorporated in 1950 and is located in the Yukon Territory.
en.wikipedia.org/wiki/Whitehorse,_Yukon

[2012 GMC Yukon Hybrid | Hybrid SUV | GMC - New](#)
Explore 2012 GMC Yukon Hybrid SUV photos, features and specifications. The Yukon Hybrid is a Hybrid SUV with customized configuration.
www.gmc.com/yukon-hybrid-suv.html

[Yukon Gear & Axle](#)

Yukon Gear & Axle. Built to Perform, Built to Last. Find auto parts by searching for your vehicle's make, model and year.
www.yukongear.com/

[Yukon Territory Alaska Northern British Columbia](#)

Complete Attraction & Service guide to the Yukon Territory, Northern British Columbia and Skagway, Alaska.
www.yukoninfo.com/

on-target

[Image Results](#)



off-target

[Image Results](#)



mixed

[Image Results](#)



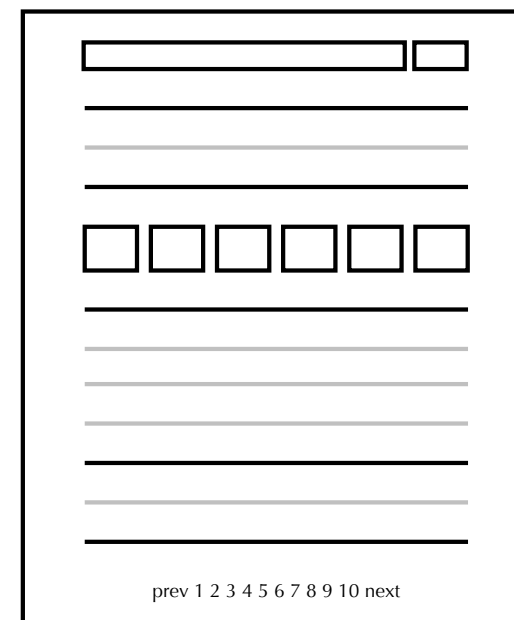
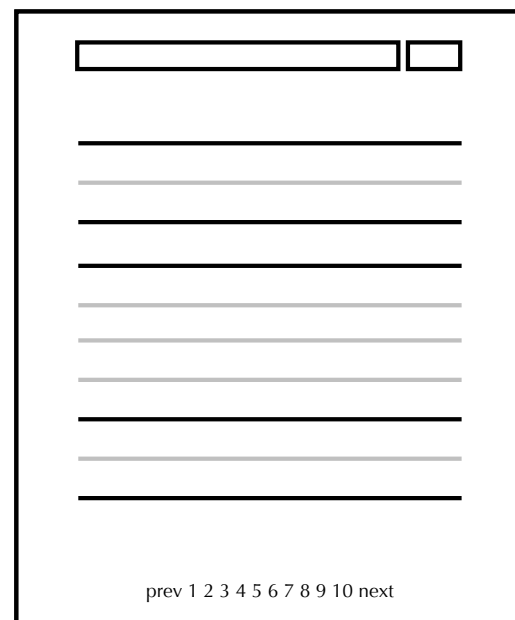
web 1-3

web 4-10

User Study 1 (RQ1-3)

- All top-10 web results on the off-target sense except for one
- **Web condition:** on-target web result shown in rank 1, 3, 4, 8, and 10
- **9,600 AMT HITs:** 80 tasks x 4 image conditions x 5 web conditions x 6 (redundant) search sessions per condition

layouts for
no images
condition



layouts for
on-target, off-
target, and
mixed images
conditions

User Study 2 (RQ1-4)

- Top-10 algorithmic web results from Bing Web Search API
- Tasks binned based on distribution and rank of on-target algorithmic results
- Binning based on NDCG, considering the on-target sense as the relevant class
- Web condition:
 - ▶ high (on-target) bin: 16 tasks (20%) with highest NDCG
 - ▶ low (off-target) bin: 16 tasks (20%) with lowest NDCG
 - ▶ mid bin: the 48 tasks (60%) with NDCG in the mid-range
- 6,400 AMT HITs: 80 tasks x 4 image conditions x 20 (redundant) search sessions per condition

Research Questions

RQ1

How do the query-senses in the web results affect user interaction with the web results?

RQ2

How do the query-senses in the image results affect user interaction with the web results?

RQ3

Is there an interaction between the query-senses in web results and the image results?

RQ4

Can the images affect user interaction with the kinds of web results retrieved by a competitive commercial system?

Outcome Measures

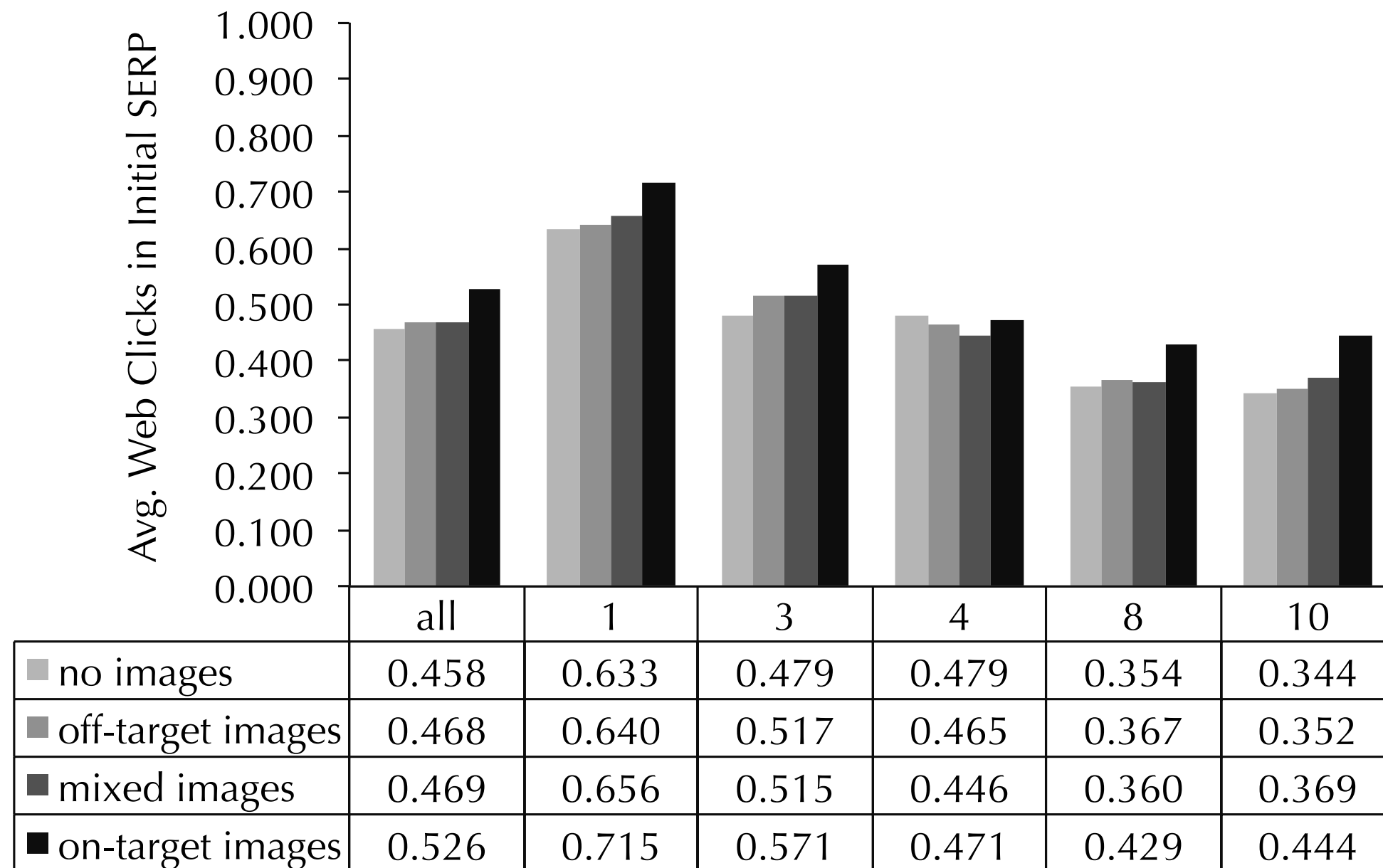
- User Study 1
 - **found answer (binary-valued)**: did the participant find the answer page in the initial SERP web results?
(implies no reformulation)
 - **number of clicks (real-valued)**: how many times did the participant click on the initial SERP web results?
(with or without reformulation)
- User Study 2
 - **number of clicks (real-valued)**: how many times did the participant click on the initial SERP web results?
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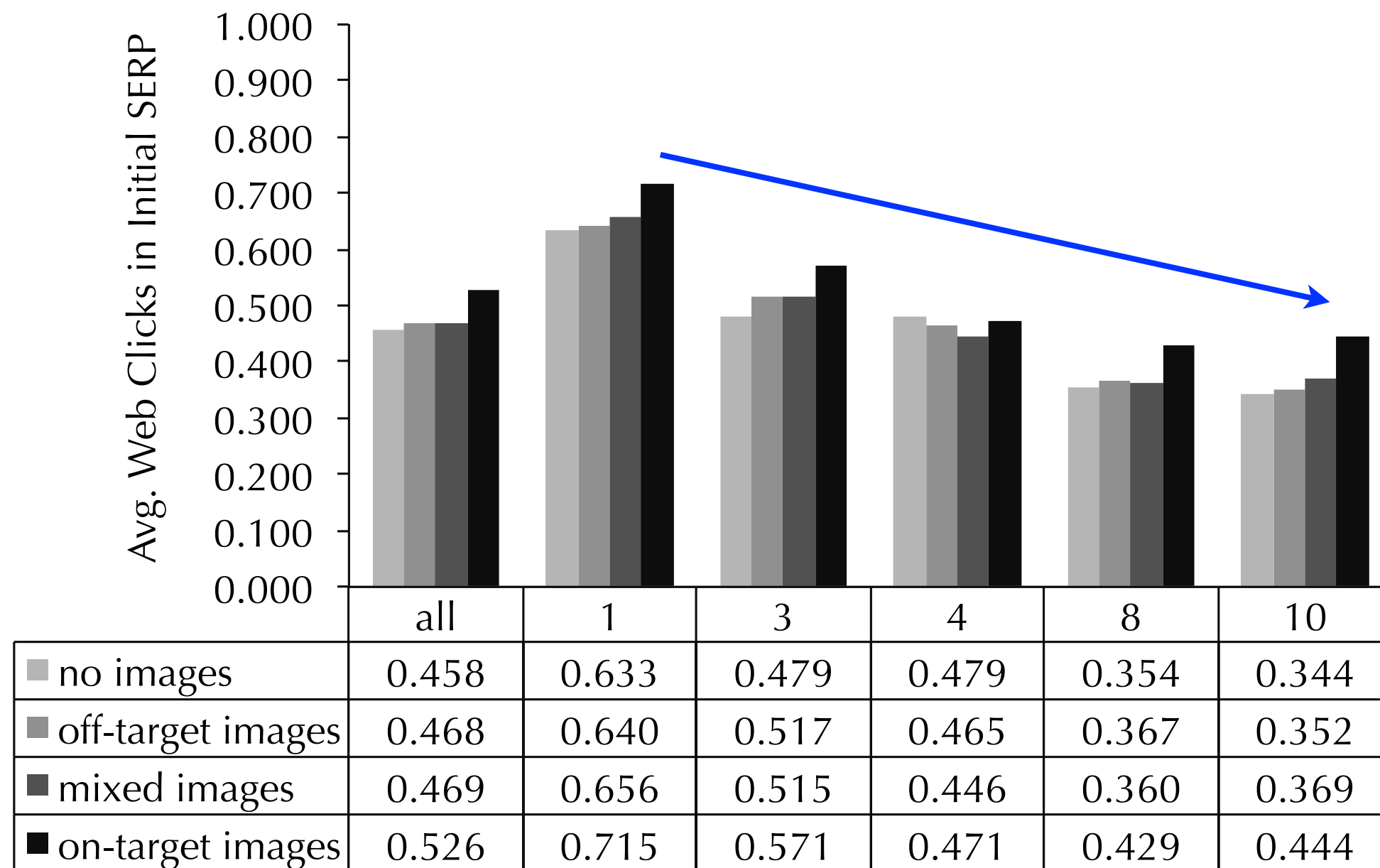
User Study 1 Results

User Study 1 Results



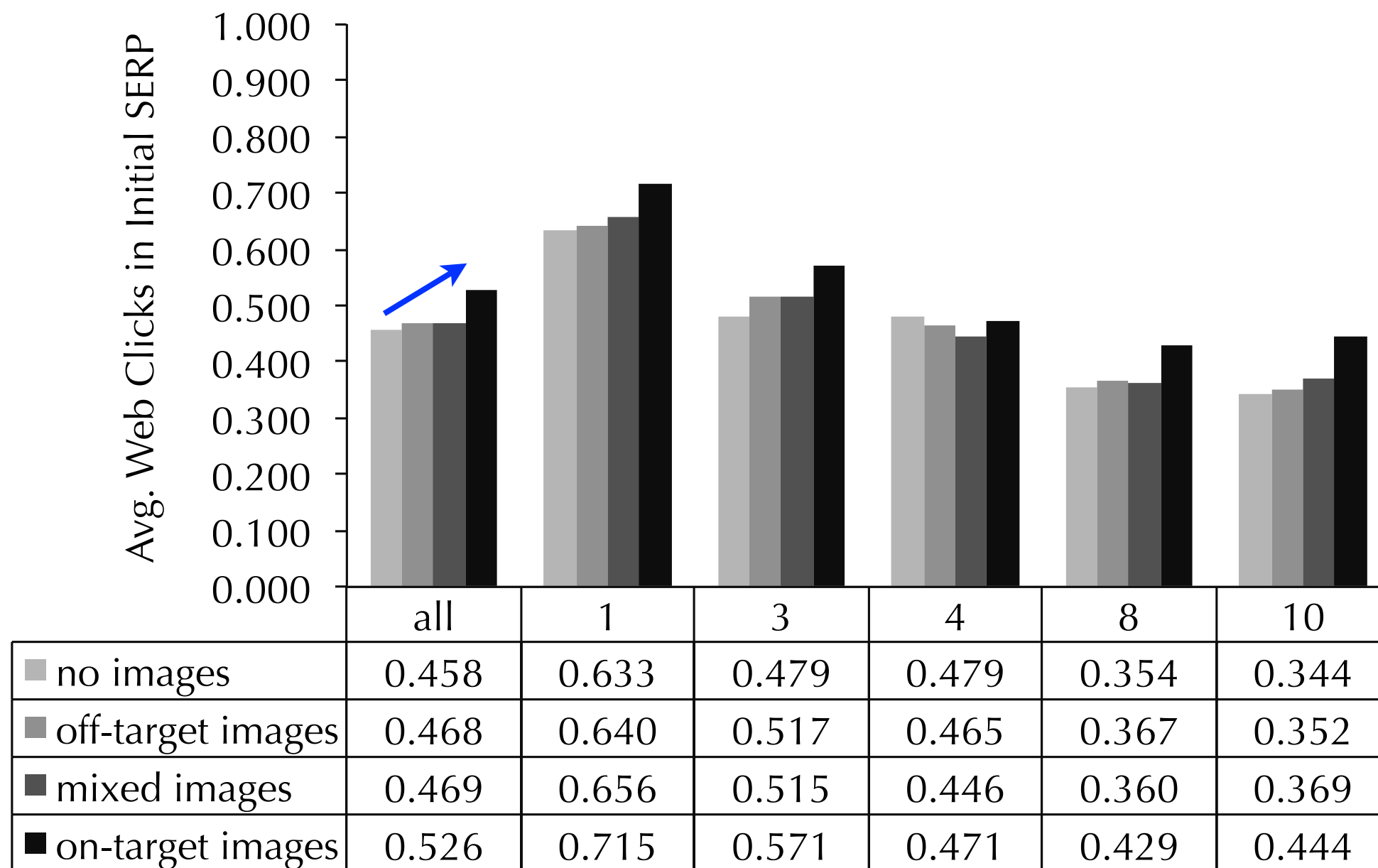
- Note: average web clicks < 1.0 due to reformulations without web clicks

User Study 1 Results



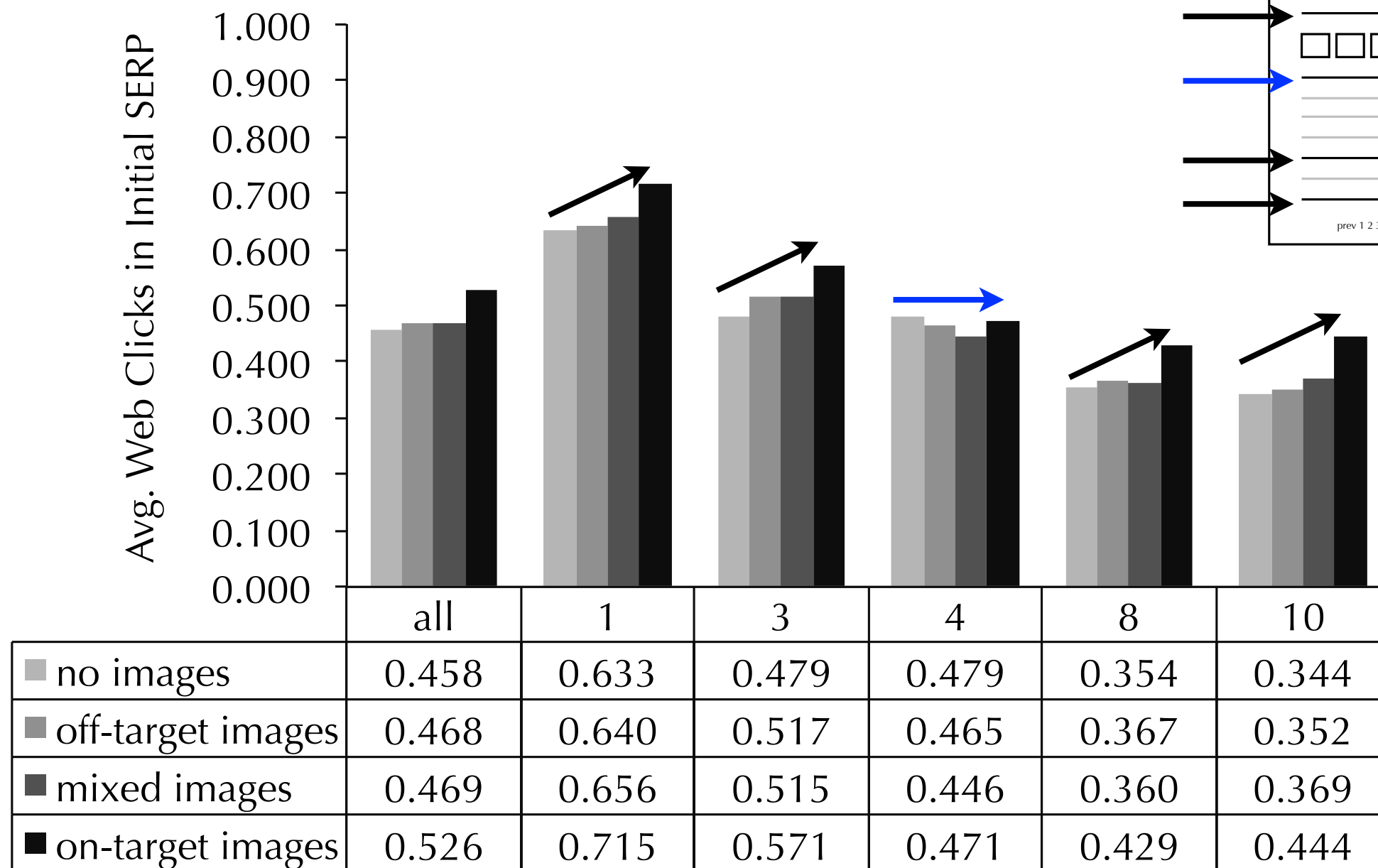
- RQ1: The rank of the (on-target) answer page had a significant effect ($p < .001$) on user interaction with the web results
- All post-hoc comparisons significant except b/w rank 8 and 10

User Study 1 Results



- RQ2: The query-senses in the image results had a significant effect ($p < .001$) on user interaction with the web results
- Post-hoc comparisons showed a significant difference between the on-target condition and all other image conditions

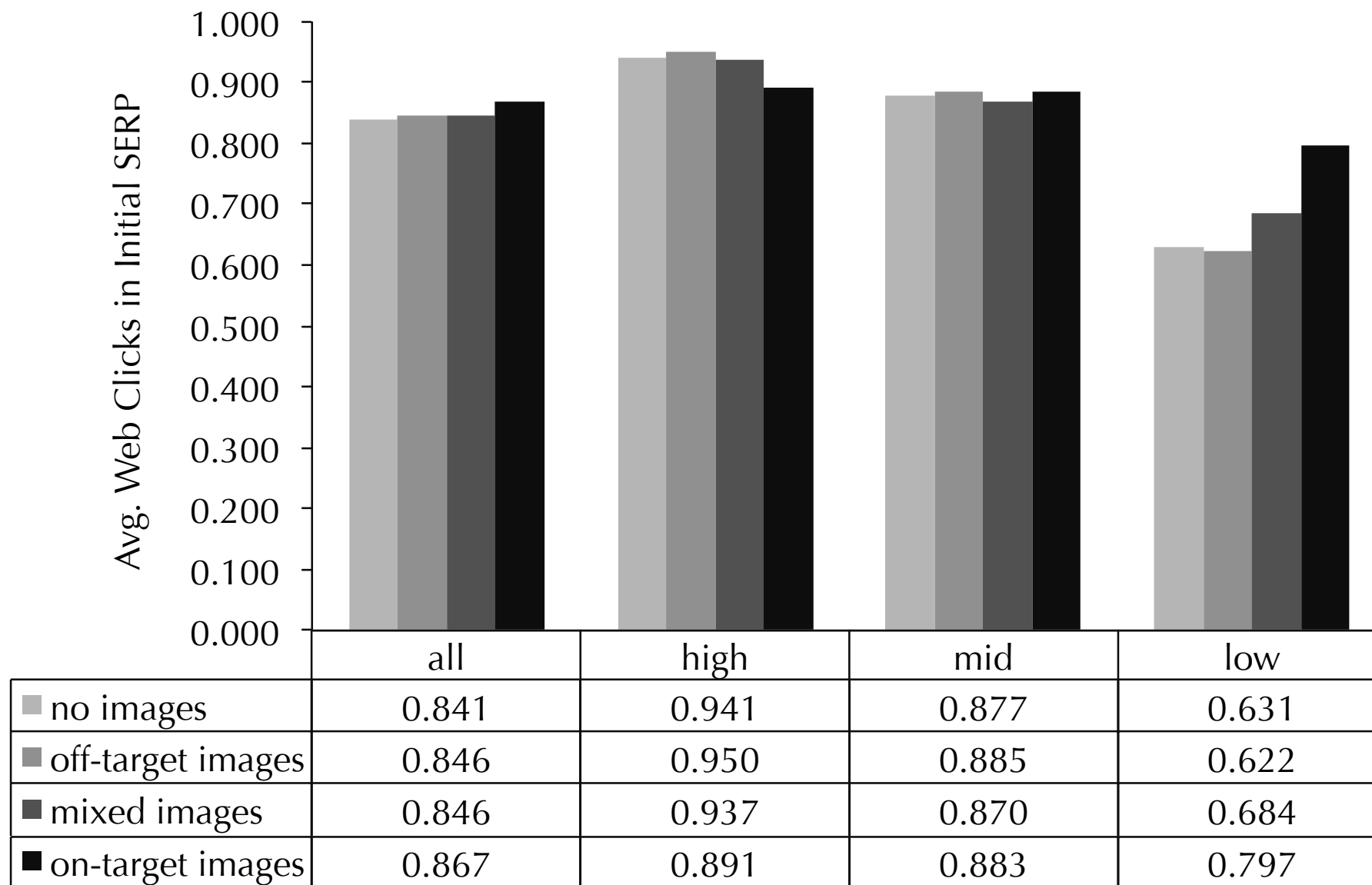
User Study 1 Results



- RQ3: There was no significant interaction between the answer rank and the image results
- However, there was an interesting trend...

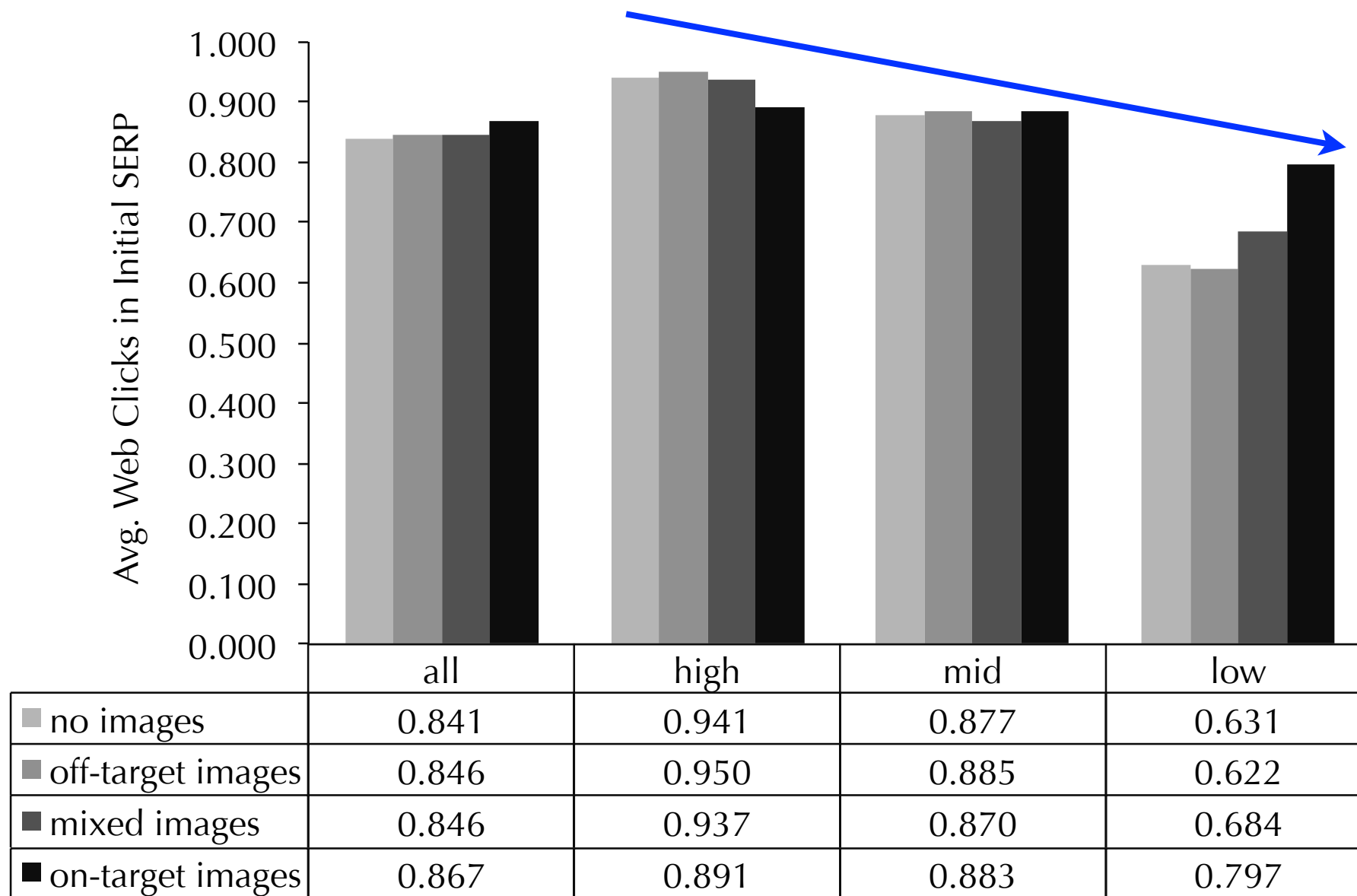
User Study 2 Results

User Study 2 Results



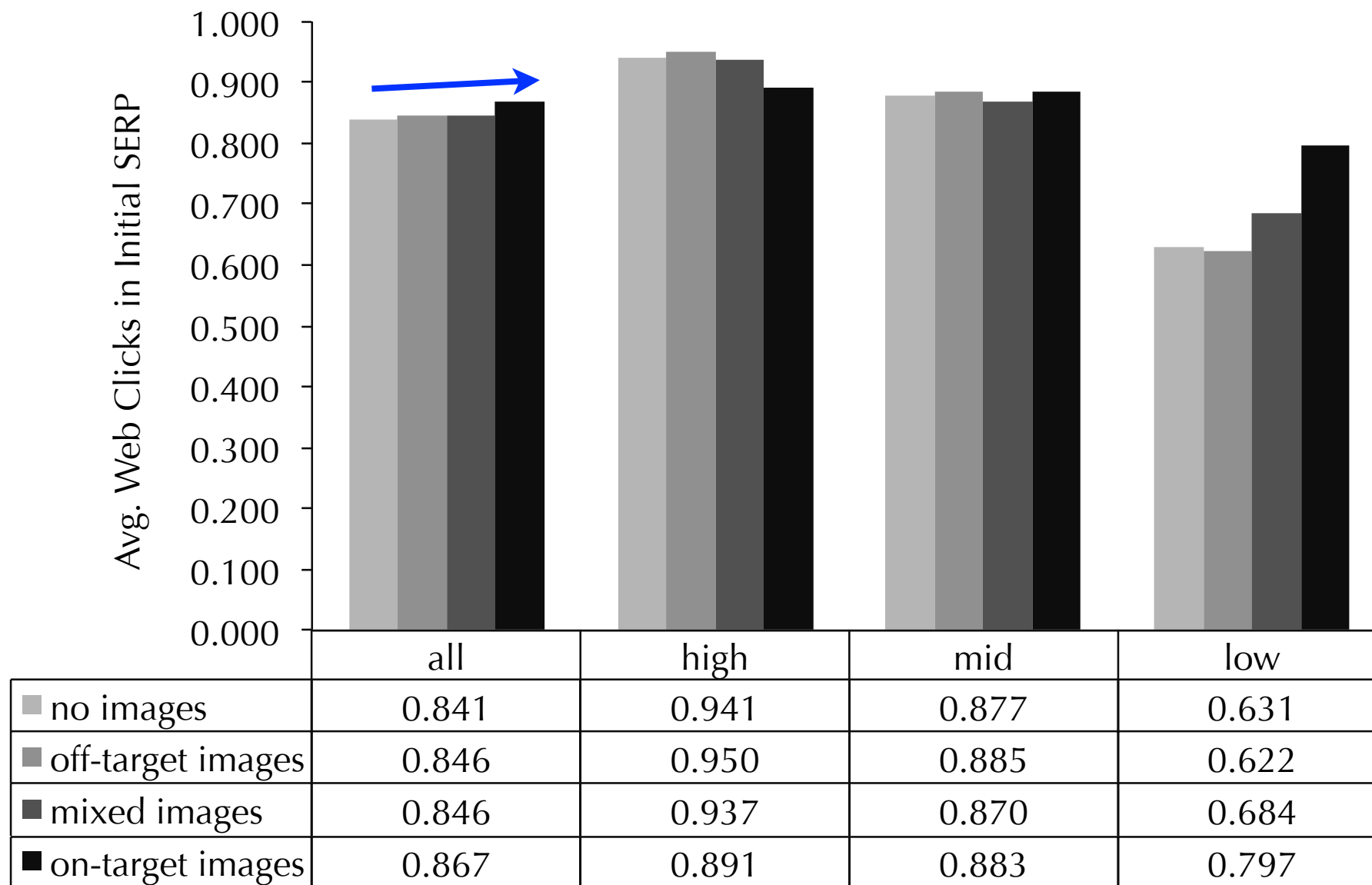
- Note: average web clicks < 1.0 due to reformulations without web clicks

User Study 2 Results



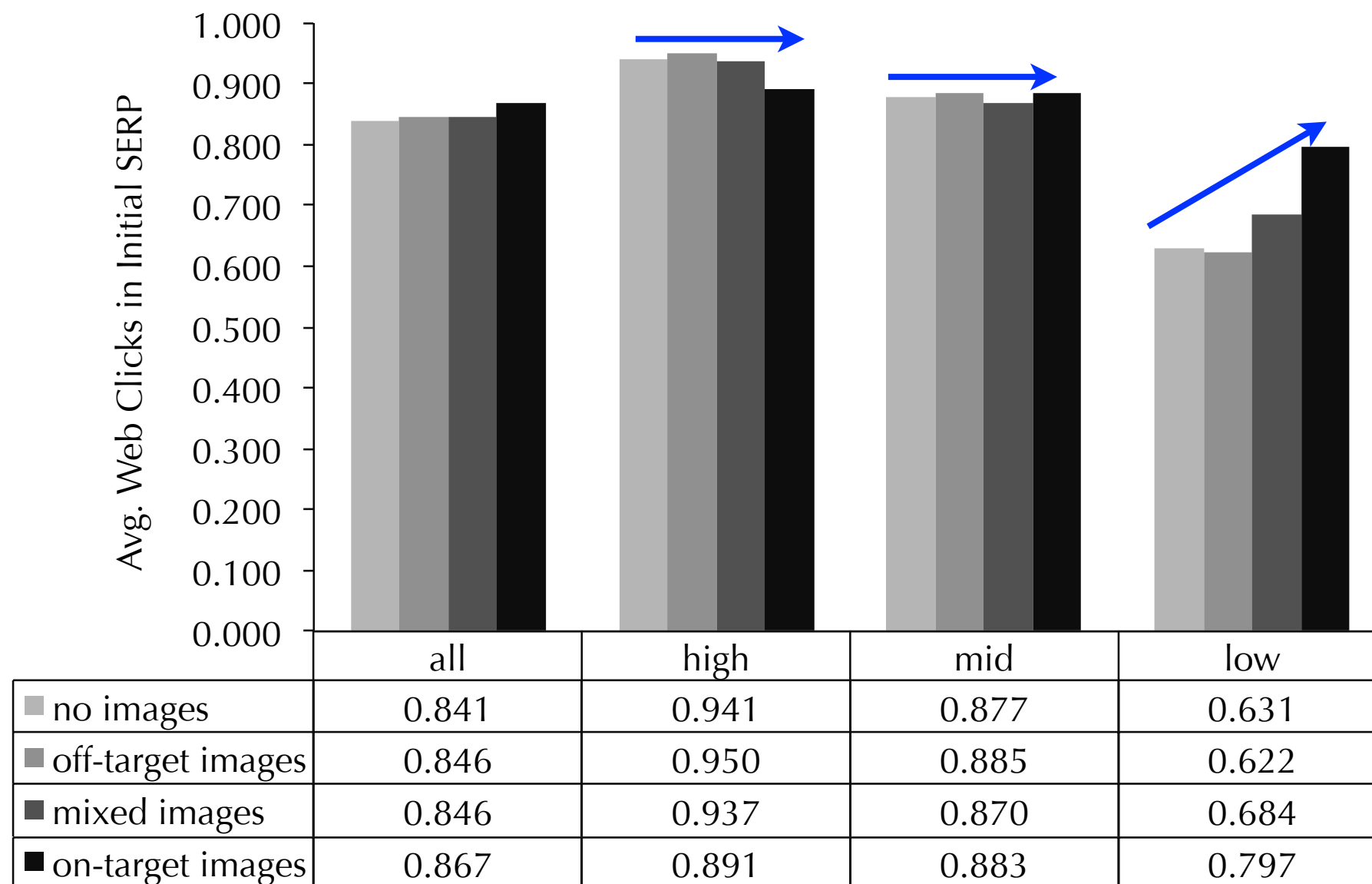
- RQ1: The distribution and rank of the on-target web results had a significant effect ($p < .001$) on interaction with the web results
- Post-hoc comparisons between all bin-pairs were significant

User Study 2 Results



- RQ2: Considering all search tasks together, the effect of images was not significant

User Study 2 Results



- RQ3: Image condition and bin-assignment showed a significant interaction effect ($p < .05$)
- The query-senses in the image results had a significant effect on initial SERPs that were assigned to the low bin

Discussion

- **RQ1:** The query-senses in the web results affect user interaction with the web results
- **RQ2/RQ3:** The query-senses in the image results can affect user interaction with the web results, but it depends ...
 - ▶ If many of the top web results are largely consistent with the task, then the images have no effect
- **RQ4:** The images can have an effect on commercial-quality web results that are not heavily biased towards the target sense
 - ▶ This will be the case for web results that are heavily diversified across query-senses

Implications

- Diversity Ranking

- ▶ Approaches to diversity ranking assume homogeneous results (e.g., only web results)
- ▶ New approaches may need to consider the amount of diversification within other components in the page

- Aggregated Search

- ▶ Approaches to vertical selection and ranking assume that all false positive predictions are equally bad
- ▶ New approaches may need to consider their (positive or negative) effect on other components in the page

Open Questions

- Factors that may affect the magnitude of the effect:
 - ▶ **Vertical salience:** image-based (e.g., video) vs. text-based (e.g., blogs) vertical results
 - ▶ **Vertical position:** may depend on the user's assumptions about the system (the degree of coherence between components)
 - ▶ **Prior knowledge about the query-senses:** does the user recognize the multiple query-sense in the vertical results?
 - ▶ **Layout:** some layouts may make it more explicit that results in different components come from independent systems

Conclusions

- Image vertical results can affect user interaction with the web results
- However, it depends on the extent to which the web results are consistent with the task
- The magnitude of the effect may be greater when the web results are heavily diversified
- Suggests the need for more integrated aggregated search and diversity ranking decisions

Thank you!
Questions?

