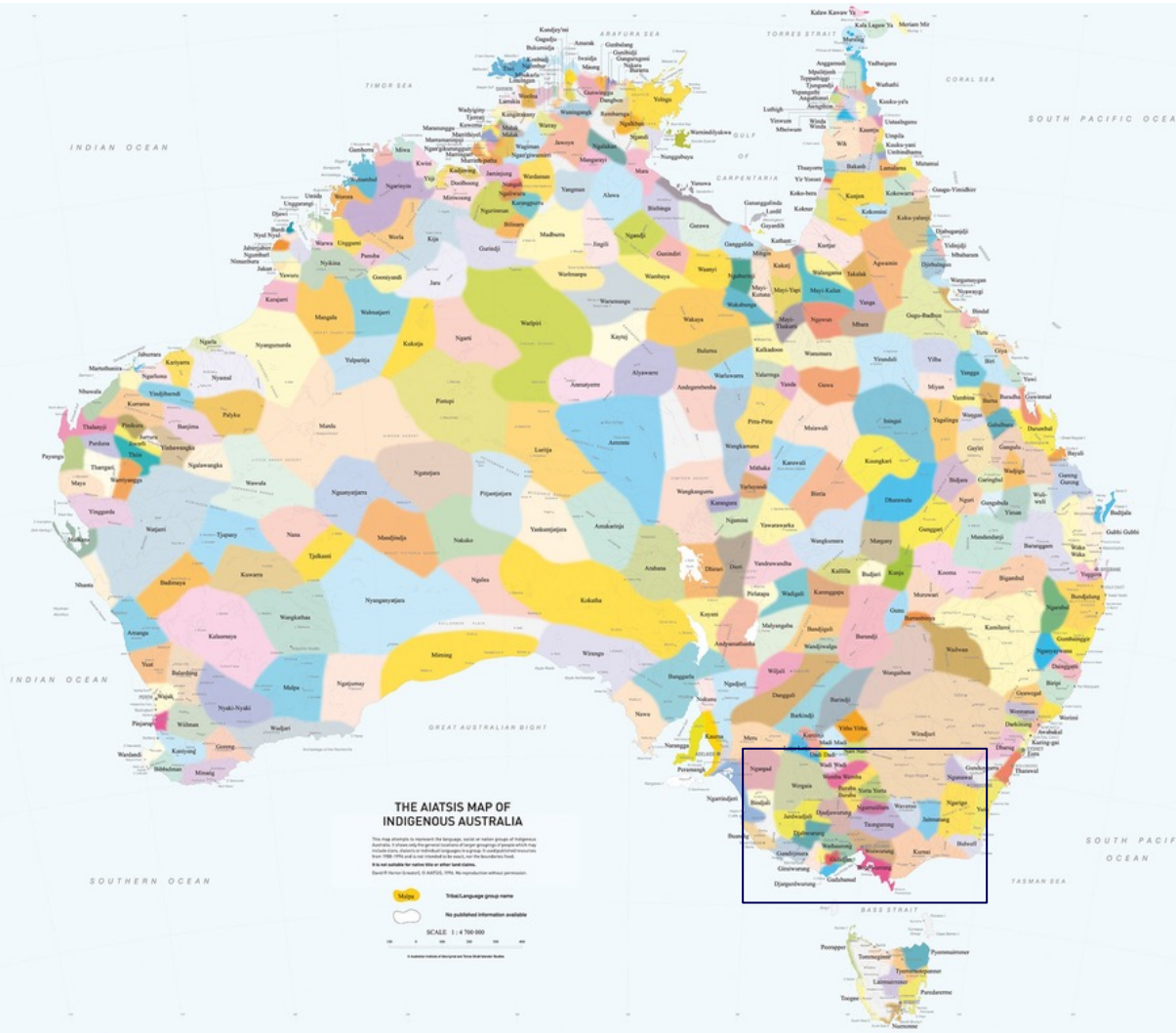


A Crowdsourcing Methodology to Measure Algorithmic Bias in Black-box Systems: A Case Study with COVID-related Searches

Binh Le, *Damiano Spina*, Falk Scholer, Hui Chia

damiano.spina@rmit.edu.au
@damiano10
damianospina.com





Source: AIATSIS Map of Indigenous Australia.
<https://aiatsis.gov.au/explore/map-indigenous-australia>



ustralia.
genous-

Acknowledgment of Country

I would like to acknowledge the people of the Woi wurrung and Boon wurrung language groups of the eastern Kulin Nation on whose stolen lands I live, teach, work, and learn.

I acknowledge that sovereignty was never ceded.

I respectfully acknowledge their Ancestors and Elders past, present, and emerging.

I also acknowledge the Traditional Custodians and their Ancestors of the lands and waters across Australia, and I pay my respect to any Aboriginal and Torres Strait Islander people joining us today.



A Crowdsourcing Methodology to Measure Algorithmic Bias in Black-box Systems: A Case Study with COVID-related Searches

BHCC 2022

Previously presented at BIAS workshop at ECIR'22

Binh Le, *Damiano Spina*, Falk Scholer, Hui Chia

damiano.spina@rmit.edu.au

[@damiano10](#)

damianospina.com





Google



**Search
Engine
Results
Page**





Search
Engine
Results
Page



SERP 1



SERP 2



SERP 3



Google



RQ1:
Do different users
get the same search results?



Should I get vaccinated for covid



User



Should I **avoid** getting vaccinated for covid



RQ2:
**Do results vary between
positive and negative
query formulations?**

Methodology

Methodology

Crowdsourcing Platform to Audit a Web Search Engine

- Requesters: Publish micro-tasks or Human Intelligent Tasks (HITs)
 - Annotation tasks to obtain labels for machine learning development and evaluation)
- Crowd workers: Can choose to carry out micro-tasks at their convenience

The logo for Amazon Mechanical Turk, featuring the word "amazon" in white with its signature arrow, followed by "mechanical turk" in orange, all on a dark grey background.

Crowdsourcing Task

Upload the HTML file for the following query: is hydroxychloroquine effective for covid

Click on the following query to open a new page with the corresponding google search results: [is hydroxychloroquine effective for covid](#)

Choose file No file chosen

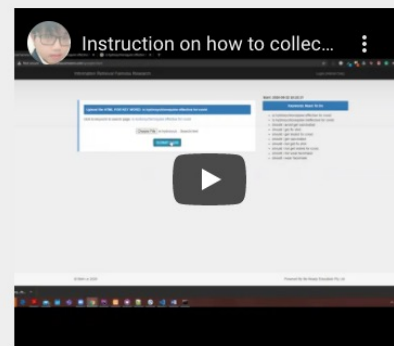
SUBMIT DATA

Start: 2021-08-30 07:27:41

Queries that still need to be completed:

- should i get flu shot
- should i get tested for covid
- should i get vaccinated
- should i not get tested for covid
- should i not get flu shot
- is hydroxychloroquine effective for covid
- is hydroxychloroquine ineffective for covid
- should i avoid get vaccinated
- should i wear facemask
- should i not wear facemask

Instruction



Useful Links

[Participant Information Sheet](#)

Google

should i get vaccinated

AI News Videos Images Shopping More Tools

About 1,540,000,000 results (0.62 seconds)

Vaccination is the most effective way to protect against **infectious diseases**. Vaccines strengthen your immune system by training it to recognise and fight against specific viruses. When you get vaccinated, you are protecting yourself and helping to protect the whole community.

<https://www.health.gov.au/covid-19-vaccines-why-should-i-get-vaccinated-for-covid-19-australian>

Why should I get vaccinated for COVID-19? - Australian ...

About featured snippets Feedback

COVID-19 >

Common questions

What are some common side effects of the COVID-19 vaccine?

Can you still spread Covid if vaccinated?

When should the COVID-19 vaccine be given?

Do I need the vaccine if I had Covid?

For informational purposes only. Consult your local medical authority for health advice.

Feedback

<https://www.hopkinsmedicine.org/health/coronavirus>

COVID-19 Vaccine Hesitancy: 12 Things You Need to Know

Getting the COVID-19 vaccine can protect you from getting sick. ... The COVID-19 vaccines work with your immune system so your body will be ready to fight the ...

<https://www.science.org.au/curious/people-medicine>

Should I get a COVID-19 vaccine? How to weigh up your risks ...

13 July 2021 — When you are vaccinated against COVID-19, you not only protect yourself, but also those around you. Even if you are fit and healthy and have a ...

<https://www.cdc.gov/coronavirus/2019-ncov/facts>

Myths and Facts about COVID-19 Vaccines | CDC

Vaccines work by stimulating your immune system to produce antibodies, exactly like it would if you were exposed to the disease. After getting vaccinated, you ...

<https://www.mayoclinic.org/in-depth/art-20484859>

Get the facts about COVID-19 vaccines - Mayo Clinic

Find out about the COVID-19 vaccine, the benefits of a COVID-19 vaccination, ... Should I get the COVID-19 vaccine even if I've already had COVID-19?

<https://www.mayoclinic.org/coronavirus-covid-19>

Why get vaccinated? - Mayo Clinic

Prevent the COVID-19 virus from spreading and replicating, which allows it to mutate and possibly become more resistant to vaccines. More about why you should ...



Participant (Crowd Worker)

1. Submit the query to Google using their browser
2. Download SERP as HTML file
3. Upload HTML file into the web app

The webapp removes all the personal information i.e. avatar, email address before saving the HTML file.

Google

should i avoid get vaccinated

AI Images News Videos Shopping More Tools

About 115,000,000 results (0.37 seconds)

<https://www.health.gov.au> > ... > About immunisation >

Who can be immunised? - Australian Government Department ...

30 Nov 2017 — Should you get vaccinated if you have allergies? ... a minor illness and do not have a fever, you can be safely and effectively vaccinated.

<https://www.hopkinsmedicine.org/health/coronavirus>

COVID-19 Vaccine Hesitancy: 12 Things You Need to Know

The vaccines do not contain live coronavirus, and you cannot and will not get COVID-19 from getting vaccinated. After the shots, you might experience a sore ...

<https://www.healthline.com/health/vaccinations-immunisation>

Vaccines: Who Should Avoid Them and Why - Healthline

Vaccinations are safe — However, these vaccines may not be right for everyone. The CDC advises that certain people not get specific vaccines, or to wait ...

Overview · Flu · Takeaway · Pros and cons

<https://www.sydney.edu.au/news/2021/02/22/not-just-vaccine-refusers-who-might-not-get-the-covid-19>

It's not just vaccine refusers who might not get the COVID-19 ...

22 Feb 2021 — The surprising reasons why people don't get vaccinated ... Least doesn't do this thinking just for Australians. As chair of a World Health ...

<https://www.bbc.com/future/article/20210720-who-should-not-get-covid-19-vaccine>

Why some people don't want a Covid-19 vaccine - BBC Future

20 July 2021 — There should be no doubt about it: Covid-19 vaccines are saving lives. ... the fears of most vaccine hesitant people should not be confused ...

<https://www.cdc.gov/vaccines/vpd/should-not-vacc>

Who Should not Get Vaccinated | CDC

Has a weakened immune system, or has a parent, brother, or sister with a history of hereditary or congenital immune system problems; Has ever had a condition ...

<https://www.cdc.gov/parents/why-vaccinate/vaccination-decision>

Making the Vaccine Decision: Common Concerns | CDC

5 Aug 2019 — The diseases vaccines prevent can be dangerous, or even deadly. Statistically, the chances of your child getting diseases such as measles, ...

<https://www.science.org.au/curious/people-medicine>

Should I get a COVID-19 vaccine? How to weigh up your risks ...

13 July 2021 — and are more willing to accept an outcome if it's the result of doing nothing ('if I avoid the vaccine, I know I might catch COVID-19'), ...

<https://www.who.int/news/2021/07/14/covid-19-vaccine-advice-public>

COVID-19 advice for the public: Getting vaccinated - WHO ...

14 July 2021 — If you experience an immediate severe allergic reaction to a first dose of the COVID-19 vaccine, you should not receive additional doses of ...



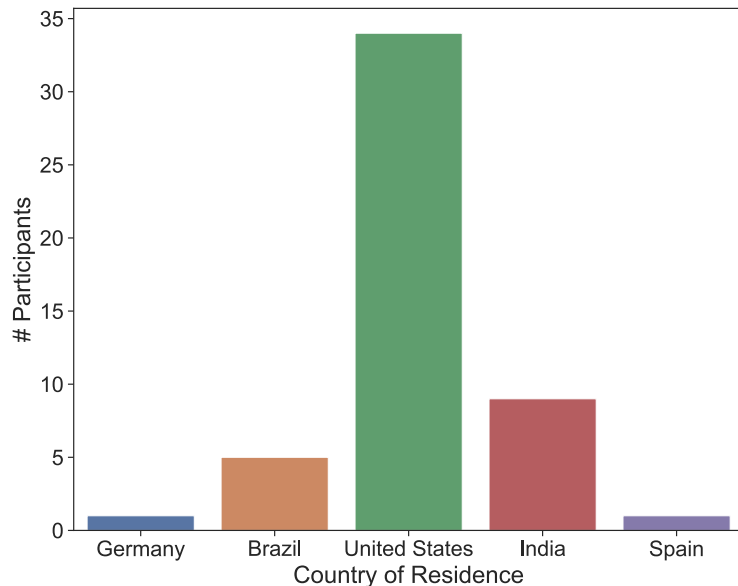
Queries

10 queries – 5 pairs

- | | | |
|----|---|--------|
| 1 | should i get tested for covid | Pair 1 |
| 2 | should i not get tested for covid | |
| 3 | should i get flu shot | Pair 2 |
| 4 | should i not get flu shot | |
| 5 | should i get vaccinated | Pair 3 |
| 6 | should i avoid get vaccinated | |
| 7 | should i wear facemask | Pair 4 |
| 8 | should i not wear facemask | |
| 9 | is hydroxychloroquine effective for covid | Pair 5 |
| 10 | is hydroxychloroquine ineffective for covid | |

Queries

- US\$ 1.20 per HIT
- 10 queries per HIT
- 1 HIT per participant
- N=50 participants
- Average time: 23' 30"
- All (50+1) crowdsourcing tasks completed in 2 days. Only 1 incorrect submission.
- Pre-questionnaire: Age, gender, country of origin, country of residence, level of education, ...



Comparing SERPs

Rank-Biased Overlap (RBO)

- Non-conjoint, top-weighted, and incomplete ranked lists
- Parameter “p” (patience): probability of the user to continue inspecting the ranking
 - It determines the strength of the weighting to top ranks
 - E.g., $p=0.67$: the user inspects only the top-3 search results.

Jaccard Similarity

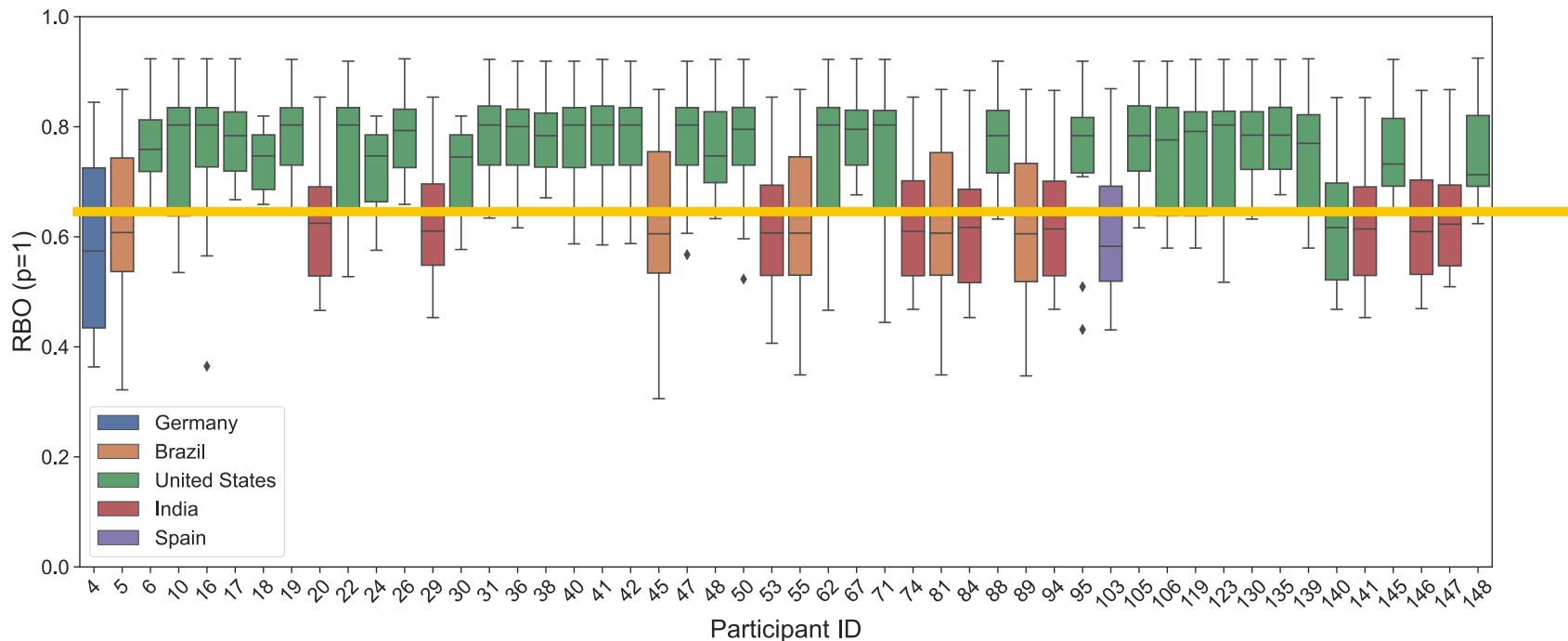
- Overlap of items in two sets
- It does not consider ranking positions, i.e., it only measures conjointness

2 levels of granularity: domain or URL

Preliminary Results

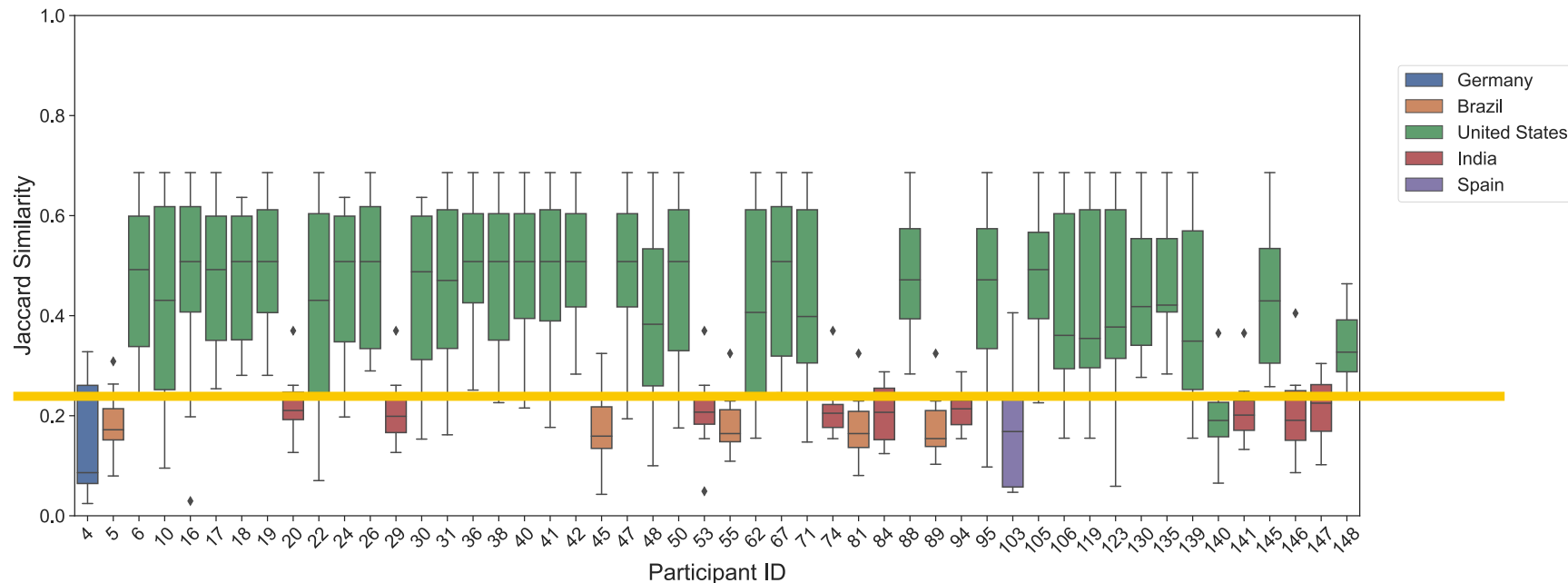
Do Different Users See Different SERPs?

Comparing items at domain level



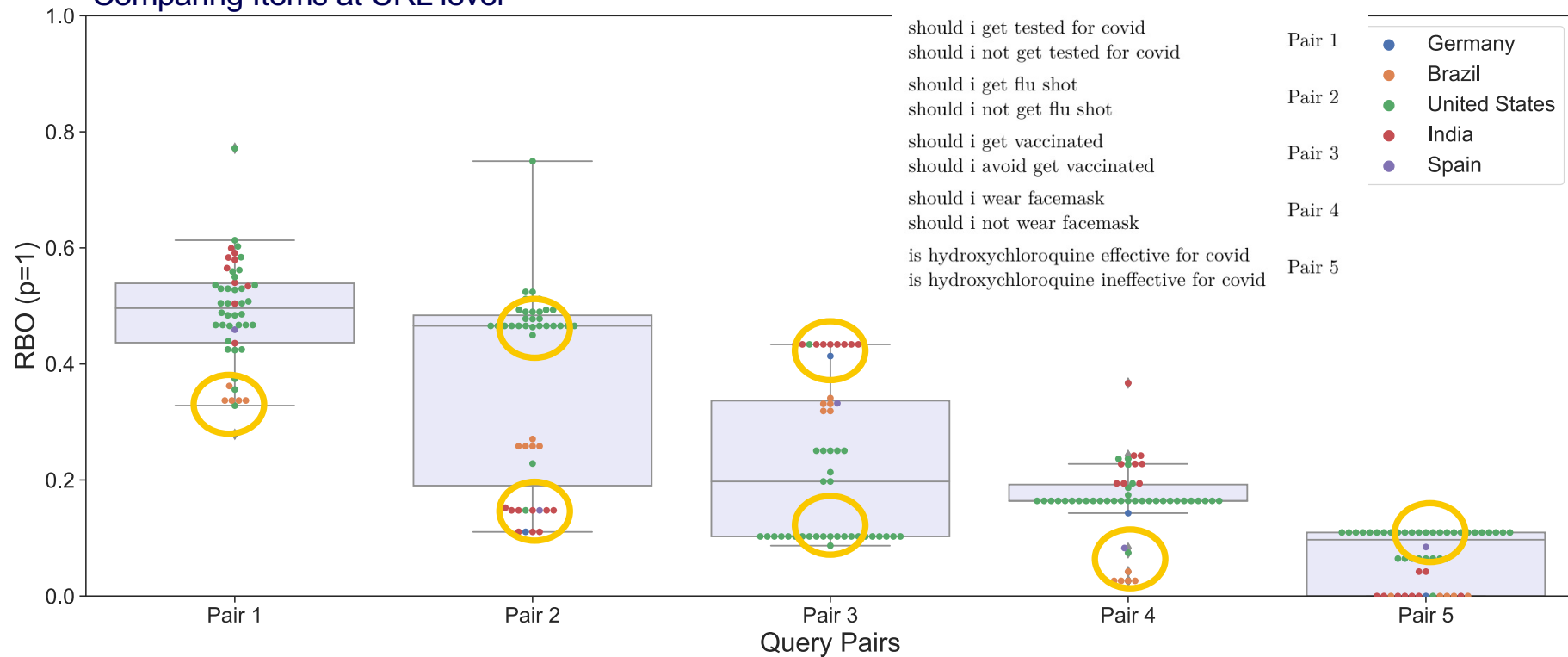
Do Different Users See Different SERPs?

Comparing Items at domain level



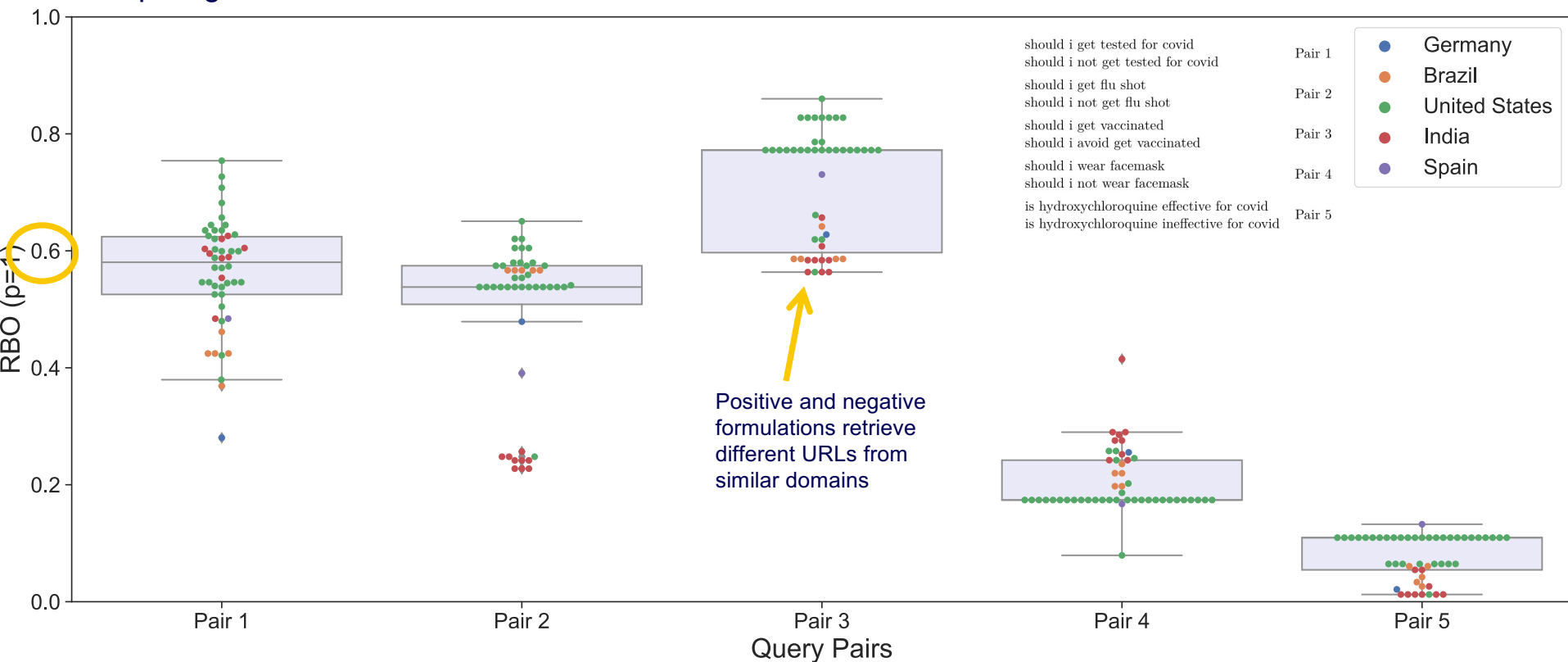
Does Query Formulation Change SERPs?

Comparing Items at URL level

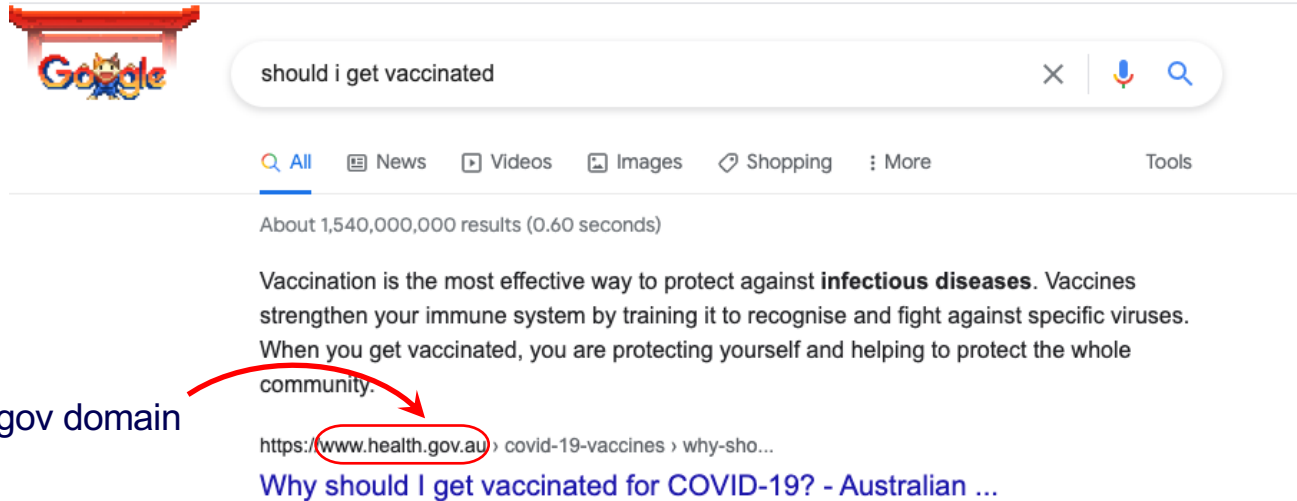


Does Query Formulation Change SERPs?

Comparing Items at domain level



[EXTRA] Quality of Information Sources



The screenshot shows a Google search interface. The search bar contains the text "should i get vaccinated". Below the search bar, the results are displayed. The first result is from the Australian Government Health Department, with the URL "https://www.health.gov.au/covid-19-vaccines/why-should-i-get-vaccinated-for-covid-19-". The text of the result is "Vaccination is the most effective way to protect against **infectious diseases**. Vaccines strengthen your immune system by training it to recognise and fight against specific viruses. When you get vaccinated, you are protecting yourself and helping to protect the whole community." A red arrow points from the ".gov domain" text to the "www.health.gov.au" part of the URL, which is circled in red.

Google

should i get vaccinated

All News Videos Images Shopping More Tools

About 1,540,000,000 results (0.60 seconds)

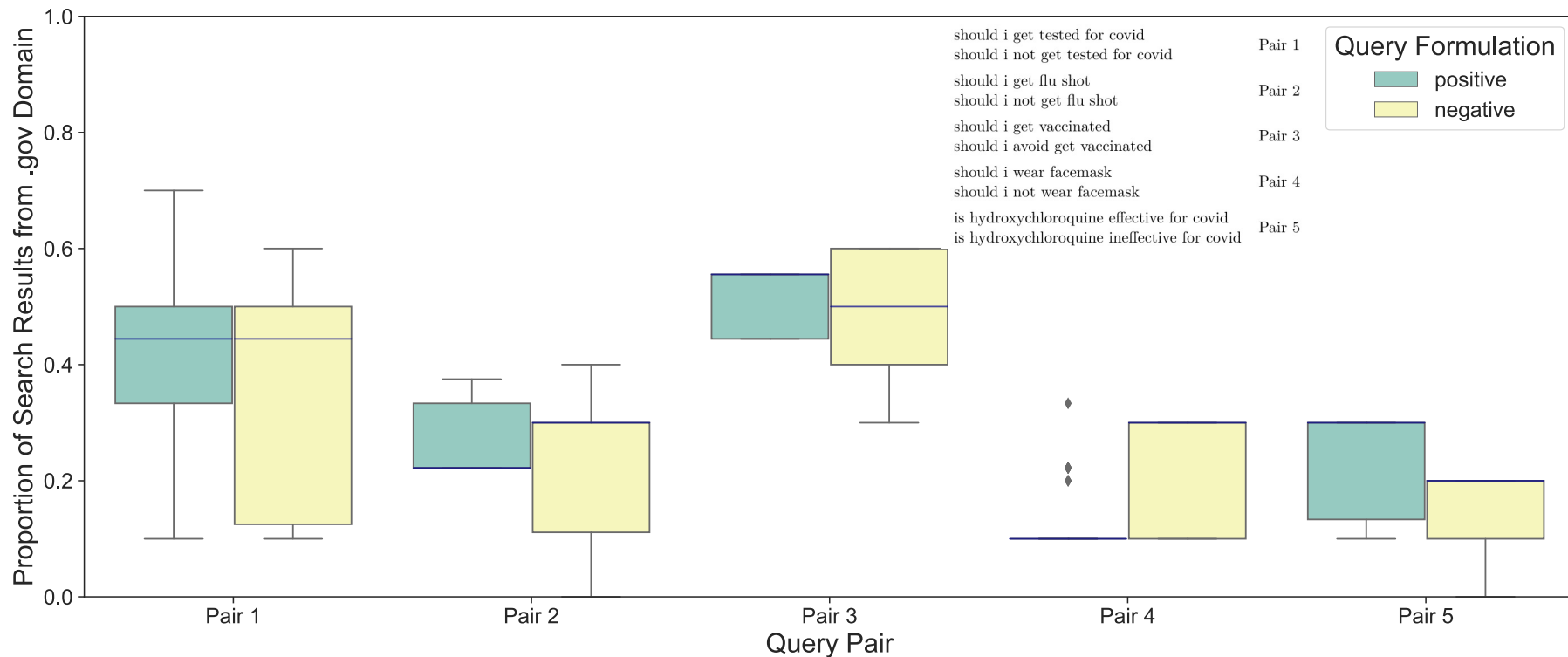
Vaccination is the most effective way to protect against **infectious diseases**. Vaccines strengthen your immune system by training it to recognise and fight against specific viruses. When you get vaccinated, you are protecting yourself and helping to protect the whole community.

<https://www.health.gov.au/covid-19-vaccines/why-should-i-get-vaccinated-for-covid-19-> covid-19-vaccines › why-should-i-get-vaccinated-for-covid-19- ...

Why should I get vaccinated for COVID-19? - Australian ...

.gov domain

Items from .gov Domain in SERPs



Conclusion

Conclusion

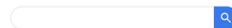
- We used a crowdsourcing platform to audit a web search engine (black-box system)
 - Preliminary study
 - We observed differences in the SERPs obtained by crowd workers / participants

RQ1. Do different users get the same search results?
Yes, due to contextualization (country of residence)

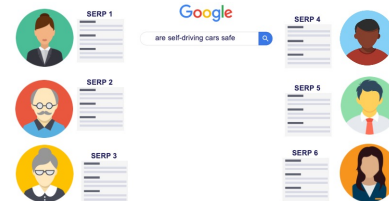
RQ2. Do results vary between positive and negative query formulations?
Yes, and some query formulations have more effect than others.
- Our study validates the feasibility of this approach
 - A more scalable (but less controlled) methodology than *data donation* approaches (e.g., the ADM+S Australian Search Experience project)
 - Future work: Larger query set & number of workers

amazon mechanical turk

Google



Search
Engine
Results
Page



A Crowdsourcing Methodology to Measure Algorithmic Bias in Black-box Systems: A Case Study with COVID-related Searches

Paper: bit.ly/crowdsourcing-algorithmic-bias

Data: github.com/rmit-ir/crowdsourcing-algorithmic-bias



binh.le@rmit.edu.au

damiano.spina@rmit.edu.au

falk.scholer@rmit.edu.au

chia.h@unimelb.edu.au

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