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Authors (Name and Partner Institution)	Maria Kasinidou (OUC) Styliani Kleanthous (OUC) Monica Lestari Paramita (USFD)
Contributors (Name and Partner Institution)	Frank Hopfgartner (USFD) Jahna Otterbacher (OUC)
Reviewers	Veronika Bogina (UH) Nandu Chandran Nair (UNITN)
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Abstract

This document describes the process for designing, implementing and evaluating the CyCAT: Bias Intervention tool. This deliverable is part of WP5, which focused on designing and developing interventions for bias awareness. Both USFD and OUC contributed to this deliverable.

Keyword(s): Bias Awareness, Visualization Tool, Intervention, Information Access.

Contents

1. Executive Summary
2. Participatory approach for designing bias aware search engines
3. Development of Tool-based Intervention
4. CyCAT: Bias Intervention Tool Evaluation
5. Conclusion

1. Executive Summary

As described in CyCAT's DoA the goal of WP5 is to implement and evaluate a selection of the "solutions on paper" that were developed in WP4. In D5.5, we provided a brief description of a prototype tool/software, of the type "demonstrator". In this deliverable D5.6, we provide a detailed description of the design, implementation and evaluation of the CyCAT: Bias Intervention tool. The sections that follow will provide all necessary information for the reader to understand the process followed by the CyCAT researchers in understanding the user needs and evaluating a number of prototypes, before moving into the development of the CyCAT: Bias Intervention tool. The evaluation of the tool was done via a user study, where students from OUC and partner institutions were involved and focused on the usability of the tool and the effectiveness of the design features selected. Finally, according to the results, overall recommendations for future work are provided.

2. Participatory approach for designing bias aware search engines

A prototype of the final tool-based intervention was published in D5.5. A few updates have been applied to the prototypes to provide users with better visualisation and reranking features. In this section, we describe the user studies that led to the final design of the tool.

2.1. Prototypes Design

Prior to developing the tool-based intervention, we adopted a participatory approach for designing the system by organising three (online) user studies with participants located in different countries, namely Israel, Italy, and Cyprus. A total of 18 participants took part in these studies, all of them were students of The University of Haifa, the University of Trento and the University of Cyprus, respectively. Most of the participants (13) identified themselves as male, four participants were female, and one preferred not to say. Sixteen people were between 18–30, and two between 31–50. Five students were enrolled in a Bachelor Degree program, and the rest were postgraduate students (Masters and PhD). Most students came from a Computer Science background, and one studied Business Administration.

We started the online sessions by giving a brief introductory presentation on bias in information retrieval (IR), followed by an overview of the impact of bias on search engine users and some examples of political and gender bias. We then asked participants to work in small groups (2-4 members) and to imagine that they are using a news search engine to look for a topic and asked them to complete two activities: a) to identify a list of biases that, in their opinion, should be highlighted by search engines, and b) to create a design (mock-up interface) to visualise these biases in search results to the users.

2.2. Bias-aware prototypes

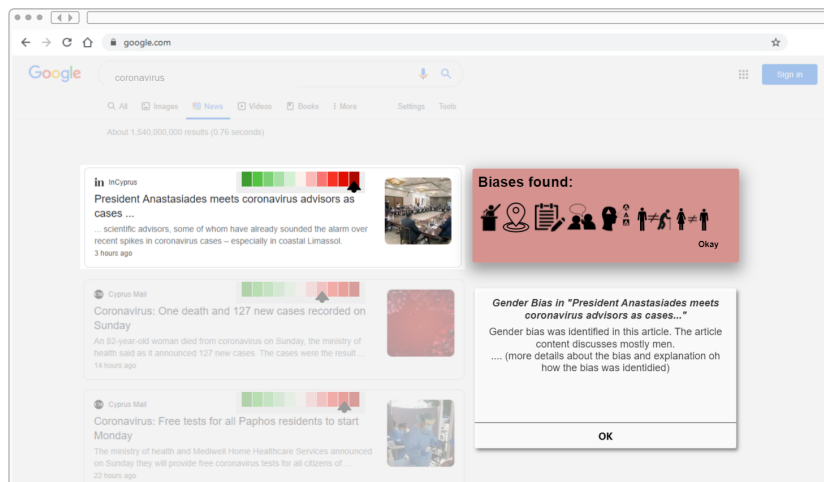
We collated all designs from the three sessions, removed similar designs, and selected eight distinctive designs of bias-aware systems. We developed them into high-fidelity prototypes using [Proto.io](#). The eight prototypes have different features and allow different levels of user control. We categorised them using two approaches. The first approach is bias-visualisation and aims to inform users of any biases found in the results and contains four prototypes:

- System 1 (Figure 1a) informs users of the bias in each article in the form of a bias meter.

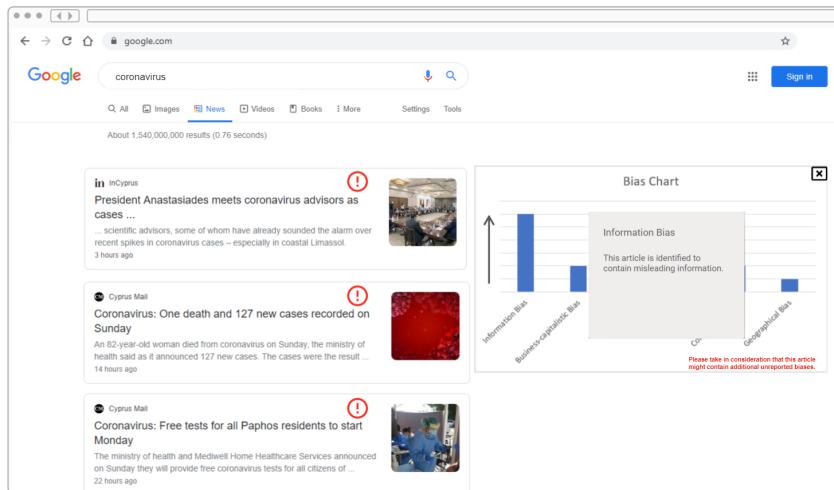
- System 2 (Figure 1b) allows users to see the bias level of each type (e.g., political bias, gender bias) for each document in the form of a graph.
- System 3 (Figure 1c) informs users of a related aspect not included in the article.
- System 4 (Figure 1d) hides the content of a biased article.

The second approach is results-reranking and aims to rerank the original search results to either reduce biases in the results, or to allow users to gather a new set of results based on their preferences and contains four prototypes:

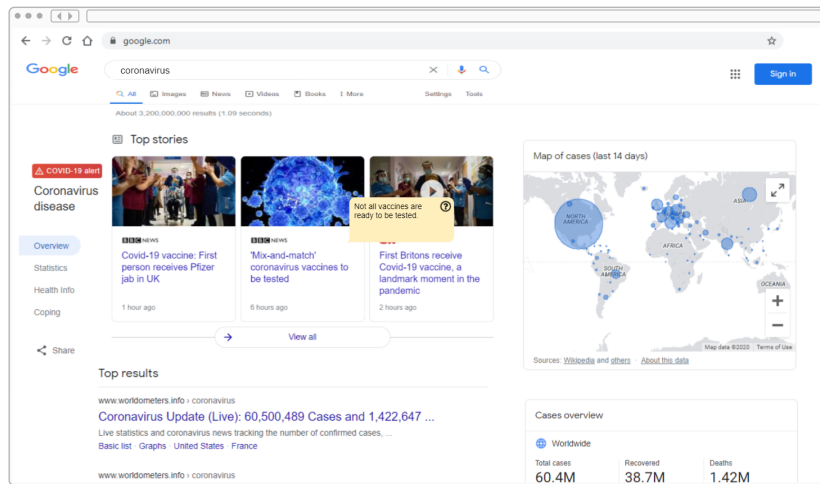
- System 5 (Figure 1e) allows users to automatically retrieve a new set of results that contains only unbiased content by clicking a different search button.
- System 6 (Figure 1f) allows users to modify the search results by manually specifying a biased aspect they would like to retrieve in the results (e.g., viewing articles that have “left-wing”, “right-wing” bias).
- System 7 (Figure 1g) allows users to modify the search results by manually specifying the amount of bias they would like or allow to exist in the results for all bias types (e.g., political bias, information bias, gender bias).
- System 8 (Figure 1h) automatically reranks the results to include articles from alternative viewpoints. For example, when users search for “vaccines”, the results will include articles describing how vaccines will end the pandemic, and those reporting an opposite viewpoint, such as that vaccines are not enough to end the pandemic.



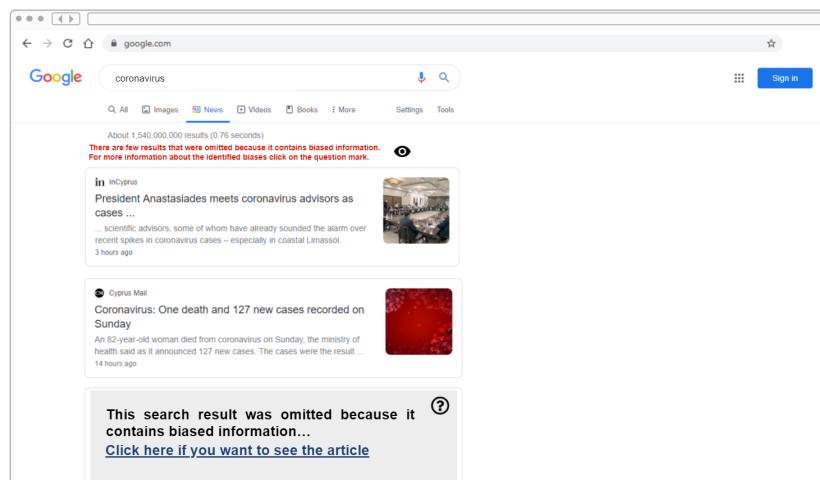
(a)



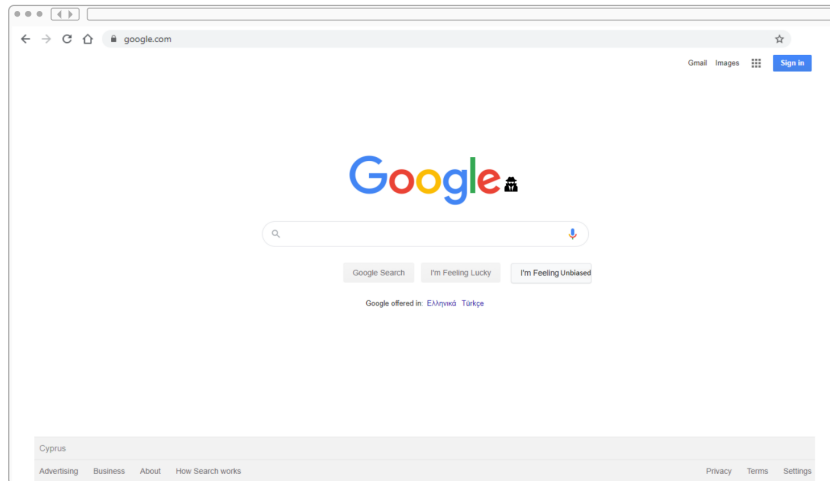
(b)



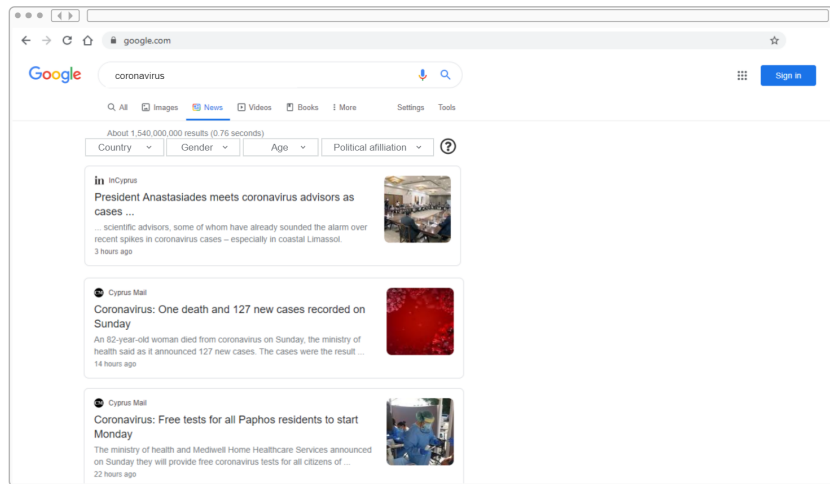
(c)



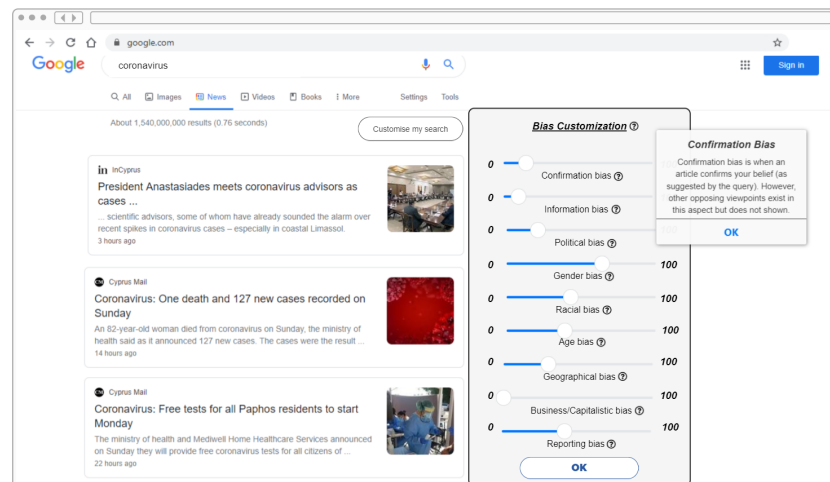
(d)



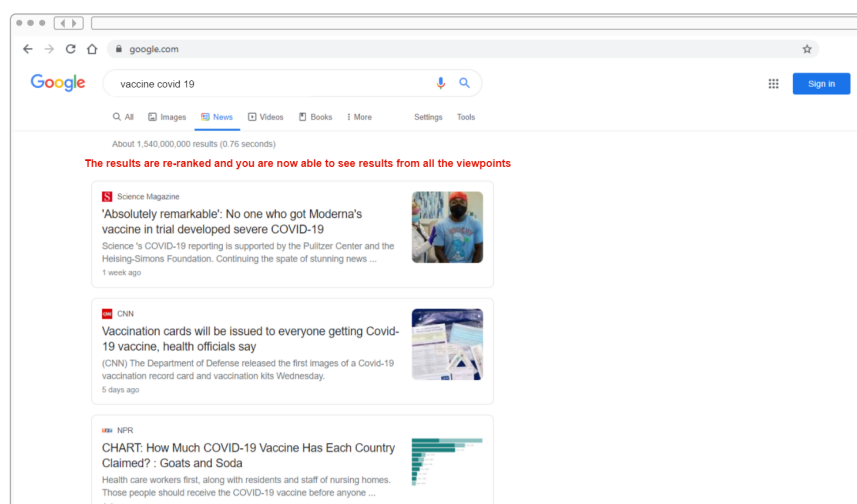
(e)



(f)



(g)



(h)

Figure 1: Bias-aware prototypes.

2.3. Evaluation of the prototypes

Three small-scale user studies were run for evaluating the eight prototypes. We conducted a mixture of lectures and evaluation activities in the three studies. The three studies contain the following four parts:

1. Introduction to bias: a brief background of bias in search engines.
 2. Demo of prototypes: a demonstration of the prototypes, how to use them, and what features are provided by each prototype.
 3. Evaluation task: participants were asked to interact with the prototypes and fill in an online questionnaire for evaluating the prototypes and the two approaches.
 - a. How would bias visualisation/reranking approach influence your information seeking task? (open-ended question)
 - b. How would you rank the bias visualisation/reranking prototypes (Rank1=best, Rank 4=worst)?
 - c. Which approach would you like to see implemented by Web search engines?
 4. Discussion: participants were invited to discuss their ranking of prototypes and their preferences of approaches with the class.
- Study 1: The first study included 60 postgraduate students from the University of Sheffield. The evaluation session was run as part of the Information Retrieval module in the Information School (Information Management programme). In this study, participants first worked individually and they were asked to provide feedback for the eight prototypes by filling out an online questionnaire. A total of 49 students out of 60 filled in the questionnaire. The second evaluation task was carried out as group work in synchronous online sessions. A total of 26 groups (2–4 participants, an overall of 60 participants) participated in the group evaluation task.
 - Study 2: The second study included 56 undergraduate students from the Polytechnic University of Valencia. The evaluation session was run as part of the module Natural

Language And Information Retrieval in the Data Science programme. In this study, participants worked individually, resulting in a total of 56 individual responses.

- **Study 3:** The third study included 11 undergraduate students from the University of Cyprus. The evaluation session was run as part of the module Explorations into Computer Science module, a mandatory course for Computer Science students. In this study, participants worked individually, resulting in a total of 11 individual responses.

All sessions were run online due to COVID-19 restrictions.

Based on the evaluation results, we identified several aspects that participants highlighted to be important across the different designs:

- *Awareness of biases in the results.* Participants valued the ability to see the overall bias score for each article. However, they also noted that some articles might have a high bias score for one type but low/no bias for a different type; providing an overall bias score only would lose this information. Hence, participants also would like to see the degree of each bias type for each article.
- *Ability to access items out of their filter bubbles.* Participants also valued the results-reranking approach as it allows them to access new results.
- *Transparency of methods used to measure bias.* Some participants raised the issue that it was unclear how the biases were measured and whether possible subjectivity might have been included in these tasks. Participants further noted their concerns that visualisation or re-ranking methods might limit their access to certain information and compromise the search engine quality. Our findings further highlight the importance of transparent and clear definition of these methods in order to avoid introducing more bias in the results.
- *Ease-of-use.* Whilst participants preferred more control for customising search results, these features were also identified to increase the complexity of the system and may reduce the ease-of-use of the system. A balance between the systems' complexity and ease-of-use will need to be prioritised for future systems.

3. Development of Tool-based Intervention

In this section, we discuss the development of the bias aware system. The final system can be accessed in the following link: <https://cycat.group.shef.ac.uk/prototype/v1.3/>

3.1. Final design of the bias aware system

We incorporated the feedback from the user studies into the design of the CyCAT: Bias Intervention tool, providing both the bias visualisation feature (i.e., displaying the types of biases) and the results-reranking feature (i.e., allowing users to re-rank the results using the aspects they specified). Due to the availability of methods for measuring biases, we selected only four aspects to be included in the CyCAT: Bias Intervention tool, i.e., political bias, geographical locations of the publishers, geographical focus of the articles, and the entity focus of the articles.

Furthermore, all the designs that were submitted in the user studies focused on displaying bias for each article. Previous studies, such as Papadakos & Konstantakis (2020)¹, have also explored the importance of displaying bias for the entire search results. We adopted this idea and incorporated aggregated bias information at the search results' level. We further described the workflow of the resulting CyCAT: Bias Intervention tool in Section 4.3.

3.2. Workflow of the CyCAT: Bias Intervention tool

The CyCAT: Bias Intervention tool developed in the CyCAT project focuses on the news domains, specifically for COVID-19 queries. The workflow for the CyCAT: Bias Intervention tool is illustrated in Figure 2.

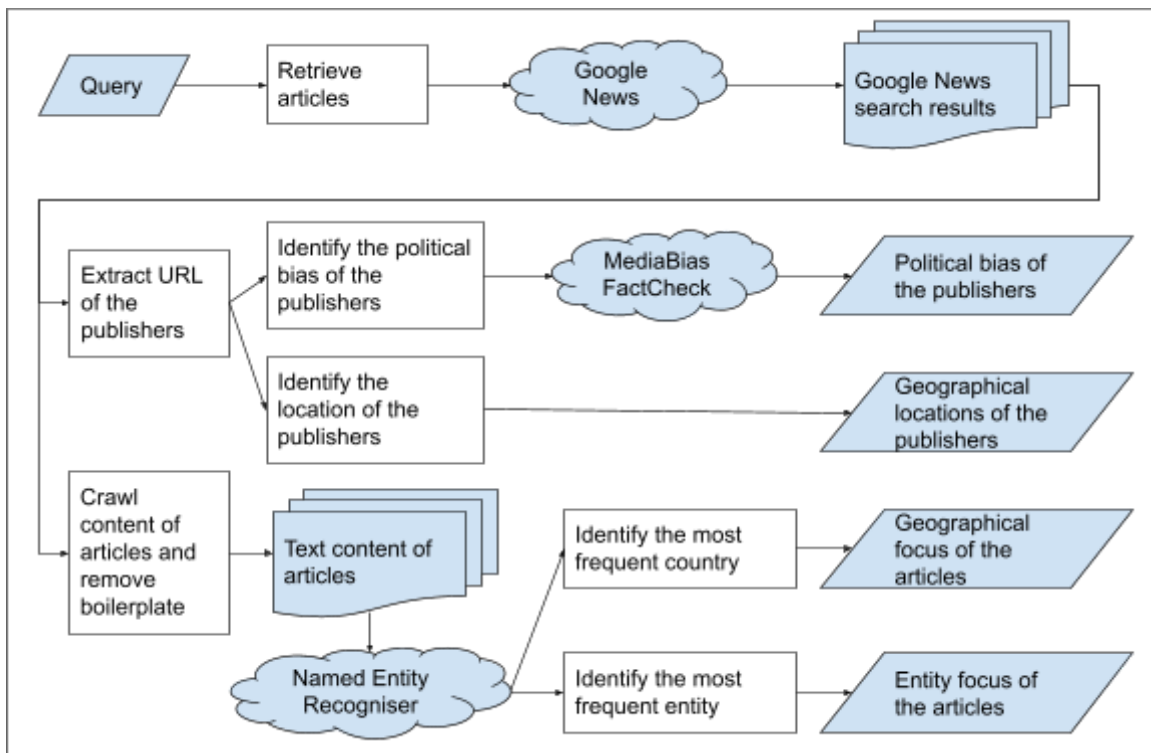


Figure 2: Workflow of the CyCAT: Bias Intervention tool.

We selected four popular queries related to the COVID-19 pandemic, namely “coronavirus”, “covid”, “coronavirus lockdown” and “covid vaccine”. These queries were identified as the most popular queries by Google Trends in February 2021. Using these queries, we retrieved 100 news articles returned by Google News using the Zenserp API². For the purpose of this study, we only retrieved news articles returned by Google News for a user based in the UK. This process is conducted daily to allow users to access the most updated news articles using the CyCAT: Bias Intervention tool.

¹ Papadakos, P., & Konstantakis, G. (2020). bias goggles: Graph-Based Computation of the Bias of Web Domains Through the Eyes of Users. In J. M. Jose, E. Yilmaz, J. Magalhães, P. Castells, N. Ferro, M. J. Silva, & F. Martins (Eds.), *Advances in Information Retrieval* (pp. 790–804). Springer International Publishing.

² <https://zenserp.com/>

Zenserp API returns the following information for each article:

- title of news article
- URL of the news article
- date of the article
- source (i.e., the name of the publishers)
- description (i.e., snippets of the article content)
- thumbnail

For each article, we carried out processes to identify bias information of the article. We extracted the URL of the publisher from the URL for the news articles. We *identified the political bias of the publishers* by utilising an external source (Media Bias/Fact Check), which annotated the bias based on the publishers' i) political affiliations, ii) story choices (if they publish from both sides or just one), iii) use of biased wording to sway readers, and iv) rates of factual reporting. By August 2021, Media Bias/Fact Check has annotated 3,103 news publishers using five different rating to represent the political bias: "left" represents a liberal view, "left-center", "center/least biased", "right-center" and "right" represents a conservative view. It has further used four categories to represent sites that are considered to be "questionable sources", "pro-science", "satire" or containing "conspiracy-pseudoscience". These ratings were extracted to represent the "political bias of the publishers" in the CyCAT's bias aware tool. The political bias of all the news articles displayed in the results is aggregated and represented in a bar chart (see Figure 3) to allow readers to get some insights into the possible bias presented in their search results. For cases where publishers were not included in the MBFC database, the political bias is listed as "unknown".

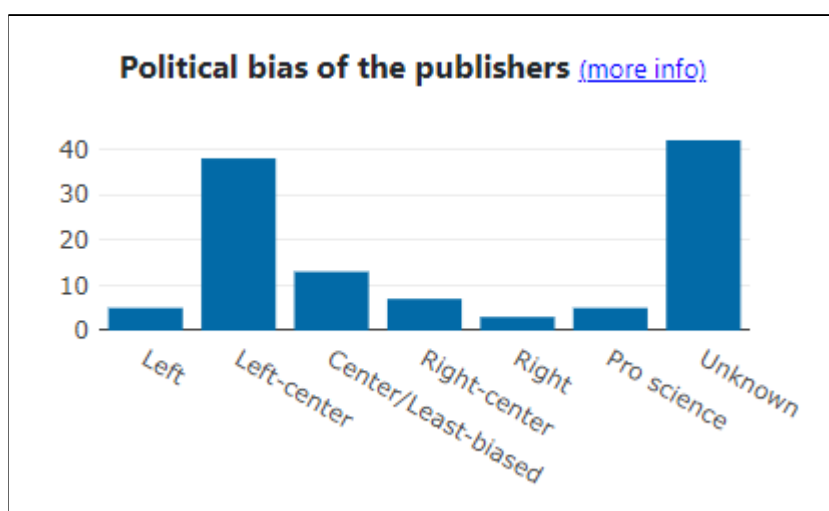


Figure 3: Political bias of the publishers.

We further determined *the location of the publishers* by analysing the suffix of the URL (e.g., "bbc.co.uk" is based in the UK, "abc.net.au" is based in Australia). If this information is not available, we used 'whois' command to identify the country where the domain is registered. Similarly, this information is aggregated for all the search results and is displayed using a choropleth map (see Figure 4). Since this tool is not fully implemented, not all countries/nationalities were considered for article inclusion.



Figure 4: Geographical locations of the publishers.

We used Scrapy to crawl the content of the articles³ and removed boilerplates (e.g., advertisement, related articles, etc.) using **justext** library in Python, resulting in the main text content of the articles. We used a named entity recogniser (*spaCy*, trained using the *en_core_web_trf* model) to identify country names and entities discussed in each article. The most frequent country is selected as *the geographical focus of the article*. Similarly to the locations of the publishers, this information is also displayed at the search results level using a choropleth map (see Figure 5).

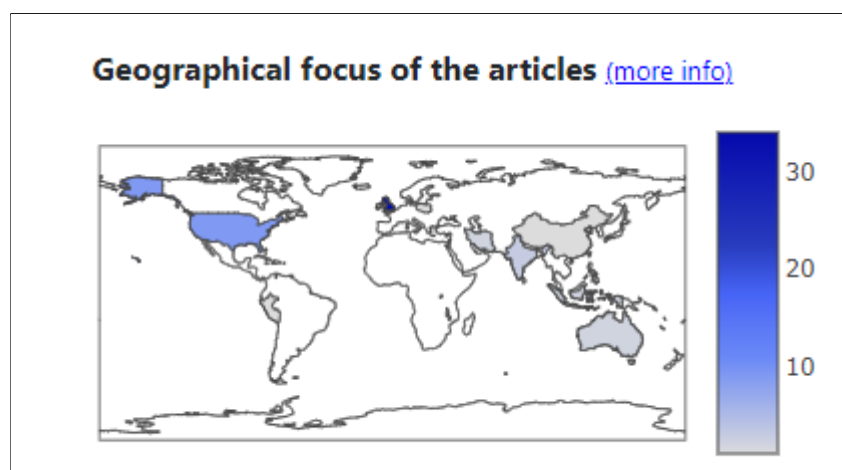


Figure 5: Geographical focus of the articles.

Finally, we selected the most frequent entity discussed in the article as *the entity focus of the article*. If multiple entities had the same frequency, one was chosen randomly as the entity focus of the article. This information is aggregated for all the search results and the top 10 most popular entities are shown in a bar chart. E.g., Figure 6 shows the most popular entities for the query: “covid vaccine”. This includes popular vaccine manufacturers, such as “Pfizer”, “Moderna” and “AstraZeneca”, and also relevant UK government and health entities such as “Joint Committee on

³ In some cases, articles could not be automatically crawled and therefore could not be processed in this stage.

Vaccination and Immunisation” (JCVI), Medicines and Healthcare products Regulatory Agency (MHRA) and National Health Service (NHS).

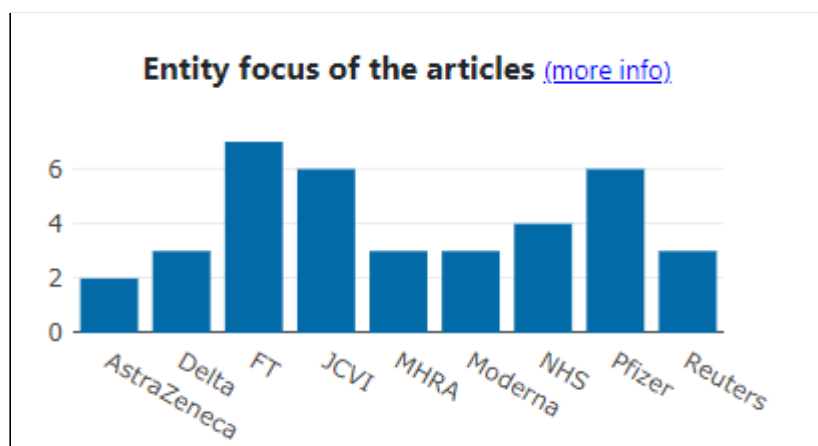


Figure 6: Entity focus of the articles.

Due to the amount of processing required to identify these aspects, the documents were pre-processed offline. This information was stored in a MySQL database, which was then retrieved and displayed to the users when they used the CyCAT’s bias aware system to search for news articles.

3.3. Design of CyCAT: Bias Intervention tool

When users access the link for the CyCAT: Bias Intervention tool, they are asked to enter a query: “coronavirus” to start searching (Figure 7). Once the user submits the query, the system will display the search results and the *bias visualisation features*, which provides information for each search result (shown on the right side of each article, see Figure 8), and the aggregated results (shown on the right side of the page, see Figure 9).

We also incorporated the *results-reranking features* in these figures, allowing users to view only documents from specified political bias, countries of entities. Users can rerank the features by clicking the aspect they would like to see further. E.g., by clicking “Left-center” on the political bias figure, the results will be updated to contain only articles from news publishers identified to have a “left-center” bias. Similarly, if users click on the country “Australia” in the “geographical focus of the articles” graph, users will then be able to view only those articles reporting COVID-19 in Australia.

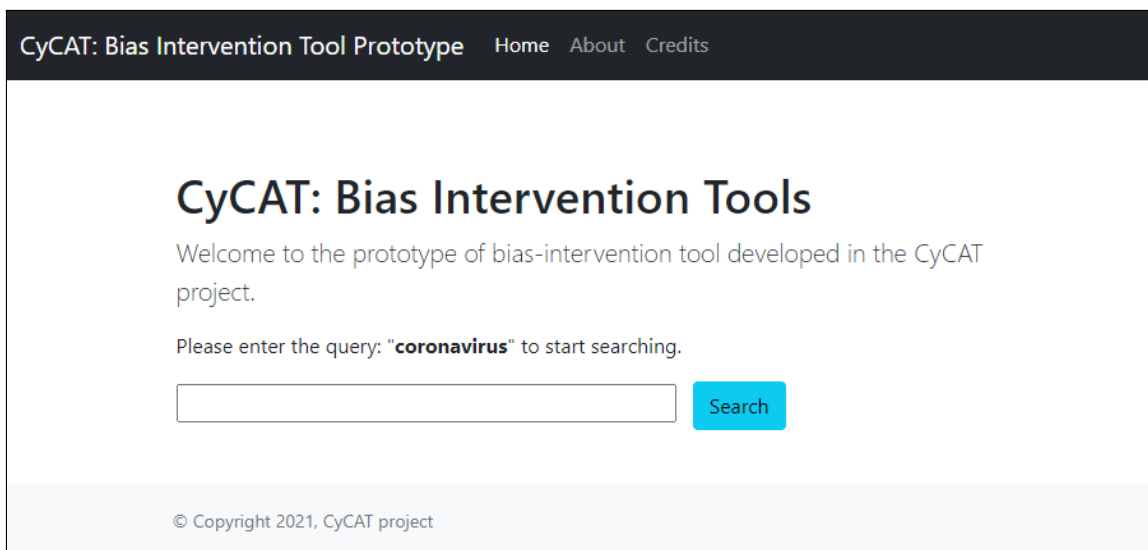


Figure 7: Main page of the CyCAT: Bias Intervention tool.

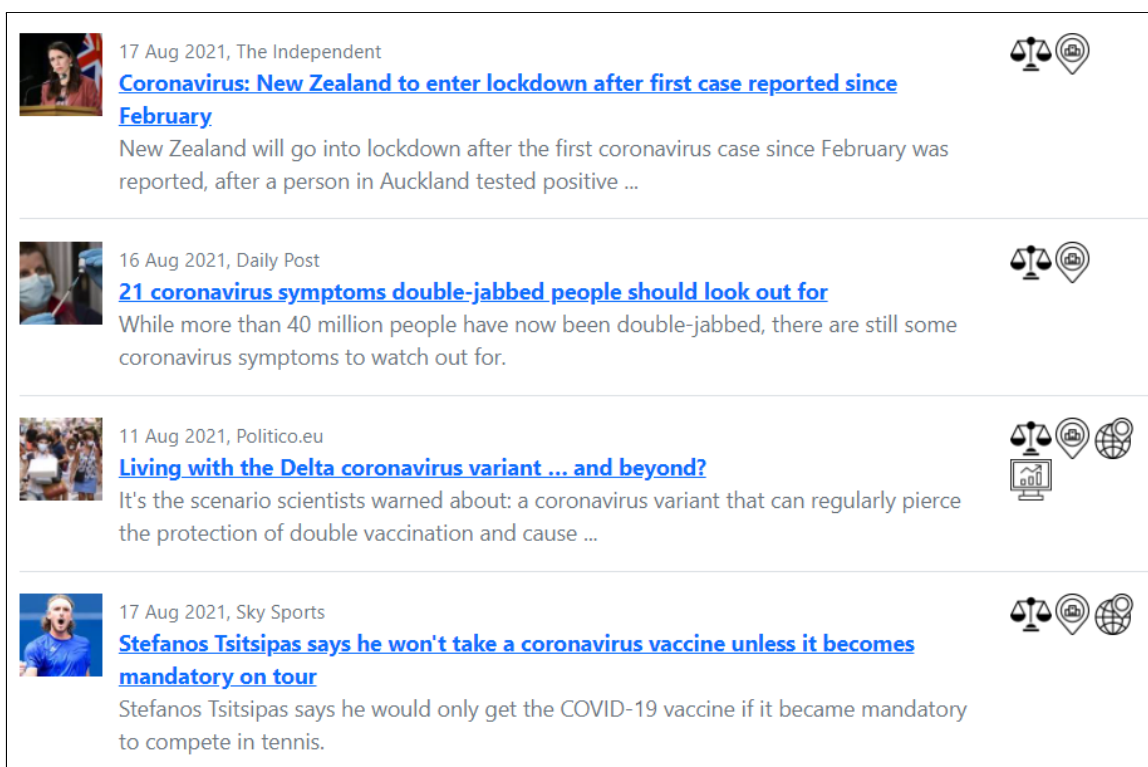


Figure 8: Bias information shown for each article.

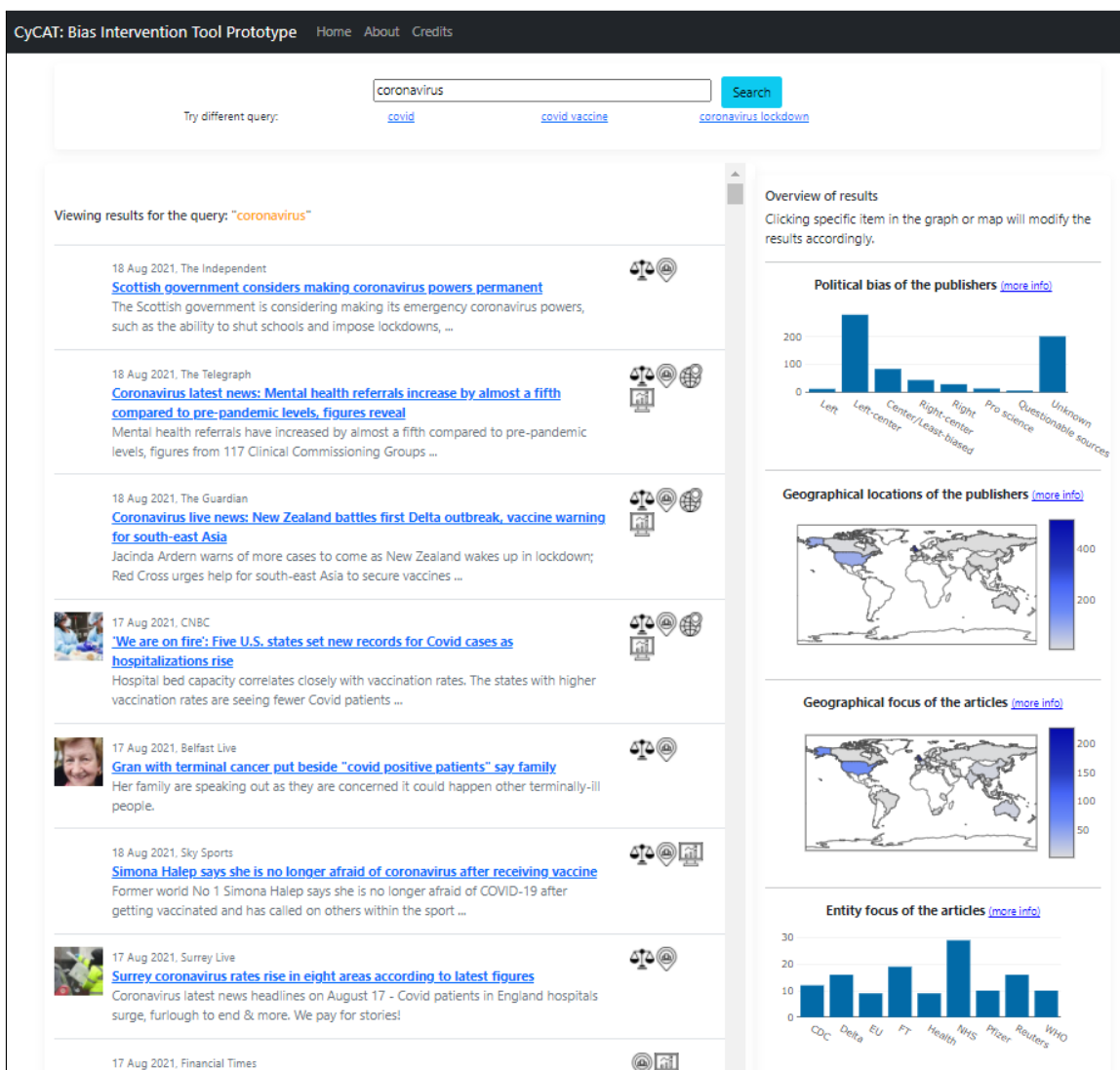


Figure 9: Overall search results for the query: “coronavirus” (aggregated results shown on the right-hand side).

4. CyCAT: Bias Intervention Tool Evaluation

The evaluation of the CyCAT: Bias Intervention Tool, took place between October and November 2021. A study was designed based on basic human computer interaction principles for evaluating the usability of the tool and the overall user experience, including the effectiveness of the icons and prompts used in the above prototype.

4.1. Methodology

In order to evaluate the usability of the tool, the System Usability Scale (SUS)⁴ was employed as part of a questionnaire that was distributed to OUC students and CyCAT’s social media. In addition to SUS, the questionnaire consisted of demographics questions (age, gender, country), questions related to the year and program of study - if the participant is a student, and questions

⁴ <https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html>

related to their knowledge regarding bias in search results and the frequency in which they use search engines. Specifically, the following questions were asked:

- How often do you use a Search Engine during the day for finding articles/information?
- How knowledgeable are you regarding bias in search results?

Furthermore, specific questions were asked, regarding the design decisions that were taken: the use of icons that represented major features of the tool (e.g., “*The icon used (appearing next to each article) for the following aspect was representative.*”), as well as, the information provided regarding the features of the tool (e.g., “*The information provided for the following aspect (by hovering on the icon) was sufficient for understanding its use.*”) and the filtering feature provided (e.g. “*The filtering feature (by clicking the graph/figures selecting one option) was useful to complete the search task.*”). The full questionnaire is attached as an Appendix to this deliverable.

Participants

In total 21, participants replied to the questionnaire, of them 38.1% males and 61.9% females, with the ages ranging from 18 to over 40 years old (see Figure 10 (down) for more details), while the majority were coming from Cyprus (42.9%) and Greece (47.6%) followed by France and Italy (4.8% from each) (Figure 10). The majority of the participants were students in a postgraduate Masters degree, while 14.3% were not students (Figure 10).

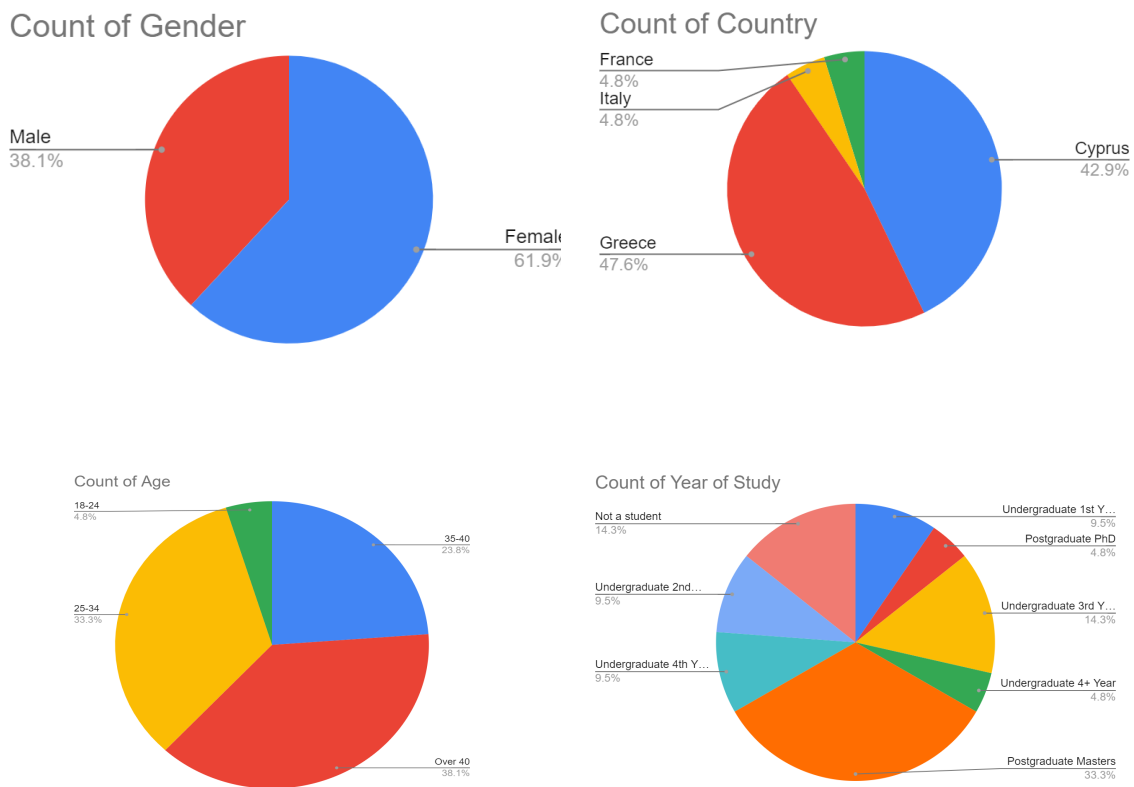


Figure 10: Participants’ gender (left upper), country (right upper), age (left down) and student status (right down) in percentages.

4.2. Results

Use of Search Engines and Knowledge of Bias in Search Results

Before we ask the participants to use the CyCAT: Bias Intervention tool, we wanted to know how frequently they use search engines for finding information and their knowledge regarding bias in search - “How often do you use a Search Engine during the day for finding articles/information?” selecting from the following options:

- More than 10 time a day
- More than 5 times a day
- At least once a day
- At least once a week
- Less than once a week

and “How knowledgeable are you regarding bias in search results?” where they provided a 5-point likert scale (1, Not knowledgeable at all - 5, Very knowledgeable) to select from.

47.6% mentioned that they use a search engine more than 10 times a day for searching for articles and other information. The rest of the results can be found in Figure 11.

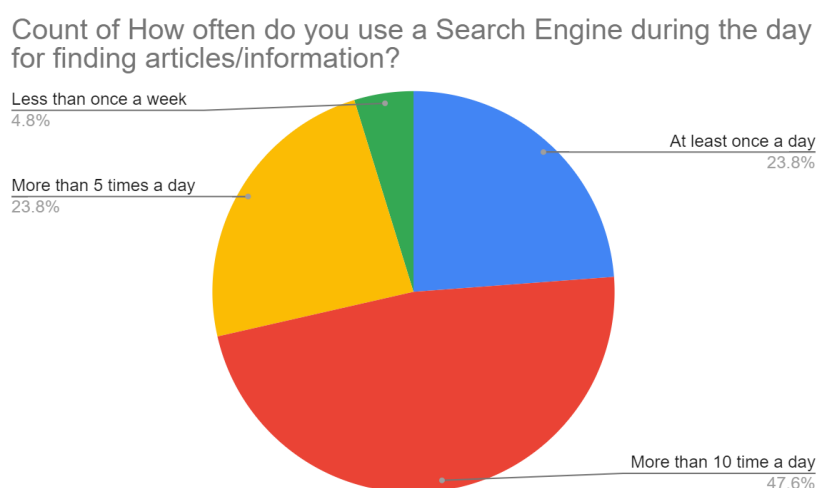


Figure 11: Frequency in which participants are searching for articles/information through a search engine.

Regarding the self-assessment about their knowledge on bias in search results, 47.6% of the participants selected the upper options of the scale (4-5) indicating that they are very knowledgeable or knowledgeable about this issue. 19.04% selected the lower end of the scale (1-2) indicating that they are not knowledgeable at all on the topic and the rest selected the middle option 3.

Effectiveness and usefulness of design features

As mentioned earlier we were interested in evaluating the specific design features and information provided in the tool for bias awareness. Thus, we asked participants to state their opinion for the design decisions for representing: i) the geographical location of the publisher, ii) geographical focus, iii) political bias of the publisher, and iv) entity focus, using a 5-point likert scale (1 Strongly Disagree - 5 Strongly Agree):

- the icons used for indicating a specific bias of the article,
- whether the information provided when hovering on the icon for the above aspects was sufficient for understanding its use,
- the usefulness of the bias graph/figures for the above aspects for getting an overview of potential bias,
- the usefulness of the filtering feature provided in completing the search task.

Firstly, we evaluated the icons used for representing the four biases (Figure 12). 33.3% of the participants selected the upper end of the scale indicating that the icon used for the political bias of the publisher is representative. The majority, however (42.8%) selected the middle value of the scale (3) indicating that probably the graphical representation might not be so obvious. 23.8 % of the participants selected the lower end of the scale, which is an indication that they did not find the use of the specific icon as representative.

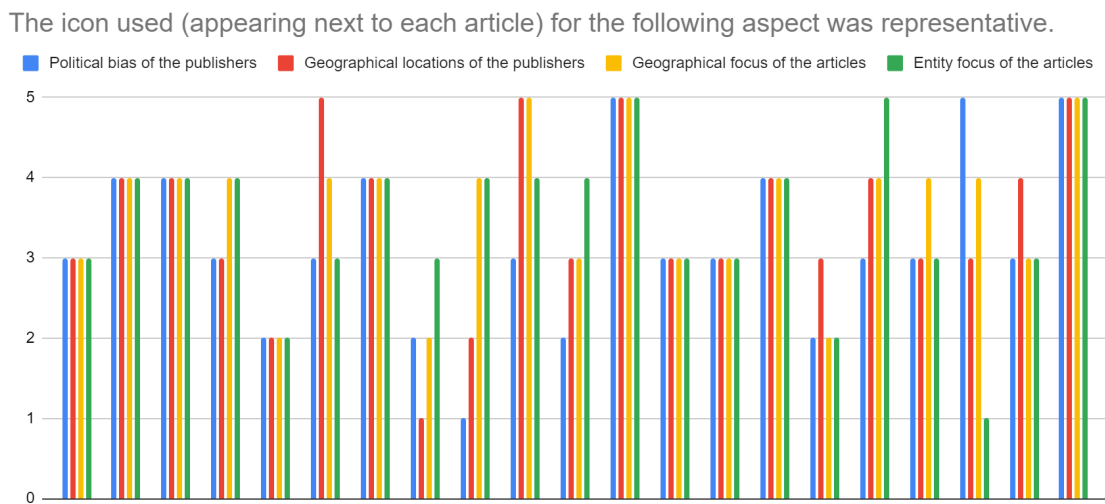


Figure 12: Participants' opinions on the icons used for representing the specific biases. The x-axis represents the answers of each participant.

Participants in their majority (47.6%) selected the upper end of the scale regarding the icon representing the geographical location of the publisher, while only 14.2% selected options 1 and 2, to indicate that the icon was adequately representing its purpose. Similarly, for the geographical focus of the article icon, 61.9% of the participants indicated that the icon was representative. 52.3% of the participants agree that the icon used for the entity focus of the article was representative, with only 14.2% (3 participants) selecting the lower ends of the scale. Figure 14 provides an overview of the above results.

An important communication aspect is the information provided to the user when hovering over important design items. In the case of the CyCAT: Bias Intervention Tool, it was important to evaluate whether the information provided when hovering over the bias representation icons was sufficient. 57.1% of the participants agree that the information provided for the political bias of the publisher was sufficient, as they are for the information regarding the geographical location of the publisher (52.3%). Similar results were extracted for the information on, geographical focus

of the article (52.3%) and the entity focus of the article (42.8%). Figure 13 provides more information.

The information provided for the following aspect (by hovering on the icon) was sufficient for understanding its use.

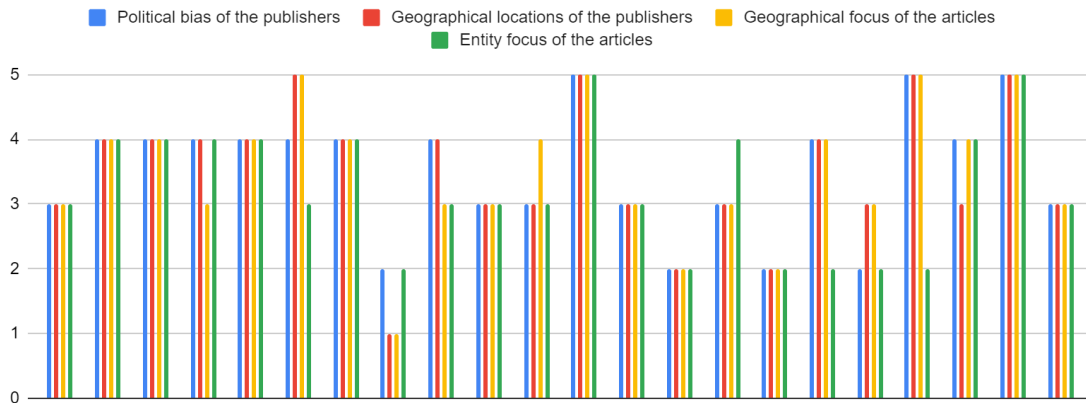


Figure 13: Participants’ responses on the information provided by hovering on the icons used for representing the specific biases. The x-axis represents the answers of each participant.

Graphs and figures were employed as a feature for providing an overview of potential biases in the search results. Overall, most of the participants appeared positive by selecting the upper ends of the scale opinions (see Figure 14), while only 14.2% selected the lower ends of the scale for all design features.

The bias graph/figures for the following aspect was useful for getting an overview of potential bias in the search results in this task.

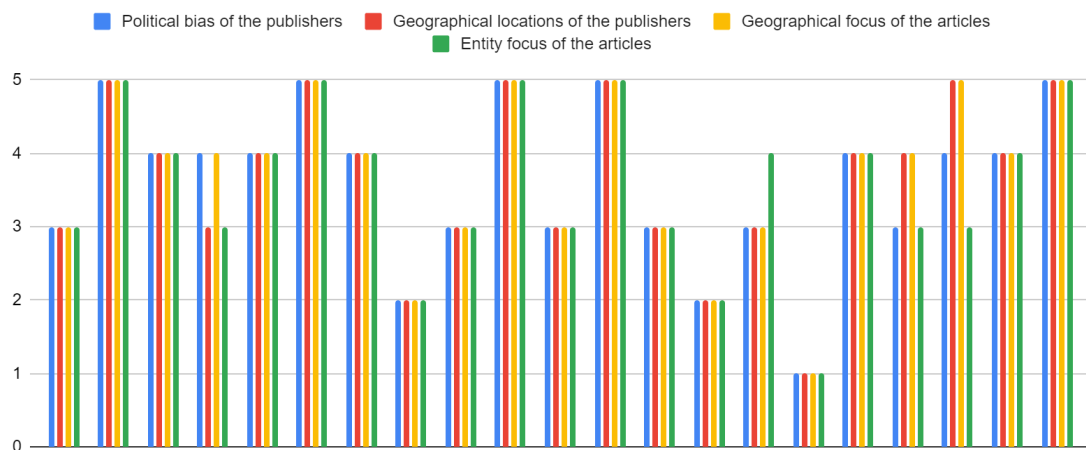


Figure 14: Participants’ responses on the graphs/figures for the different biases. The x-axis represents the answers of each participant.

It is equally important to understand whether the information provided for each graph/figure, for explaining to the user potential biases in the search results, was useful. The majority of the participants rated the information provided positively. Figure 15 provides the detailed results.

The information provided in the bias graph/figures for the following aspect (by hovering on it) was useful for getting a better understanding of potential bias in the search results in this task.

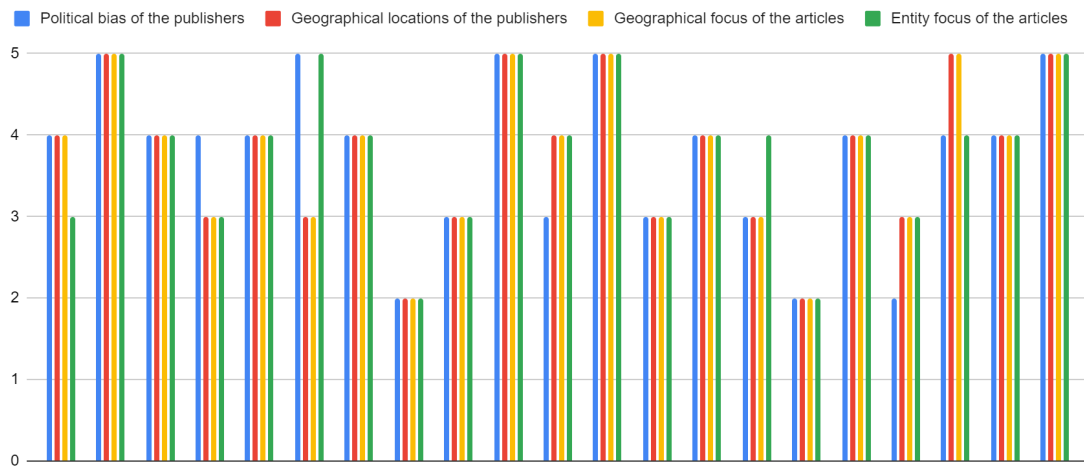


Figure 15: Participants’ responses on the information provided by hovering on graphs/figures used for representing the specific biases. The x-axis represents the answers of each participant.

The filtering feature for selecting one option when clicking on a graph/figure was also positively evaluated (Figure 16). We further asked participants whether they think that filtering feature might potentially allow the user to retrieve articles that only reflect their viewpoint, thus enforcing more biases. For all four biases (political bias of the publisher, 57.1%; geographical locations of the publishers, 42.8%; geographical focus of the article, 61.9% and entity focus of the articles, 52.3%) the majority selected options 4 and 5 in the scale indicating that they believe that this feature can potentially be used negatively.

The filtering feature (by clicking the graph/figures selecting one option) was useful to complete the search task

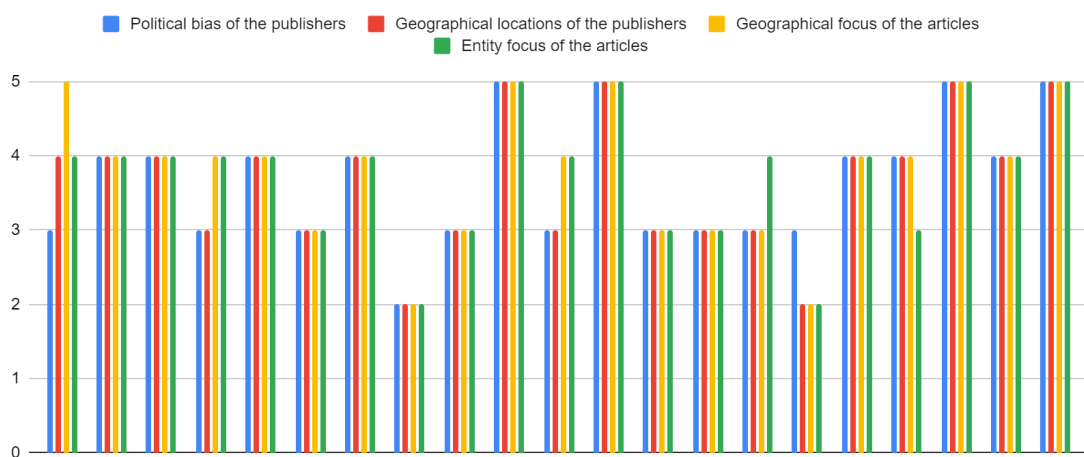


Figure 16: Participants’ responses on the filtering feature provided. The x-axis represents the answers of each participant.

We asked participants whether they would prefer to have only one of the design features provided (icons next to the article or graphs for visualizing and filtering bias in the results) or have a combination of both. 81% replied that they would prefer having both features available.

In order to understand how the participants would potentially use this system we asked them to indicate whether they would “use this app to search for: [a Person], [News articles in general], [News articles (local/current location)], [News articles (abroad/international)], [Health related topics], [Trending Topics], [Politics]”.

According to the results (Figure 17) participants would not probably use this system to search for a person (61.9% selected options 1-3 from the 5-points scale), however, the majority of the participants would use this tool to search for all other options we provided. Specifically, 71.4% indicated they would use it to search for news articles in general, 71.5% to search for news articles in their local/current location, 71.4% to search for news articles abroad/international, 57.1% to search for health related topics, 61.9% to search for trending topics and 57.1% to search for politics. We also asked participants to elaborate, however, the majority did not answer that question. One participant commented that “[I would search] only on controversial or difficult topics where bias plays an important role” (Participant 19 - P19).

I would use this app to search for:

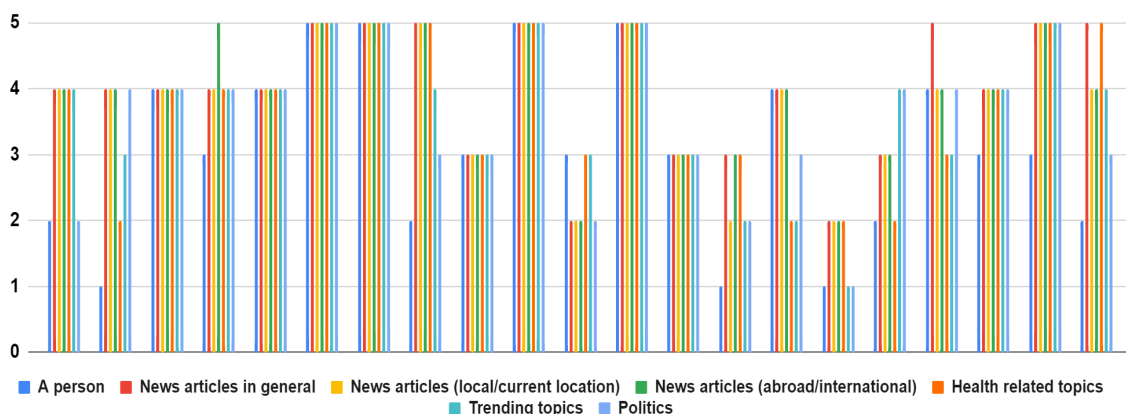


Figure 17: Potential use of the system. The x-axis represents the answers of each participant.

Usability Evaluation

The usability of the tool was assessed through the SUS questionnaire. The questionnaire consists of 10 questions and it is considered one of the most popular instruments for measuring usability. Since SUS is a standardized instrument, the results have been scored and analyzed according to the guidelines provided in the literature⁵ and a usability score of 64.3⁶ out of 100 has been achieved. Interpreting this number in terms of usability, we can conclude that the CyCAT: Bias Visualization tool achieved a moderately positive usability score. Looking deeper into the scores provided by the participants we can see that they tend to think that the tool was easy to use (Mean: 3.86, SD: 0.72), most of the people would learn to use the system very quickly (Mean: 3.43, SD 1.16) and they would like to use this system frequently (Mean: 3.76, SD: 0.83).

⁵ Brooke, J. "SUS-A quick and dirty usability scale." Usability evaluation in industry 189, no. 194 (1996): 4-7.

⁶ Anything above 50 is considered usable and anything above 80 is considered excellent in the SUS scores.

In addition to SUS we asked participants to “*List the three (3) most negative aspect(s)*” and “*List the three (3) most positive aspect(s)*”. Participants thought that the colors and presentation of information can be improved in order for the user to be able to comprehend the information “*user interface is not attractive, colors used not good, font style and size is not good*”(P9). Some of the participants commented on the clarity and complexity of the user interface and through that there was unnecessary detail in the way information was presented, “*Complexity, Lack of Clarity, Persistence on Detail*” (P8), “*too much information, need to check in many icons in order to get info, icons do not represent their meaning*” (P9), and “*More time needed to analyze the details Miss of focusing when you have so many details*” (P10).

In addition to the aesthetics of the interface participants also commented on the features provided for bias awareness: “*(1) it took 1-2 minutes to figure out how exactly the filters work; (2) the categories (left/right/etc.) seemed a bit random, e.g. a source can be both left-leaning and questionable; (3) I don't know how the political bias was calculated...*” (P19). Another participant noted that the tool might be complex for people who are not experts “*Might be a bit complex for people not so much familiar with those type of information*” (P20).

On the positive note, participants commented on the transparency the tool can potentially provide, as it was characteristically mentioned: “*Transparency of political views, General overview of the tensions in worldwide media,...*” (P10). The ease of use of the tool was also brought up as a positive aspect “*easy to use...*” (P12) as well as the potential of the tool if it is implemented in a larger scale “*would be amazing to see it work on a large dataset, not just 4 keywords; has good potential*” (P19).

Overall Recommendations

- The participants appreciated the icon feature, however, the icons used in this occasion were not very clear of the bias they meant to represent.
- Participants like having both features, visualising the biases for each article using the icons and the visualization of the existing biases in all articles using the graphs and being able to filter the results.
- The information provided for explaining both icons and figures, (by hovering over the respective feature), was adequate and appreciated by the participants.
- Having the filtering (e.g., selecting articles from specific sources) option, can potentially be used negatively as indicated by the results.
- Although the participants pointed out that the system would be useful and easy to use, they also mentioned that the tool at its current state is complex and provides to the user a lot of information resulting in cognitive overload.
- The overall usability score of the tool, according to the SUS instrument, was not very high, indicating that further work is needed in identifying how the overall design of the tool can be re-configured to aid usability and reduce cognitive overload.

5. Conclusion

The main goal of this deliverable is to provide more detailed information on the design and implementation of the CyCAT Bias Intervention Tool described in D5.5 and describe the methods

and procedures followed in evaluating the tool in a user study as well as discussing the main findings. The evaluation examined the attitudes of the participants towards the design decisions taken by the CyCAT researchers, particularly on the interface design of the tool and the overall usability of the tool. The results indicated that although some of the design features were very effective in providing bias awareness, some others were less effective and thus, further work is needed in understanding the user needs. This outcome is very important since it emphasizes the different needs that different user groups have when it comes to designing a system for providing bias awareness. Overall the participants believe that the system can be potentially useful, especially when searching for controversial topics. The usability score achieved is moderately above average in the SUS scale (CyCAT Bias Intervention Tool achieved a 64.3 out of 100) indicating that the tool is usable but further improvements might be needed when finalizing the tool into a fully functioning system.

APPENDIX I - Bias Intervention Tool Evaluation Questionnaire

Bias Intervention Tool Evaluation

You are invited to participate in a study designed to evaluate the bias-aware tool which aims to inform search engine user about potential biases in the search results.

Before taking part in this study please read the information below. When you are finished, click on the "I consent" option at the bottom of this page if you understand the statements and freely consent to participate in this study.

The study is anonymous.

Estimate 20 minutes for completion.

There are no risks to individuals participating in this study beyond those that exist in daily life.

To participate in this study you must be 18 years of age or older.

*Required

1. Participants Consent *

This study is conducted by researchers from the Cyprus Center for Algorithmic Transparency (CyCAT) project. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 810105. This study has received ethical clearance by the Cyprus National Bioethics Committee. By participating in this activity, you give your consent to use the data from your group discussion for research purposes.

Tick all that apply.

Yes, I give my consent for the CyCAT project to use our data for research purposes.

Demographics

2. Age *

Mark only one oval.

18-24

25-34

35-40

Over 40

3. Gender *

Mark only one oval.

- Female
- Male
- Prefer not to say
- Other: _____

4. Country *

5. Year of Study *

Mark only one oval.

- Undergraduate 1st Year
- Undergraduate 2nd Year
- Undergraduate 3rd Year
- Undergraduate 4th Year
- Undergraduate 4+ Year
- Postgraduate Masters
- Not a student

6. Program of Study

7. How often do you use a Search Engine during the day for finding articles/information? *

Mark only one oval.

- More than 10 time a day
 More than 5 times a day
 At least once a day
 At least once a week
 Less than once a week

8. How knowledgeable are you regarding bias in search results? *

Mark only one oval.

- 1 2 3 4 5
-
- Not knowledgeable at all Very knowledgeable

Evaluation
Task

1. Please click the following link to access the CyCAT Bias Intervention Tools:
<https://cycat.group.shef.ac.uk/prototype/v1.3/>
2. Use one or more of the following terms ('coronavirus', 'covid', 'covid vaccine', 'coronavirus lockdown') to search for relevant articles using the CyCAT tool.
3. There are some icons appearing next to each article, try to explore those with respect to the article itself.
4. On the right hand side there are some figures/plots, take some time to explore those and see how your interaction is reflected on the initial search results.

State your view on the following statements regardless of accuracy of the information you received.

9. The icon used (appearing next to each article) for the following aspect was representative. *

(1 Strongly Disagree - 5 Strongly Agree)

Mark only one oval per row.

	1	2	3	4	5
Political bias of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical locations of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Entity focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. The information provided for the following aspect (by hovering on the icon) was sufficient for understanding its use. *

(1 Strongly Disagree - 5 Strongly Agree)

Mark only one oval per row.

	1	2	3	4	5
Political bias of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical locations of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Entity focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. The bias graph/figures for the following aspect was useful for getting an overview of potential bias in the search results in this task. *

(1 Strongly Disagree - 5 Strongly Agree)

Mark only one oval per row.

	1	2	3	4	5
Political bias of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical locations of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Entity focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. The information provided in the bias graph/figures for the following aspect (by hovering on it) was useful for getting a better understanding of potential bias in the search results in this task. *

(1 Strongly Disagree - 5 Strongly Agree)

Mark only one oval per row.

	1	2	3	4	5
Political bias of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical locations of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Entity focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13. The filtering feature (by clicking the graph/figures selecting one option) was useful to complete the search task *

(1 Strongly Disagree - 5 Strongly Agree)

Mark only one oval per row.

	1	2	3	4	5
Political bias of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical locations of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Entity focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. The filtering feature (by clicking the graph/figures) can potentially allow the user to retrieve articles that only reflect their viewpoint *

(1 Strongly Disagree - 5 Strongly Agree)

Mark only one oval per row.

	1	2	3	4	5
Political bias of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical locations of the publishers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geographical focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Entity focus of the articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. I would prefer to have only the icons next to each article pointing at potential bias in the specific article. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

16. I would prefer to have only the graphs for visualizing and filtering bias in the results *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

17. I prefer the combination of both the icons and the graphs for identifying potentially biased articles. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

21. I found the system unnecessarily complex. *

Mark only one oval.

1 2 3 4 5

Strongly Disagree Strongly Agree

22. I thought the system was easy to use. *

Mark only one oval.

1 2 3 4 5

Strongly Disagree Strongly Agree

23. I think that I would need the support of a technical person to be able to use this system. *

Mark only one oval.

1 2 3 4 5

Strongly Disagree Strongly Agree

24. I found the various functions in this system were well integrated. *

Mark only one oval.

1 2 3 4 5

Strongly Disagree Strongly Agree

25. I thought there was too much inconsistency in this system. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

26. I would imagine that most people would learn to use this system very quickly. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

27. I found the system very cumbersome to use. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

28. I felt very confident using the system. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

29. I needed to learn a lot of things before I could get going with this system. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

30. List the three (3) most negative aspect(s): *

31. List the three (3) most positive aspect(s): *

32. Let us know if you have any more comments and/or suggestions regarding this tool.
