



Augmenting Web Search Surrogates with Images

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CIKM 2013, San Francisco, CA
October 29, 2013



UNC
SCHOOL OF INFORMATION
AND LIBRARY SCIENCE

Each result is represented on a search result page (SERP) by a ***surrogate*** consisting of a title, URL, and text snippet

[Jaguar: Luxury Cars & Sports Cars | Jaguar USA](#)

www.jaguarusa.com/ ▼

The official home of **Jaguar** USA. Our luxury cars feature innovative designs along with legendary performance to deliver one of the top sports cars in the ...

[2014 Jaguar F-TYPE Price ...](#) - [2013 Jaguar XF Price & Models - Models & Pricing](#)

22,958 people +1'd this

[Jaguar - Wikipedia, the free encyclopedia](#)

en.wikipedia.org/wiki/Jaguar ▼

The **jaguar** is a big cat, a feline in the Panthera genus, and is the only Panthera species found in the Americas. The **jaguar** is the third-largest feline after the tiger ...

[Jaguar Cars - Wikipedia, the free encyclopedia](#)

en.wikipedia.org/wiki/Jaguar_Cars ▼

Jaguar Cars since December 2012 officially incorporated as **Jaguar** Land Rover Ltd, is a British multinational car manufacturer headquartered in Whitley, ...

[Jaguars, Jaguar Pictures, Jaguar Facts - National Geographic](#)

animals.nationalgeographic.com/animals/mammals/jaguar/ ▼

Learn all you wanted to know about **jaguars** with pictures, videos, photos, facts, and news from National Geographic.

Other surrogates include images

- News articles
- Shopping results
- Videos



[Vancouver's future shaped by an explosive demand for transit](#)

[Vancouver Sun](#) - 9 hours ago

VANCOUVER — Whether at the permit-application stage, about to be built, or already under construction, 90 per cent of **Vancouver's** new office ...

[Vancouver Tourism and Vacations: 383 Things to Do in Vancouver, ...](#)



[www.tripadvisor.com](#) > [Canada](#) > [British Columbia](#) ▼

Jan 30, 2013

Vancouver Tourism: TripAdvisor has 118627 reviews of **Vancouver** Hotels, Attractions, and Restaurants ...



Vancouver Canucks watches :
Gametime **Vancouver** Canucks

\$70 from 18 stores

 1 special offer

Why not include images for Web search results?



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Could images help users assess relevance?

A particular case of interest...

Ambiguous query

jaguar

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[Jaguar Dealer in Raleigh NC - New Used Jaguar Cars Durham ...](#)

www.leithjaguar.com/ ▼

Jaguar Dealer in Raleigh, NC. New Used & CPO **Jaguar** cars for sale. **Jaguar** Parts & service serving Raleigh Durham, Cary, Durham & Apex. **Jaguar** XF, XJ, XK ...

[Raleigh Used Jaguar Cars For Sale Cary Apex Durham NC](#)

www.leithjaguar.com/searchused.aspx ▼

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[Jacksonville Jaguars, Official Site of the Jacksonville Jaguars](#)

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The official team site with scores, news items, game schedule, and roster.

Diversified results

Ambiguous query



Diversified results

jaguar

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← car

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← animal

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← car

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← sports team

Diversified results



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Images might be especially helpful on SERPs with diversified results from ambiguous queries.

Prior work: images in surrogates

- Three general approaches:
 - Thumbnail of underlying page
 - Combination of visual + textual elements
 - Single images from underlying page
- Mixed results on effectiveness



Teevan, et al., 2009



(a) Dominant Image



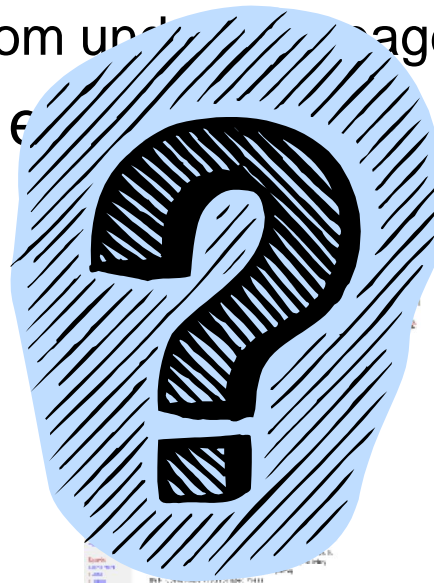
(b) Visual Snippet

Jiao et al., 2010



[Threadless graphic t-shirt designs: cool & ...
www.threadless.com/](http://www.threadless.com/)

Aula, et al., 2010



Woodruff et al., 2001

[Einstein](#)



Detailed, hyperlinked biography of **Albert Einstein** (1879-1955), from the MacTutor History of Mathematics Archive.

[cached page](#)

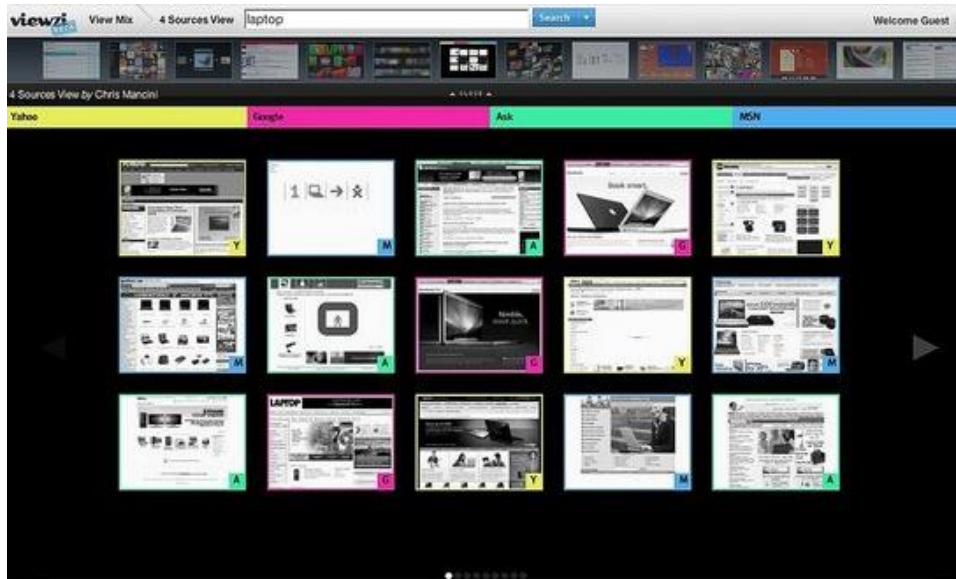
Li, et al., 2009

[Bullet train travel in China is affordable, yet exciting and runs ...](#)
28 May 2010 ... Passengers by Fuzhou-Xiamen bullet trains hit 4.52 billion in total ...
berths on Fuzhou-Xiamen bullet trains - Length of railway to hit 4500 ...
www.whatsonxiamen.com/travel-mag-1177.html



Loumakis et al., 2011

Commercial efforts

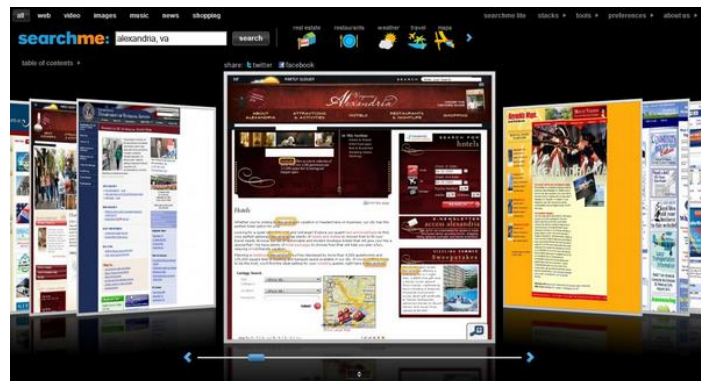


searchcube
beta

orienteeing
About - How to use searchcube - Send feedback
powered by Google™ THUMBSHOT.ORG #symmetri



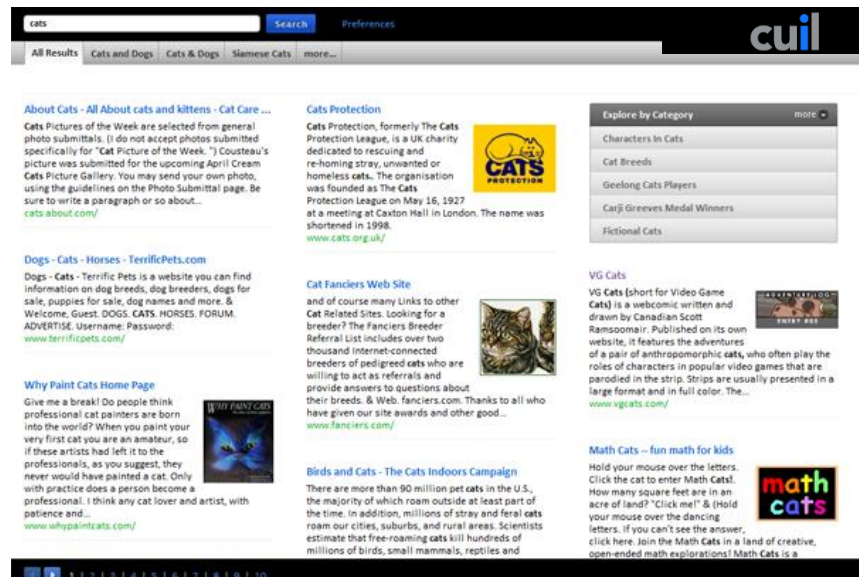
IMAGE
orienteeing.jpg
<http://www.pyb.co.uk/images/courses/int-ro-shots/orienteeing.jpg>
Orienteeing in the Welsh Mountains



City of Alexandria, Virginia
...Like many municipalities, Alexandria will be obtaining funding from the federal economic stimulus package... The City has established Alexandria.gov/economicdevelopment/...
<http://www.alexandriagov.gov>

Alexandria, Virginia: Hotels, Restaurants, Things to Do, Virginia Vacation Information
...Home ABOUT ALEXANDRIA ATTRACTIONS & ACTIVITIES HOTELS RESTAURANTS & NIGHTLIFE SHOPPING Weddings Meeting & Group Tours Stays & RV Rentals Calendar of Events My RV...
<http://www.alexandriavacations.com/>

Washington DC VA Medical Center Home
...skip to page content VA Home about VA Organizations Apply Online Locations Contact VA Washington DC VA Medical Center Home...
<http://www.va.gov/washington/alexandria.asp>



Use an image from the underlying page to *augment* the textual components of the surrogate



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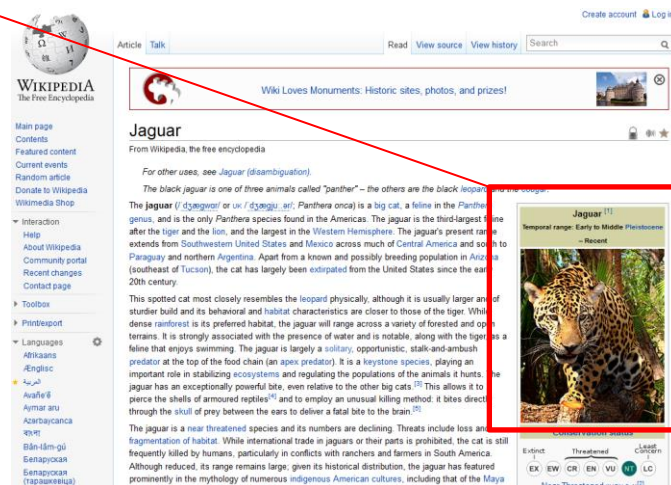
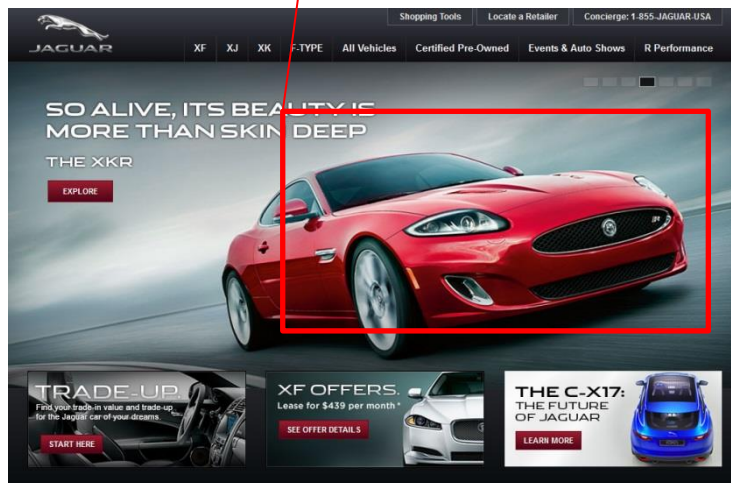
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Two ways images could help (or hurt)

Do images help/hurt?

For individual
surrogate level
judgments?

For helping to make
sense of the SERP
as a whole?



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Not all images on a page are helpful/representative

Do images help/hurt?

For individual
surrogate level
judgments?

For helping to make
sense of the SERP
as a whole?

Does image
quality matter?

Does image
quality matter?



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Good image = strongly related to the
main content of the page

Bad image = not related to the main
content of the page

Diversified vs. homogeneous results

Ambiguous queries → diversified results

Unambiguous query → more homogeneous results

Do images help/hurt?

For individual
surrogate level
judgments?

For helping to make
sense of the SERP
as a whole?

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quality matter?

Does image
quality matter?

**Does diversified
vs. homogeneous
results matter?**



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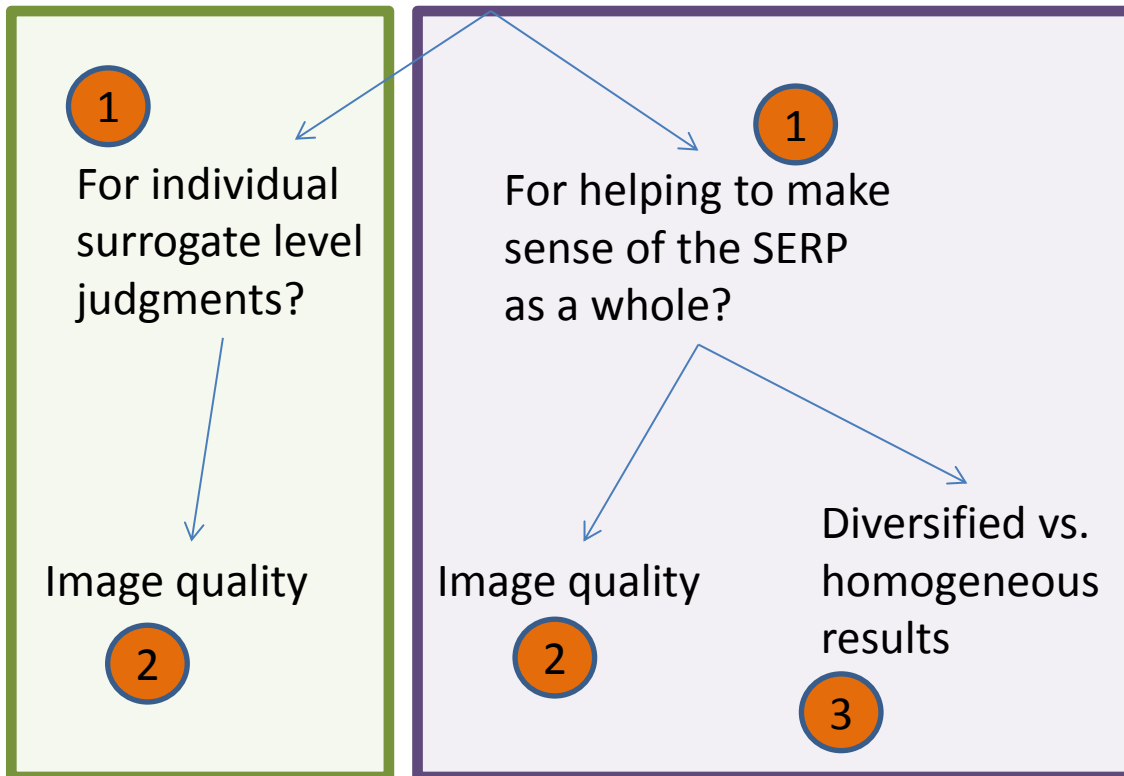
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Do images help more for SERPs with diversified results?


- 1 Do images help?
- 2 Does image quality matter?
- 3 Do images help more with diversified results?

Do images help/hurt?



Study 1 – Individual surrogates

Find information about Jake LaMotta, a boxer known as the Raging Bull.



[Jake LaMotta - IMDb](#)
<http://www.imdb.com/name/nm0483766/>
Actor: The Hustler (1961) Mob War (1989) Raging Bull (1980) The Happy Moose (1995). Jake LaMotta had one of the best chins in boxing history. In over 110 ...

I think the underlying webpage would be

when trying to answer this search task.


Study 2 – SERP interaction

Task: Find pricing information about the Porsche Cayenne.


cayenne

WEB RESULTS: 1 - 10 out of 50


None of these results contain the requested information




[All Cayenne Models - All Porsche Vehicles - HOME - Dr. Ing. h.c. F. Porsche AG](#)
Cayenne; Cayenne Diesel; Cayenne S; Cayenne S Hybrid Cayenne GTS Cayenne Turbo
www.porsche.com/usa/models/cayenne/




[Cayenne Pepper](#)
Cayenne pepper is one of the greatest health secrets in the world . The health benefits of **cayenne** pepper are many including preventing heart disease, cancer, ...
www.cayennepepper.info/




[Used Porsche Cayenne - Leesburg, VA - For sale on Cars.com](#)
Search Porsche **Cayenne** listing by price, mileage and more. Chat with a local dealer or request a quote online.
www.cars.com/for-sale/porsche/cayenne/va/leesburg/




[Cayenne - Herbs To Herbs](#)
Description regarding **cayenne**, and how the hotness of different chilies can be measured and scored.
www.herbs2000.com/herbs/herbs_cayenne.htm



[Cayenne pepper for improved blood flow - Healing and prevention...](#)
Information on using **cayenne** pepper to improve blood flow and other health benefits.
www.healingdaily.com/detoxification-diet/cayenne.htm



[Cayenne pepper - Wikipedia, the free encyclopedia](#)
The **cayenne** pepper also known as the Guinea spice, cow-horn pepper, aleva, bird pepper, or, especially in its powdered form, red pepper is a red, hot chili ...
en.wikipedia.org/wiki/Cayenne_pepper



[Curing With Cayenne - Amazing healing power of cayenne pepper](#)
If you master only one herb in your life, master **cayenne** pepper. It is more powerful than any other.
www.shirleys-wellness-cafe.com/cayenne.htm

- Search task
 - 150 search tasks
 - Ex: “Find information about the Mitsubishi Eclipse?”
- Query type
 - Ambiguous → diversified results
 - Unambiguous → more homogeneous results
- Image type
 - Good image – strongly relates to the main focus of the page
 - Bad image
 - Mixed
 - No images – baseline

Task and Query Creation

Task	Ambiguous query	Unambiguous query
Find information about the Achilles tendon.	achilles	achilles tendon
Find information about the Chevrolet Corsica.	corsica	chevy corsica
Find information about the rock band Genesis.	genesis	genesis band
Find information about Swanson, a brand of frozen and canned foods.	swanson	swanson food brand

- Ambiguous entities identified from Wikipedia disambiguation pages
- Filtered against AOL query log
- Selected 150 popular entities and wrote task descriptions

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- Unambiguous queries collected from a crowdsourced study
- Presented task description, users issued queries
- Selected most common query out of x10 redundancy

- Search Results
 - Title, URL, & snippet were cached from Bing Search API
 - 150 tasks x 2 queries x 10 results = 3,000 text surrogates
 - Relevance of each underlying page was judged by trained assessors.
- Images
 - were cached from the underlying 3,000 web pages
 - For each page, a good and bad image was selected based on a rule-based classifier + crowdsourced judgments

[Used Porsche Cayenne - Leesburg, VA - For sale on Cars.com](#)

Search Porsche **Cayenne** listing by price, mileage and more. Chat with a local dealer or request a quote online.

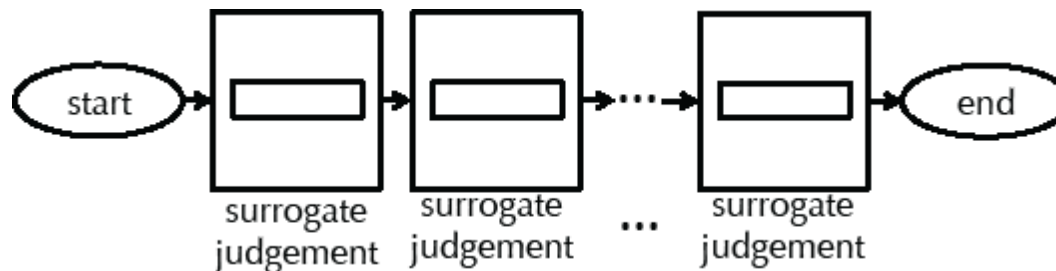
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USEFUL

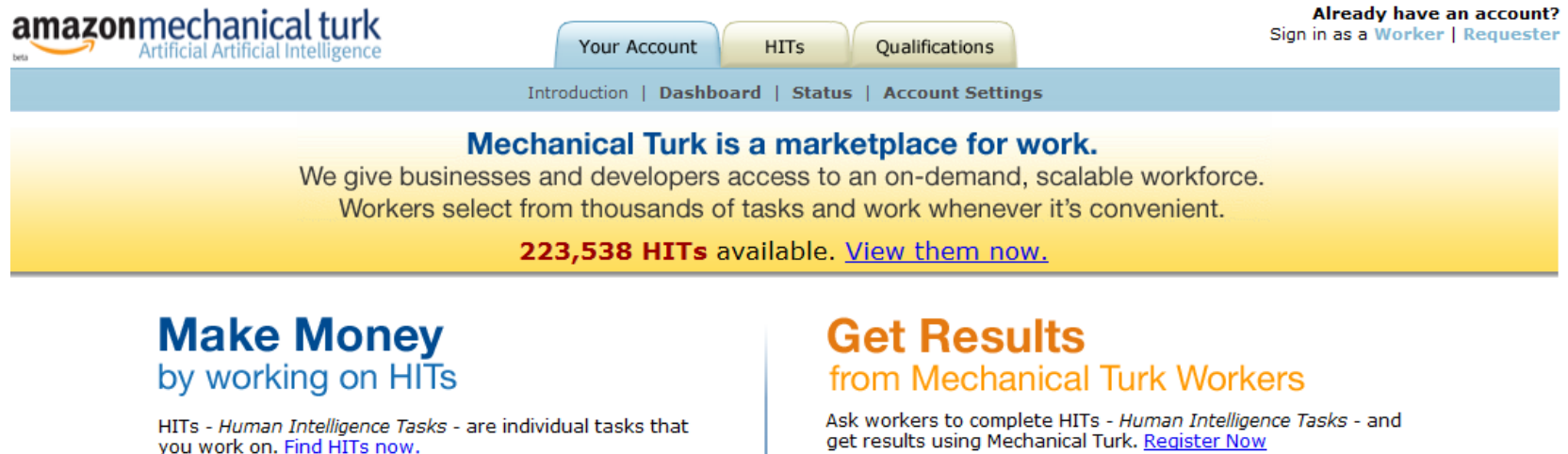
NOT USEFUL

when trying to answer this search task.

- Independent variables
 - Task: 128 tasks (not all pages had good/bad image)
 - Query type: ambiguous, unambiguous
 - Image type: good, bad, mixed, no image
- Fully crossed
 - 128 x 2 x 4 x 5 (redundancy)
- Dependent variables
 - Accuracy = % correct
 - Average judgment duration (in milliseconds)

Study 1 – Procedure

- Crowdsourced on Amazon Mechanical Turk
 - Workers cut-off if they failed > 3 “check” tasks
 - Tasks were randomly assigned
 - Workers were randomly assigned to an image condition
 - Surrogates presented in groups of 5 to 10 for the same task
- Total judgments collected = 34,000



The screenshot shows the Amazon Mechanical Turk homepage. At the top left is the logo "amazonmechanical turk" with "Artificial Artificial Intelligence" below it. To the right are three buttons: "Your Account", "HITs", and "Qualifications". Further right is the text "Already have an account? Sign in as a [Worker](#) | [Requester](#)". Below these is a navigation bar with links: "Introduction | **Dashboard** | Status | Account Settings". The main content area has a yellow background with the text: "Mechanical Turk is a marketplace for work. We give businesses and developers access to an on-demand, scalable workforce. Workers select from thousands of tasks and work whenever it's convenient. **223,538 HITs** available. [View them now.](#)". At the bottom, there are two columns. The left column is titled "Make Money by working on HITs" and contains the text: "HITs - Human Intelligence Tasks - are individual tasks that you work on. [Find HITs now.](#)". The right column is titled "Get Results from Mechanical Turk Workers" and contains the text: "Ask workers to complete HITs - Human Intelligence Tasks - and get results using Mechanical Turk. [Register Now](#)".

amazonmechanical turk
Artificial Artificial Intelligence

Your Account HITs Qualifications

Already have an account?
Sign in as a [Worker](#) | [Requester](#)

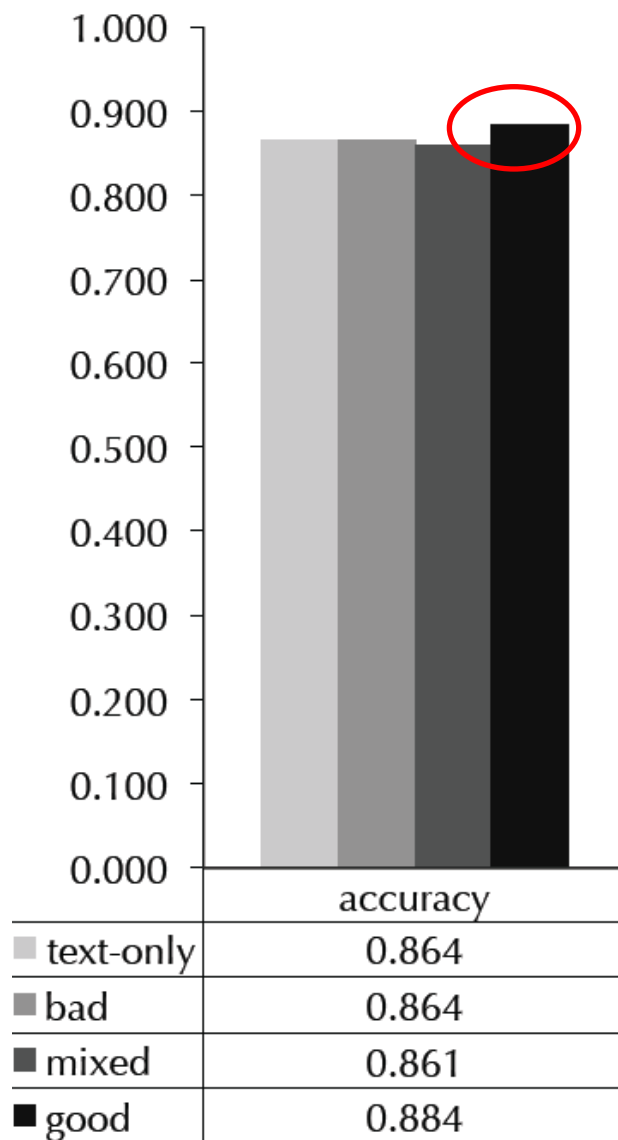
Introduction | **Dashboard** | Status | Account Settings

Mechanical Turk is a marketplace for work.
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Study 1 – Accuracy

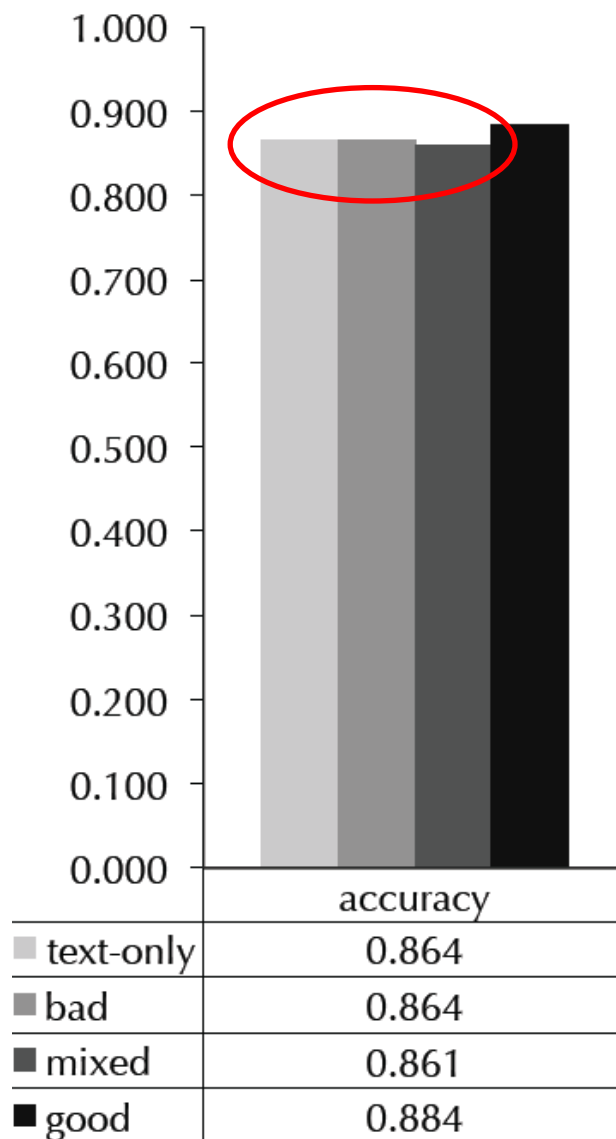


Results:

(based on 34,000 judgments)

- Good images led to 2.3% improvement in accuracy over text-only ($p < .01$).
(Effect of image: $\chi^2(3) = 24.26$, $p < .01$)
- Overall, accuracy was high.

Study 1 – Accuracy



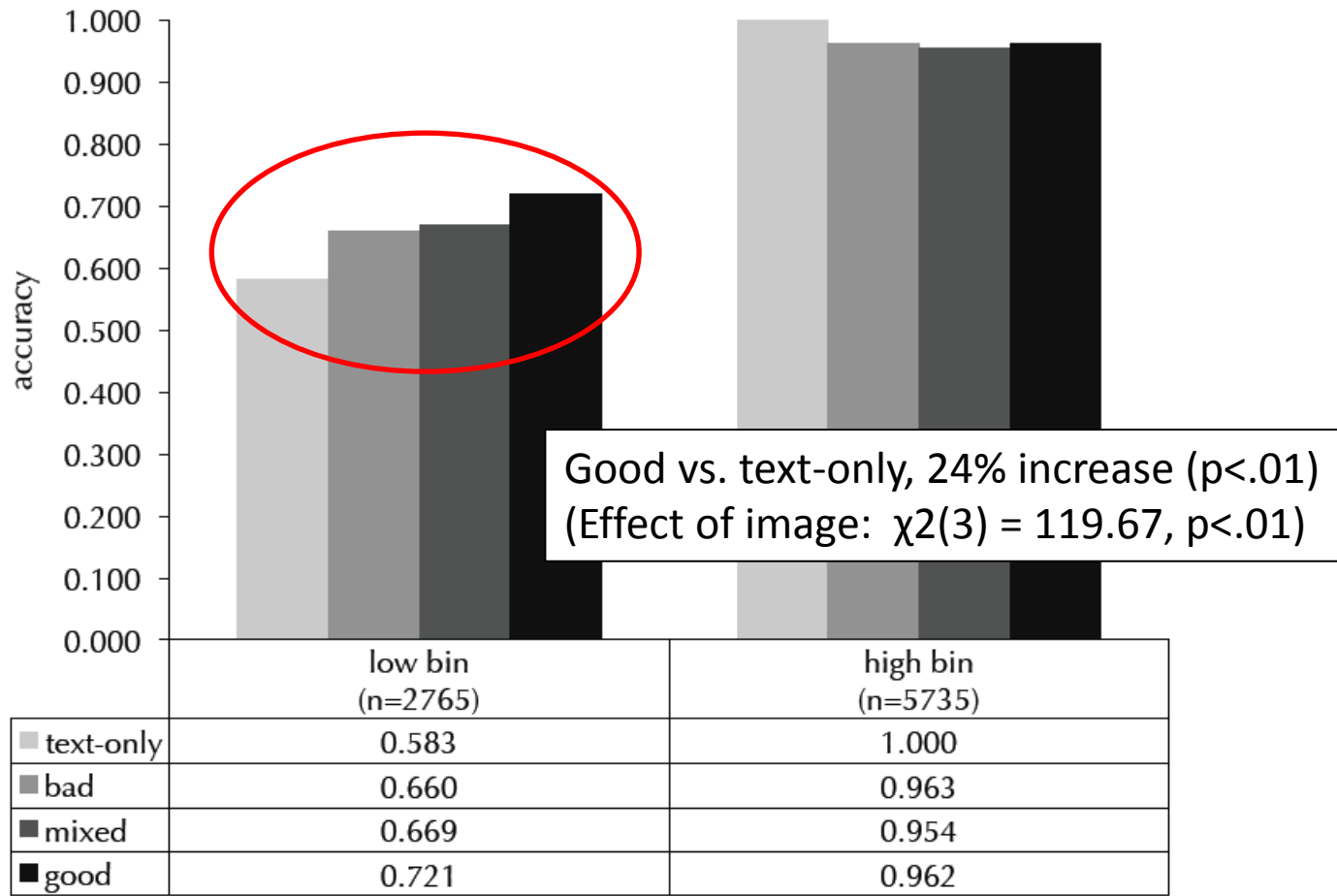
Some good news:

- No significant drop in accuracy for bad and mixed images.
- This means good helped (a little) and bad didn't hurt.

Study 1 – Binned Analysis

High bin = perfect accuracy in text-only condition

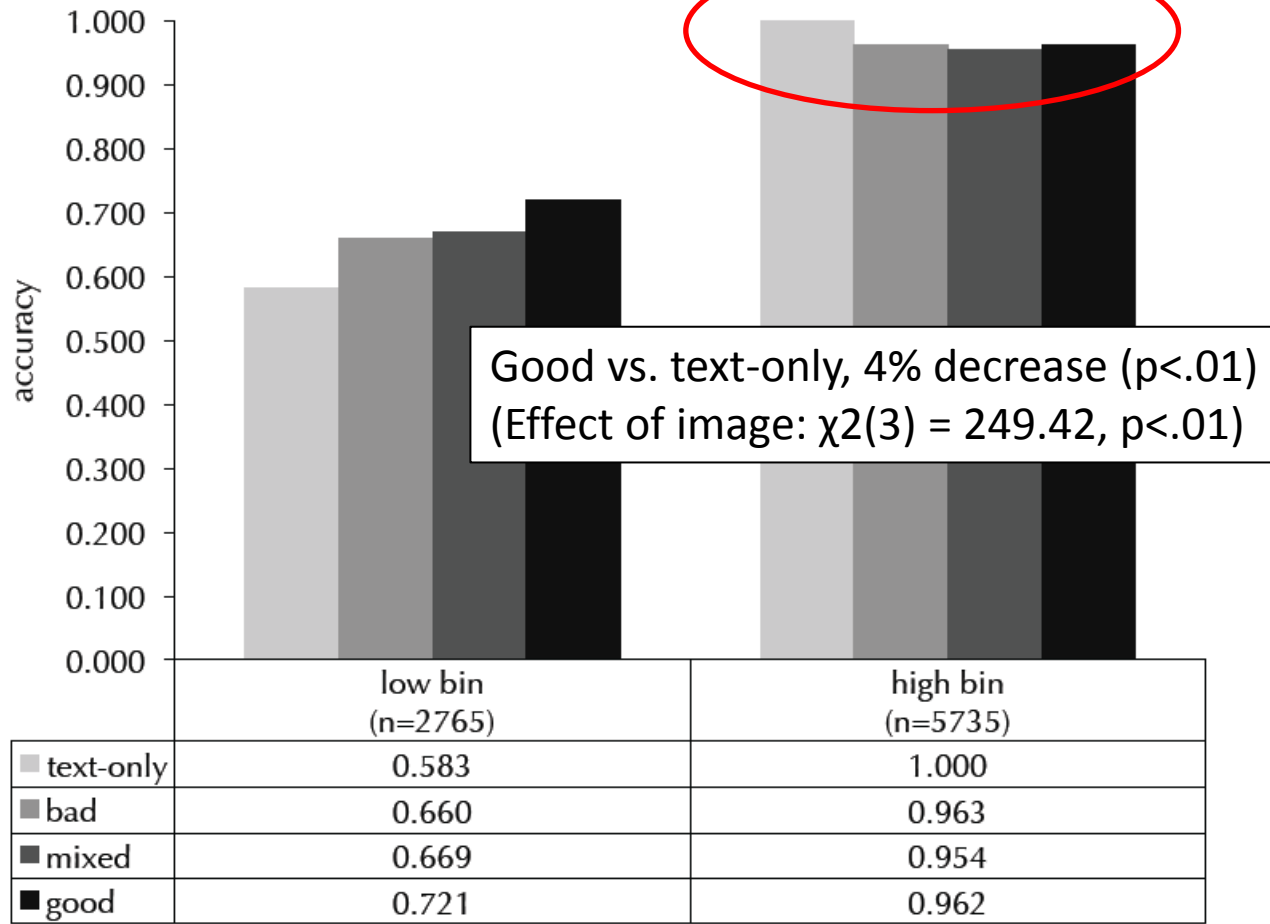
Low bin = everything else



Study 1 – Binned Analysis

High bin = perfect accuracy in text-only condition

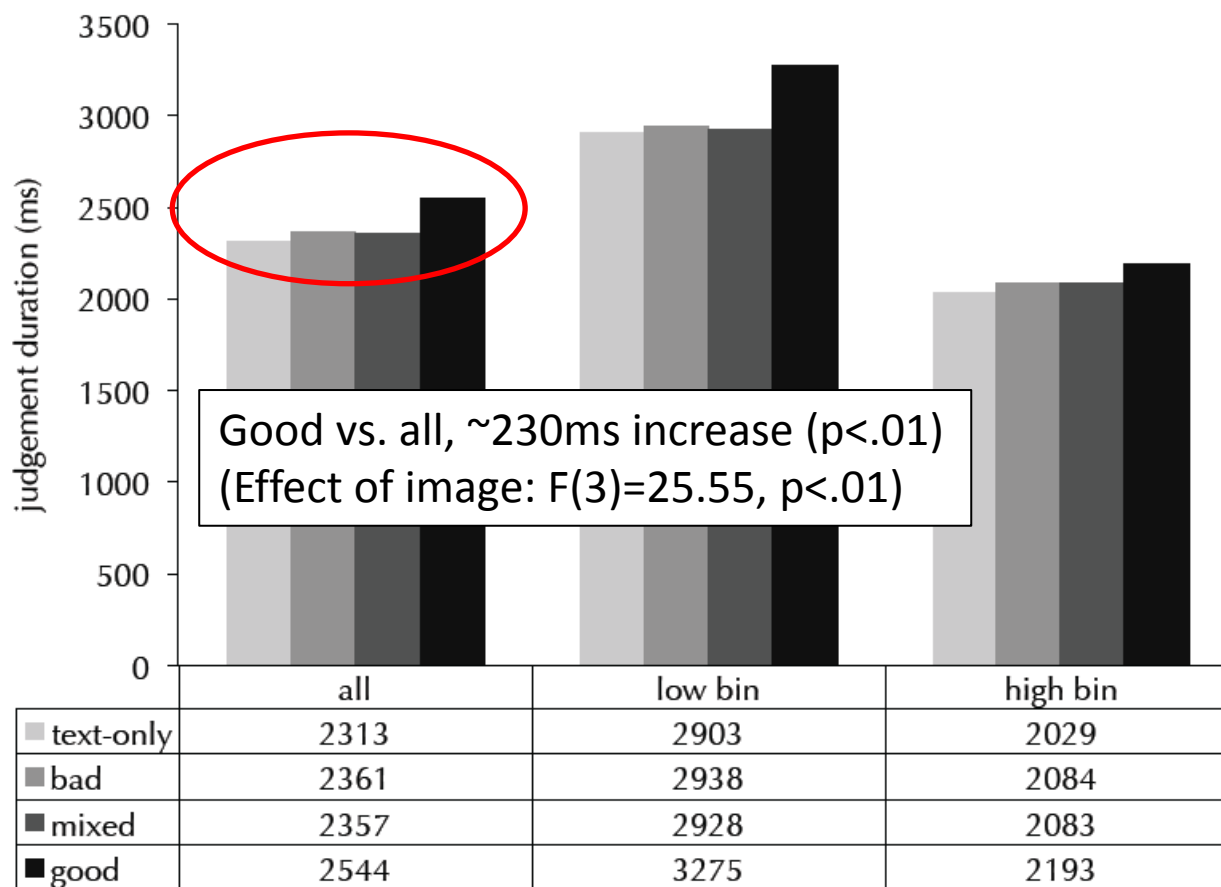
Low bin = everything else



Study 1 – Judgment duration

High bin = perfect accuracy in text-only condition

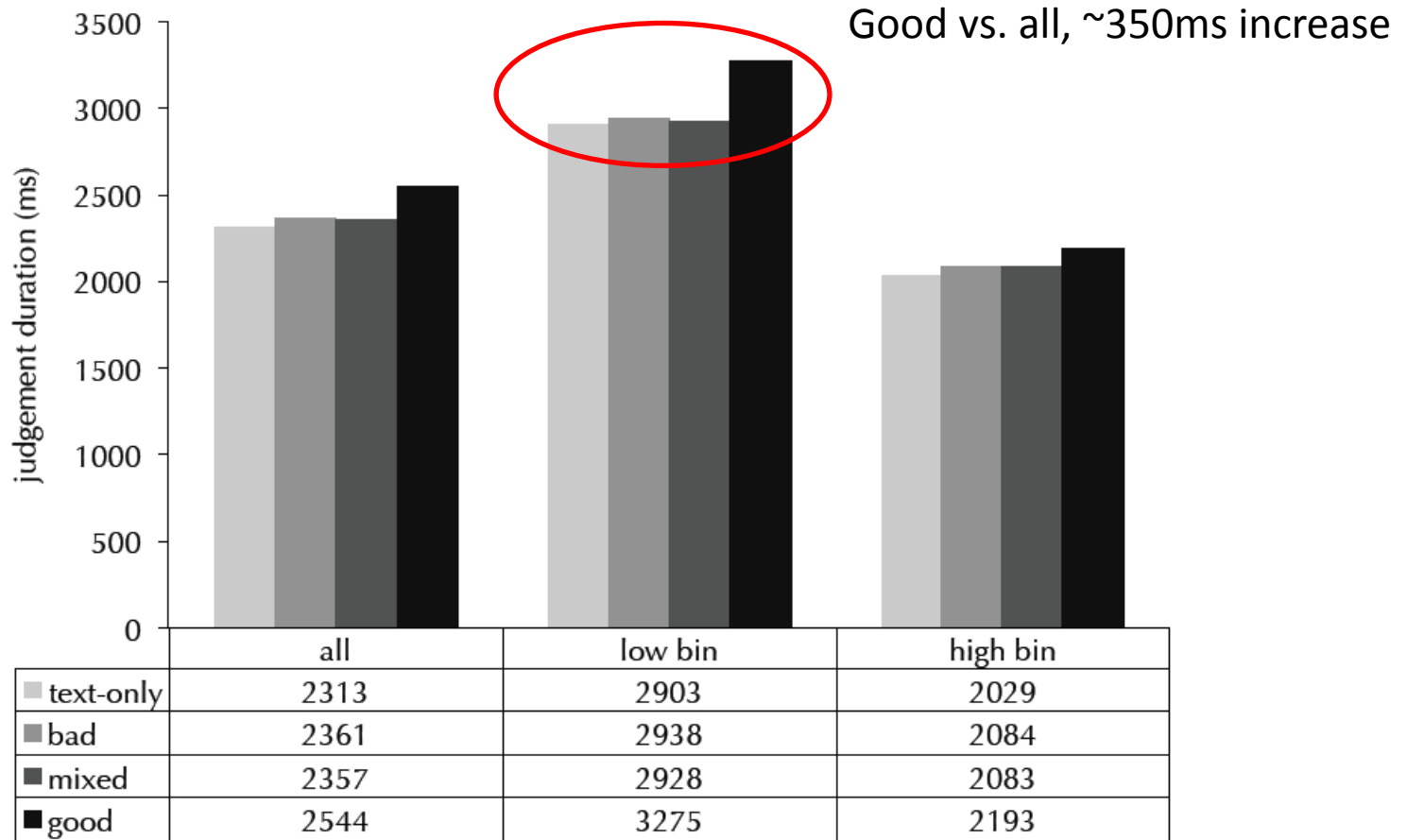
Low bin = everything else



Study 1 – Judgment duration

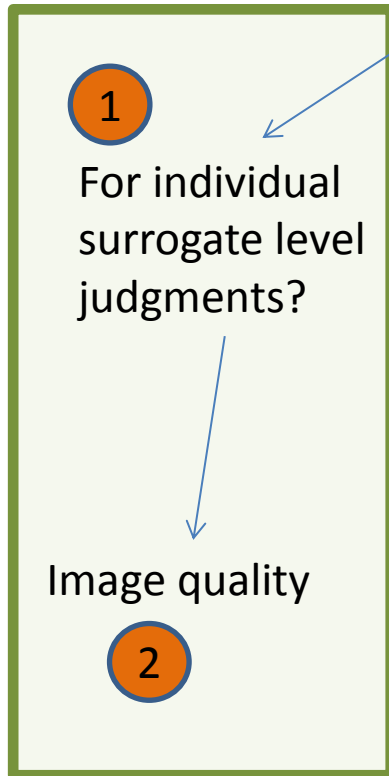
High bin = perfect accuracy in text-only condition

Low bin = everything else



Study 1 – Results Summary

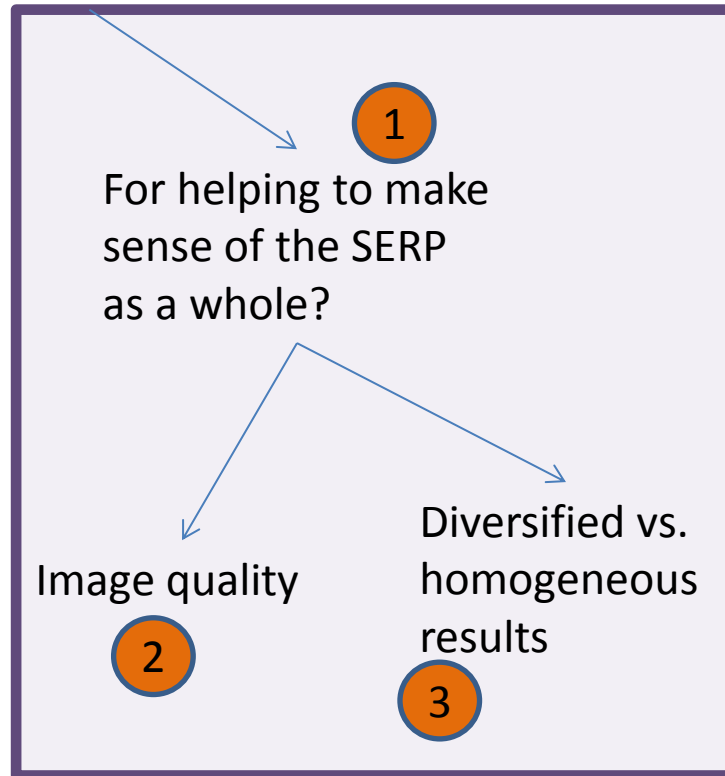
Do images help/hurt?



- 1 Good images help, but only a small amount (2.3%)
- 2 Image quality (good vs. bad) matters.
Bad images didn't help at all.

**Study 1:
Individual
surrogate
judgments**

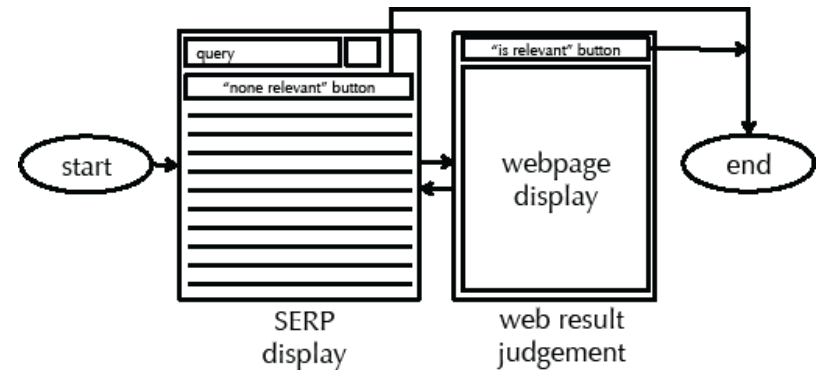
Do images help/hurt?




**Study 2:
SERP-level
interaction**

Study 2


- SERP-level judgments
 - Initial query & SERP provided
 - Task: select a relevant result
 - Or, click the “none relevant” button
 - No query reformulation allowed




Task: Find information about Pandora, the first woman according to Greek mythology.



WEB RESULTS: 1 - 10 out of 50

 **Pandora internet radio - Android Apps on Google Play**
Pandora radio is a personalized radio service that streams music on your phone. Pandora is free, personalized radio that plays music and comedy you'll love. ...
<https://play.google.com/store/apps/details?id=com.pandora.android>

 **Pandora**
August 23, 2012 From the Curators: Pandora Back to School Stations. It's time to kick off a new school year and Pandora has you covered with a new selection ...
log.pandora.com/pandora/

None of these results contain the requested information

Task: Find information about Pandora, the first woman according to Greek mythology.

Create account Log in

Article Talk Read Edit View history Search

 **WIKIPEDIA**
The Free Encyclopedia

Main page
Contents
Featured content
Current events

Pandora
From Wikipedia, the free encyclopedia

For other uses, see *Pandora (disambiguation)*.

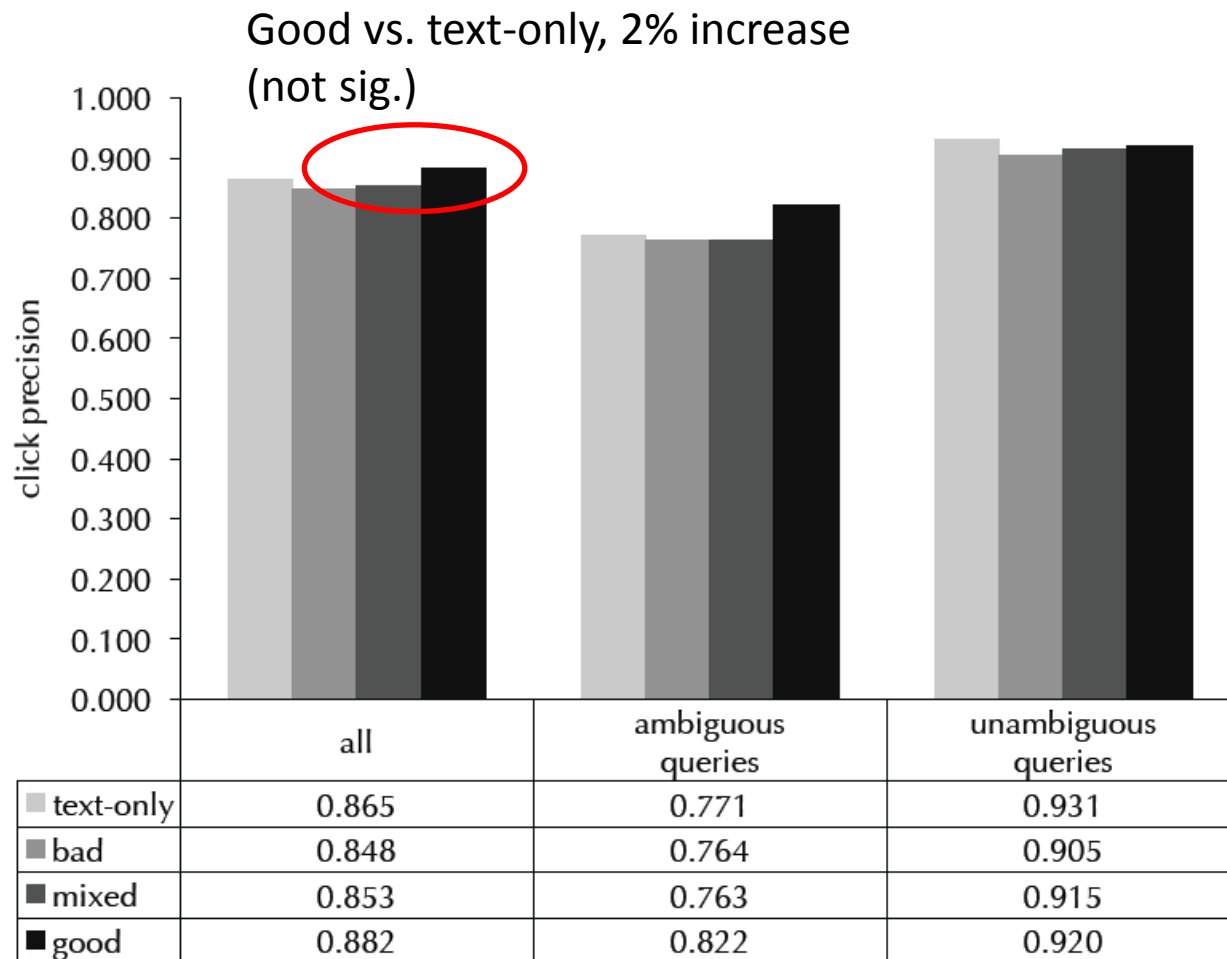
In Greek mythology, **Pandora** (Greek: Πανδώρα, derived from πᾶν, *pán*, i.e. "all" and δῶρον, *dōron*, i.e. "gift", thus "the all-endowed", "the all-gifted" or "the all-giving"^[1]) may have been an early deity about whom little knowledge survives.^[citation needed] Her other name, inscribed against her figure on a white-ground kylix in the British Museum,^[2] is *Anadōra*. "She who made us all"^[3] or perhaps "from below" within the earth, which is a clue to her origin



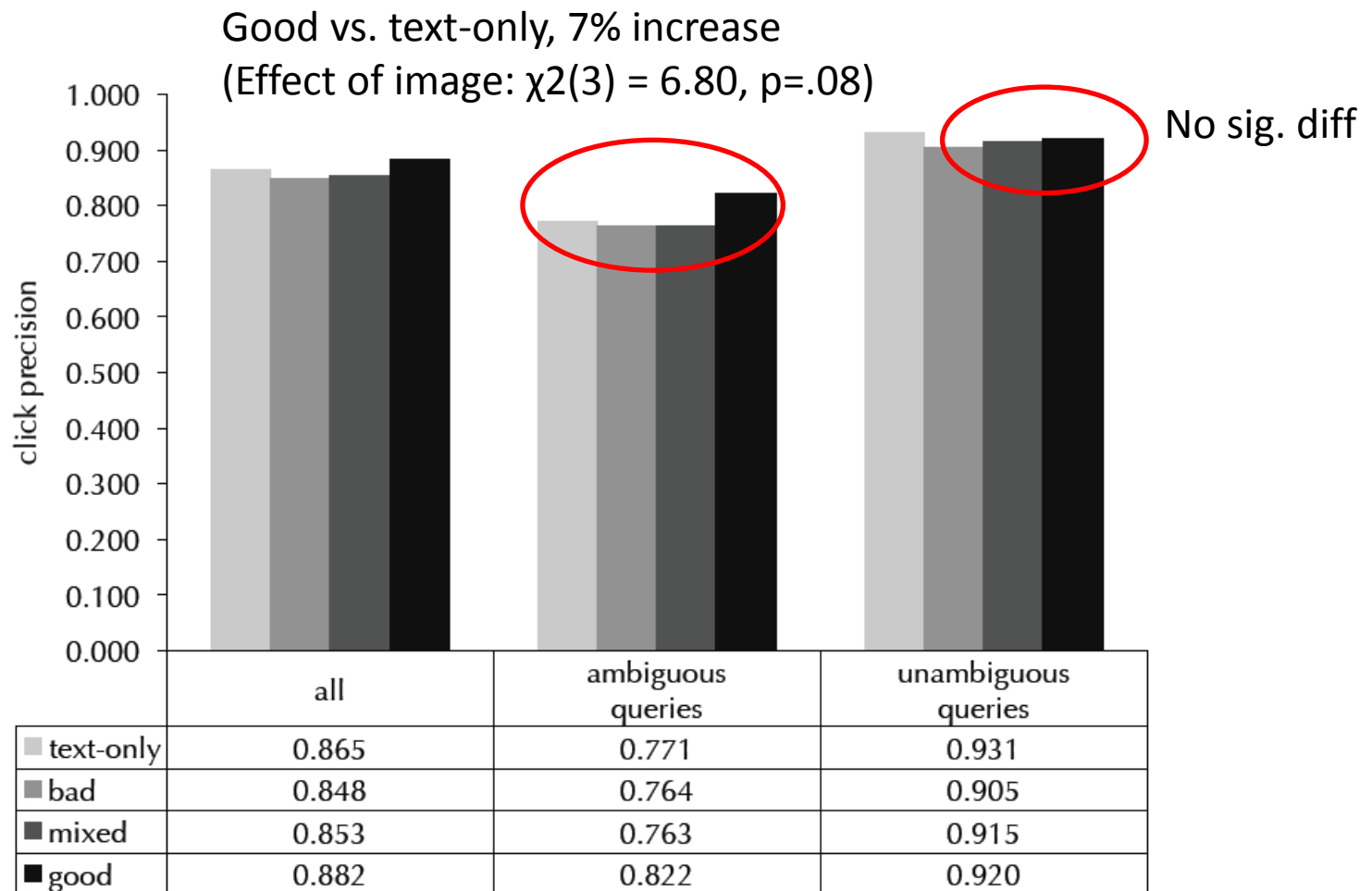
Click here if this page contains the requested information

- Independent variables
 - Same as Study 1
- Fully crossed
 - 150 tasks x 2 query types x 4 image conditions x 5 redundancy
 - 6,000 total trials
- Dependent variables
 - Click-precision = $\# \text{ clicks on relevant results} / \text{total} \# \text{ clicks}$
 - Time-to-completion = (end time – start time)
- Crowdsourced on Amazon Mechanical Turk
 - Random assignment of tasks
 - Workers assigned a random image condition

Study 2 – Click precision

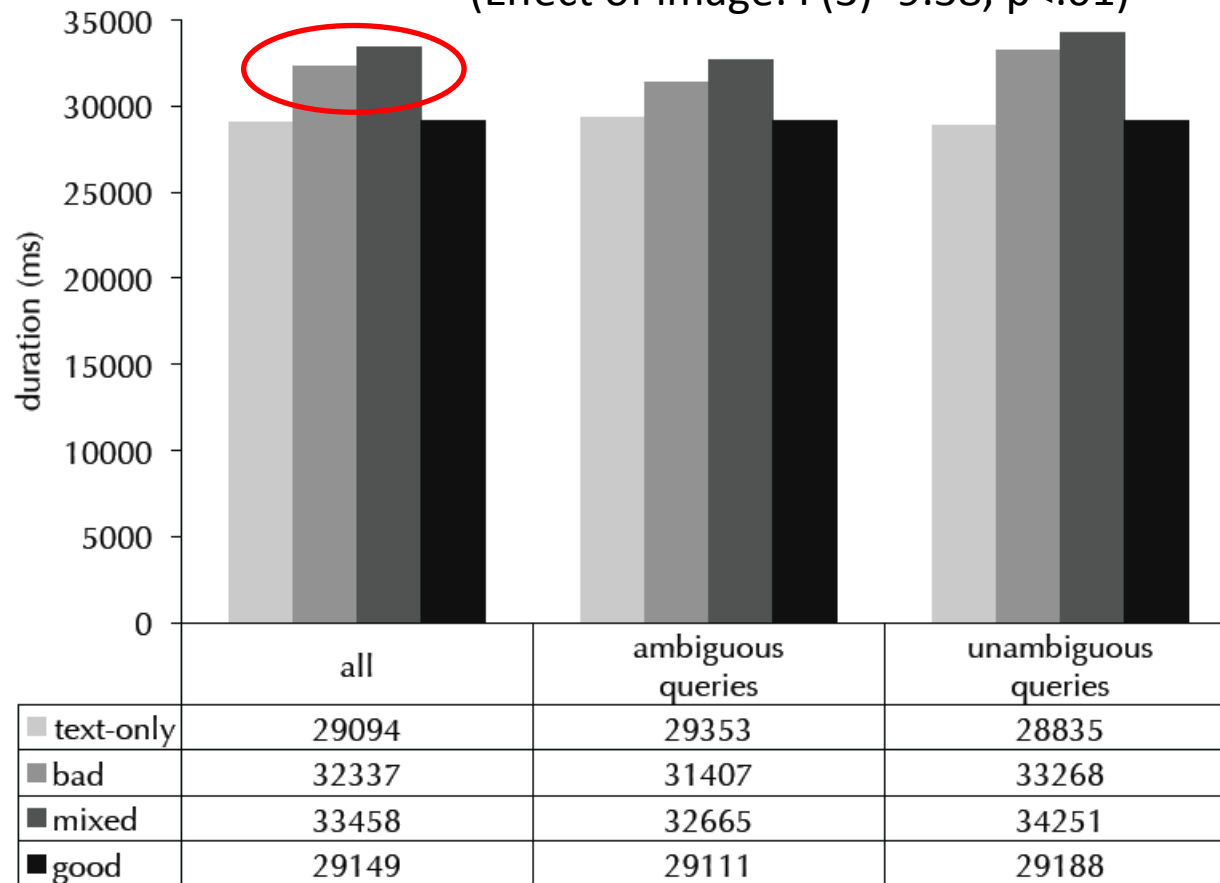


Study 2 – Click precision



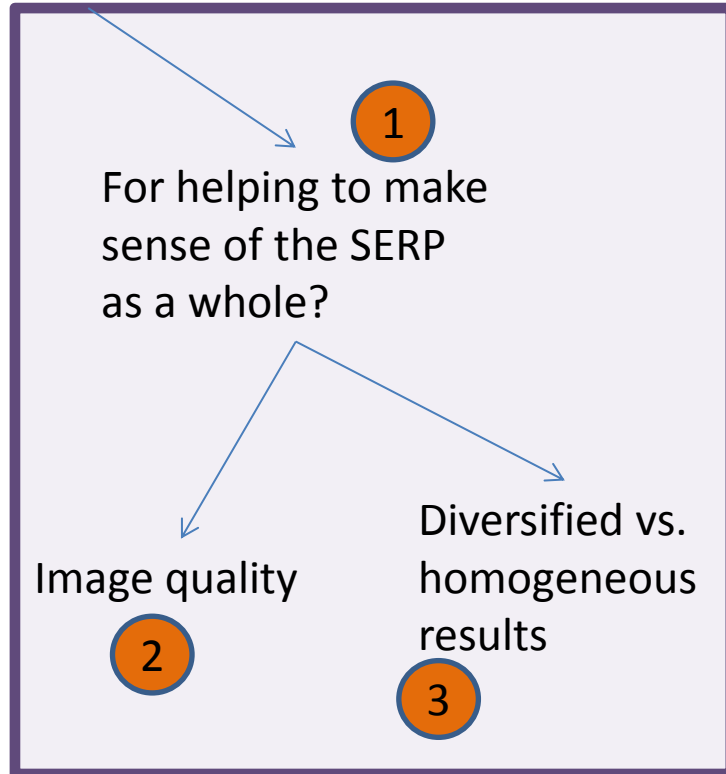
Study 2 – Time-to-completion

Bad & mixed > text-only & good ($p < .01$)
(Effect of image: $F(3)=9.38$, $p < .01$)



Study 2 – Results summary

Do images help/hurt?



- 1 Good images may help, but only a small amount (2.0%)
- 2 Image quality matters.
Bad images didn't help click-precision at all.
Bad images led to longer time-to-completion
- 3 For ambiguous queries with diversified results, good images helped more (vs. unambig/homogeneous)

- Images could help in specific cases
 - When the query is ambiguous and results are diversified
 - When the textual parts of surrogates are lacking
- Both these cases can be predicted
 - Many ambiguous queries are already known
 - Simple metrics could predict text surrogate quality
- Fast image classifiers can select a good image about 85% of the time
- Image use could be selectively, algorithmically applied



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