Usability Study of Various Cookie Consent Management Extensions

Ashutosh Kumar Singh
19CS30008
Indian Institute of Technology Kharagpur

Nisarg Upadhyaya
19CS30031
Indian Institute of Technology Kharagpur

Rajas Bhatt
19CS30037
Indian Institute of Technology Kharagpur

Seemant Achari
19CS30057
Indian Institute of Technology Kharagpur

Nikhil Tudaha
19CS10045
Indian Institute of Technology Kharagpur

1 MOTIVATION

1.1 GDPR and Cookie Consent Notices

Introduced in May 2018, the General Data Protection Regulation (GDPR) has been seen as a resounding success whose template has led to other data protection laws in many legal jurisdictions around the world such as Brazil (for LGPD), South Africa (for POPIA), etc. One of the requirements of GDPR is that any establishment that wishes to collect data about a so-called "natural person" must first obtain their consent. This person, also called the "data subject", has several other associated rights, including the right to withdraw consent previously given and the right to ask for the erasure of the data collected about them and rectify any errors therein. Although GDPR applies widely to all kinds of data being collected about "natural persons", the most widely seen effect has been imposed on the user tracking and targeted advertising industry – a driving force for the web economy.

GDPR has had far-reaching consequences in many aspects of the lives of people within its jurisdiction. The most visible consequence (to ordinary citizens) is that cookie consent banners have become ubiquitous within the jurisdiction of GDPR (EU and a few other countries such as the UK). As a consequence of the GDPR and the older ePrivacy directive, website operators are now required to ask for user consent before collecting data about them, e.g. for advertising and tracking or even for analytics to improve website performance. This is achieved by presenting a notice to the user in the form of a dialogue box that floats over the content of the website until the user provides (or denies) consent. The user decision, as well as the fact that the user has been presented with a consent notice, are both recorded in the user's browser as cookies or by using browser local storage.

1.2 Problems with Cookie Consent Notices

Although cookie consent notices have led to several changes in the web tracking industry, several studies point out that users struggle to express their privacy requirements and user tracking is still rampant [3, 6, 8, 9].

Consent Fatigue: There is a huge diversity of consent notice designs across the web. Even privacy-conscious users pick the default setting that "accepts all" trackers because they are tired of having to painstakingly browse all these different cookie consent banners to set the most private choice. This scenario is referred to as consent fatigue [5]. According to another study, consent fatigue has a stronger influence on privacy behaviour than users' privacy concerns [2].

Lack of Consent Withdrawal Mechanisms: Websites ask visitors' permission to gather their data when they first visit by displaying a banner. The consent is logged and the banner that requests consent is not displayed to the user on subsequent visits to the same website once they have given it. On most websites, it is quite difficult for a user to change their mind after they have agreed to be tracked, even if the decision to not continually ask for a user's consent is essential to ensuring a positive user experience. This is however, in direct violation of Article 7 of GDPR which gives data subjects the "right to withdraw consent".

Dark Patterns: Websites also commonly employ "dark patterns" that make it difficult for users to choose the most beneficial option for them [7]. Dark patterns are user interface design elements that nudge users into making decisions which might be detrimental for their privacy. A very common example is a highlighted, pre-selected "Accept and continue" button on the cookie consent banners of many websites.

As a result, nowadays, people are focusing on building tools that will provide automatic cookie consent management – by either blocking non-necessary, especially tracking cookies, or by setting the values of GDPR consent cookies programatically to ensure the most privacy-oriented setting. There are several such solutions available, but not all of them are usable by a regular internet user. These tools vary in the design of their interfaces, their functionality, and

the time taken by a novice user to learn using them. We have re-designed the user interface of a browser extension, named *CookieCutter*, keeping in mind several usability and design principles. We believe that *CookieCutter* should be easier to understand and use, as compared to other similar tools/extensions. Also, through some initial experiments, we found a considerable difference in the number of cookies set by websites when a user visits a website from India compared to when he/she visits the same website from the UK. So, to convey this unfairness in tracking between India and the EU, we provide an additional feature in *CookieCutter* wherein users can see a comparison between the numbers of different categories of cookies across India and the EU. We also want to test how receptive are users to this feature, and how useful they find it. Hence, in this work, we perform a longitudinal study to compare the usability of various consent management extensions available today, one of them being *CookieCutter*, and also aim to learn whether users think that the India/UK tracking comparison feature is helpful for them.

2 RESEARCH QUESTIONS

We want to gauge how *CookieCutter* compares against other consent management extensions in terms of ease of use and understandability. We also want to see how practical or beneficial do users find our India/UK tracking comparison feature. To this end, we frame the following two research questions:

RQ1 How easy/comprehensible/learnable is it for an average user to navigate through *CookieCutter* and understand its functionality, compared to other state-of-the-art consent management solutions?

RQ2 How effective and understandable is the India/UK cookie comparison mechanism for users?

3 STUDY DESIGN

3.1 Taxonomy of Consent Management Extensions

One of the extensions that we use for our study is our extension, *CookieCutter*. After much research and careful considerations, we choose two more extensions to compare *CookieCutter* against. These are *CookieBlock* [1] and *Consent-O-Matic* [10]. *CookieBlock* uses an approach similar to *CookieCutter* for detecting GDPR consent cookies and blocking tracking cookies. *Consent-O-Matic*, on the other hand, works mostly through handcrafted values for a few Consent Management Platforms (CMPs).

Thus our final set of consent management extensions consists of the following:

- *CookieCutter*
- *CookieBlock*
- *Consent-O-Matic*

3.2 Basic Details and Workflow

We plan to conduct a between-subjects, longitudinal study, comprising 2 surveys. The participants will be asked to complete the first survey before starting to use one of the extensions. This will be a common general survey for all participants and will include questions to gauge the privacy stance of the users and how much idea they have about browser cookies and cookie consent in general. After that they will be randomly assigned one of the extensions, and they will be asked to use that extension for the next 7 days. We have chosen a between-subjects design where each participant uses only one of the extensions. This is to avoid the problem of learnability because after using one extension, the other might seem easier to use, because many of the functionalities are common across these extensions. Then, after having used the extension for 7 days, they will be prompted to complete the second survey. This survey shall mainly focus on understandability and learnability of the extension, and perception of the India/UK tracking comparison interface.

Before conducting the actual survey in the wild, we run a pilot to check if there are any problems or confusions in any of the survey questions, and to get an initial idea of whether our hypotheses hold or not.

3.3 Recruitment Methods and Criteria

There are two parts of recruitment – the pilot participants, and the main survey participants. The pilot participants are invited via email or via word of mouth to participate in our survey. They are mostly our colleagues/batchmates, with few of them being our acquaintances. For recruiting our final survey participants, we will be using the online survey platform Prolific Academic, and the opportunity to participate in the survey will be advertised only to people who satisfy our recruitment criteria. Our survey participants:

- Should be at least 18 years old or above
- Must be fluent in English
- Must not have participated in our pilot study
- Should have taken a minimum of 50 prior surveys on the platform
- Must have a minimum approval rate of 95%
- Should be a regular internet user and must have been using the internet since at least 6 months
- Should also be sufficiently comfortable using a web browser (Google Chrome, Mozilla Firefox or Microsoft Edge)

There is no other criteria for enrollment. We want to achieve a diverse set of participants from various geographies and experiences for our study.

3.4 Overview of Survey Questions

The pre-usage survey is divided into two broad sections – *privacy* and *cookie consent*. The privacy section will give an idea of how concerned the users are about their privacy and how they behave when they have to take privacy-related actions. The second section is made to find out their current knowledge of browser cookies, cookie consent, and CMPs. Some of the questions in this section are later asked again in the post-usage survey to see if the user's knowledge has changed and thus, get an idea of the learnability of the extension.

The post-usage survey is divided into five broad sections – *General*, *Initial Setup/First Use*, *Interface*, *Usage*, and *Demographics*. The General section includes some questions to get an idea of the learnability of the extension and the user's knowledge of the same. The Initial Setup/First Use includes questions to gauge the user's perspective of some of the basic functionalities of the extension. The Interface section gives an idea of what the users like/dislike about the existing features and look of the extension and whether they would find a certain feature (not already present) useful or not. This section also includes two qualitative questions to understand which elements of the interface the users like and dislike. The usage section focuses on the behaviour of the extension and the user's interaction with it. The demographics section asks for country, age group, gender, educational qualification along with the user's browsing habits.

Finally, for the users who install the CookieCutter extension, an additional section is included in the post-usage survey to find the usefulness of the India-UK comparison feature. A qualitative question is added to get the user's feedback on how it can be improved.

4 ANALYSIS PLAN

We have done pilot testing, and the analysis and results for that can be found in Sec. 5. In this section, we outline our current analysis plan for the actual survey data.

4.1 Sample Size

A total of 12 people took part in our pilot study, with 9 of them being our batchmates, and 3 being our acquaintances (not from Indian Institute of Technology Kharagpur).

Our in-the-wild study will be a between-subjects study, where the participants will be divided into 3 groups (equal to the number of extensions involved in the comparison in our study). Various sources suggest that for a single study performing both quantitative and qualitative analysis, the ideal number of participants can be between 40 and 50 [4]. Since ours is a between-subjects study (with 3 groups), we need to have thrice this number. Hence, we aim for a sample size of around 150 participants for the actual survey.

4.2 Comparison Between Extensions – Quantitative Analysis

There are a number of things we would like to test, based on our survey questions. We describe each of the variables, and the methods/tests that we will be using for them below:

- **Gain in Knowledge**: We ask the participants whether they know about the various categories of cookies, and about consent management platforms first in the pre-usage survey. We then again ask the same questions after they have used the extension in the post-usage survey. Both these questions expect a boolean Yes/No answer. We will calculate the percentage of "No" responses (in the pre-usage survey) that converted to "Yes" (in the post-usage survey), for each extension. This will show which extension does the best job in educating people about cookies, their categories, and consent management platforms.
- **Need for an Initial Setup Page**: *CookieCutter* and *Consent-O-Matic* do not have an explicit initial setup page (although, *CookieCutter* has the landing page, which implicitly helps users to perform any setup or customization). For the users of these extensions, in the post-usage survey, we ask how helpful they would have found an initial setup page. For the users of *CookieBlock*, which has an initial setup page, we ask how useful did they find it. The division of responses among the various options for these questions will give us an idea that whether users feel the need for an explicit setup page.
- **Overhwelmed with Too Much Information**: We ask participants whether the extension overwhelmed them with too much information. The responses to this question are collected on a 5-point Likert scale. For a comparison of which extension overwhelms the user more, with too much information, we can use a Mann-Whitney U test, with the values being the Likert scale responses for each extension. For finding whether there is a correlation between the extension and the users feeling overwhelmed with too much information, we can use the Chi-squared test. The dependent variable would be the Likert scale responses grouped into two buckets (one for "Yes, overwhelmed" and another for "No, not overwhelmed"), and the independent variable would be the extension used.
- **Average Number of Websites Breaking**: We ask the users to choose a range for the number of websites that did not function properly when they were using the extension. We can again use the Chi-squared test to identify if there is any statistically significant correlation for this with the specific extension used.

- **Effort Required**: We ask users how much effort they felt was required to understand and use the extension, on a 5-point Likert scale. We can use the Mann-Whitney U test to compare if the amount of effort required is statistically significantly different for the various extensions.
- **Using the extension in the future**: We ask the users whether they would continue using the extension, even after the 7-day period. We can use the Chi-squared test to identify if these Yes/No responses are correlated with the extension they used.

4.3 Correlations Between Post-Usage Responses and Privacy Attitudes and Demographics

Independent Variables: We ask a number of questions in the pre-usage survey to identify the privacy attitudes and opinions of the participants. We also ask how much they knew about browser cookies, cookie consent, and consent management platforms/solutions. We also collect some demographics data like country, their daily internet usage, their educational background, etc.

Dependent Variables: There are several things like whether the user felt overwhelmed with too much information while using the extension, and how much effort they had to put in to understand and use the extension. We also ask whether participants would continue using their extension beyond the 7-day period.

We can use regression tests (ordinal regression for Likert scale responses) to see if there is any correlation between any of the dependent variables with the independent variables. Also, the coefficients of correlation might suggest some new interesting behaviours or observations.

4.4 Understanding the Utility and Users' Perception to the India/UK tracking Comparison Interface

- We ask participants whether they could understand where tracking was more (between India and the UK), the responses for this question would indicate the understandability of the design.
- We provide a suggestion to users to visit the website from a different location so that they are subjected to less tracking. So, we ask them whether they would be willing to use a solution like a VPN to visit the site in order to protect their privacy. This would give us an idea of the amount of effort people are willing to put in to protect their privacy, and would help us understand how pratical or useful this feature actually is.
- We will also be using correlation tests to identify any correlation of the responses to the above two questions with the participants' privacy stance, or their demographic information.

4.5 Qualitative Analysis Plan

We have asked three questions in the post-usage survey, where we expect a qualitative text response from the participants. The first two questions are in the Interface section of the post-usage survey, and is common to all the three extensions:

- *Which elements of the interface did you find aesthetically pleasing and why?*
- *Which elements of the interface did you find difficult to comprehend?*

For these two questions, we plan to perform in-vivo coding to uncover the exact elements which users liked/preferred, and the ones which users found difficult to understand. For the "why" part of the first question, we plan to perform open coding to uncover what design factors cause extensions to stand out from the others.

The third question is only in the post-usage survey for *CookieCutter*, as it is about the India/UK tracking comarison interface:

- *What improvements/added functionalities do you think can make this page better?*

For finding an answer to this question, we again perform in-vivo coding, as we need to identify the exact features that our participants suggest.

5 PRELIMINARY RESULTS

We have done pilot testing on a convenience sample of 12 participants. 9 out these 12 are from technical backgrounds spanning across different engineering majors, while the remaining 3 are from a non-technical background. We assigned each extension to 4 people. Since it is difficult to conduct any quantitative analysis on such a small sample, we only provide a summary of their responses and our initial inference from their responses.

5.1 Pre-Usage Survey

General Privacy Concerns: The first section in this survey comprised questions about the general privacy concerns. The key takeaways from this section are as follows:

- Majority of participants (10/12) agreed that they should be made fully aware of where their information is being used. We expected a heightened sense of privacy from our sample.
- Shockingly, despite our sample having a bias towards more technical users, almost no one (1/12) reported

that they read the privacy policies of websites asking for their consent for accepting cookies.
- Participants were divided in their opinion about companies sharing their data with third parties.
- We had asked if the participants believed whether a website having HTTPS security could violate their privacy or not. 4 out of 9 of the technical background participants believed that their privacy could not be violated on websites using HTTPS.

Knowledge about Browser Cookies and Consent Management:

- Almost everyone had heard of browser cookies, however, many did not know that cookies could be used to track them over the internet.
- Almost no one had heard about consent management platforms.
- Participants emphasized that their website experience was more important compared to setting the most privacy-oriented cookie setting.

5.2 Post-Usage Survey

General Questions: The observations we gained from the responses in this section are as follows:

- *CookieCutter* users were better able to understand the classification between the cookies.
- Mostly everyone (10/12) said that they would be able to configure the extension to ignore a certain website.

Initial Setup:

- Our pilot participants emphasized the need for having an initial setup page to help them better understand the extension's functionality.
- *CookieCutter* lagged behind about explicitly telling people what cookie categories were being set or blocked.

Interface:

- *CookieCutter* users were satisfied with the "Show all Cookies" page which listed all cookies listed according to their categories.
- Users did not care much about whether a consent management platform (CMP) was being used or not, or even about which CMP was being used.

Usage:

- Majority of *Consent-O-Matic* and *CookieBlock* users reported breaking of 5-10% sites due to the extension, whereas *CookieCutter* users reported that number to be 1-5%.
- The 5-point Likert scale values for amount of effort put in to understand the functioning of the extension were in the range of 2-3 for all the three extensions.
- *CookieCutter* users opened the extension page on about 40-60% of the websites they visited. This number was 20-40% for *Consent-O-Matic* and *CookieBlock*. This can be attributed to the much more features and statistics supported by *CookieCutter*.

India/UK Tracking Comparison Page (Specific to *CookieCutter*):

- Users were able to determine, accessing the website from which location would provide better privacy options.
- Majority of the users were not willing to use a VPN to avail better privacy options, showing that even users from technical backgrounds are willing to put only a very minimal effort to protect their privacy.
- There was a mixed opinion on if it was useful getting recommendation on which location to browse from.

6 DIVISION OF WORK

(1) **Ashutosh Kumar Singh - 19CS30008**
He was responsible for framing the research questions, filling up the first half of the IRB application form, re-design and coding the new interface for *CookieCutter*. He created the quantitative analysis plan to understand the utility of the India-UK tracking comparison page. He was also responsible for the following parts of the report - Motivation, Research Questions, and Study Design.

(2) **Nisarg Upadhyaya - 19CS30031**
He filled up the second half of the IRB application form and created the following sections for the post-usage survey –Interface, Usage, and India/UK Tracking Comparison Page. He also created the overall qualitative analysis plan. He wrote the following sections in the report - Analysis Plan, and Preliminary Results.

(3) **Rajas Bhatt - 19CS30037**
He created the recruitment form and formulated the questions for both parts of the pre-usage survey – General Privacy Concerns, and Knowledge about Cookies. He also did the pre-usage pilot analysis. He also designed the slides for approximately the first half of the presentation.

(4) **Seemant Achari - 19CS30057**
He was responsible for creating the consent form, and going through all extensions to look for their similarities and differences to help create the post-usage survey. He contributed the questions for the General and Initial Setup sections of the post-usage survey and did the post-usage pilot analysis. He also created the slides for the later half of the presentation. (Rajas

and Seemant were responsible for making the entire presentation, and they both contributed equally.)

(5) **Nikhil Tudaha - 19CS10045**
He was responsible for creating the quantitative analysis plans for comparing the extensions and for finding correlations between post-usage responses and privacy attitudes and demographics.

7 FUTURE WORK PLAN

We plan on conducting a full-fledged study in the wild with around 150 participants equally distributed among the three extensions. Based on the responses, we will improve the design further, if needed. We also want to add support for more countries in the comparison feature and improve its overall backend so that the extension can fetch up-to-date cookie data for the supported countries dynamically.

8 PRESENTATION

Presentation Video: Google Drive Link
(**Note**: The parts presented by each person in the presentation are not reflective of their exact contribution in the project. It was difficult to assign continuous sections of the presentation to group members solely based on their contribution. Please refer to Sec. 6 for the actual work division.)

Presentation Slides: Google Slides Link

REFERENCES

[1] Dino Bollinger, Karel Kubicek, Carlos Cotrini, and David Basin. 2022. Automating Cookie Consent and GDPR Violation Detection. In *31st USENIX Security Symposium (USENIX Security 22)*. USENIX Association, Boston, MA, 2893–2910. https://www.usenix.org/conference/usenixsecurity22/presentation/bollinger

[2] Hanbyul Choi, Jonghwa Park, and Yoonhyuk Jung. 2018. The role of privacy fatigue in online privacy behavior. *Computers in Human Behavior* 81 (2018), 42–51. https://doi.org/10.1016/j.chb.2017.12.001

[3] Adrian Dabrowski, Georg Merzdovnik, Johanna Ullrich, Gerald Sendera, and Edgar Weippl. 2019. Measuring Cookies and Web Privacy in a Post-GDPR World. In *Passive and Active Measurement*, David Choffnes and Marinho Barcellos (Eds.). Springer International Publishing, Cham, 258–270.

[4] Nielsen Norman Group. 2021. How Many Participants for Quantitative Usability Studies: A Summary of Sample-Size Recommendations. https://www.nngroup.com/articles/summary-quant-sample-sizes/.

[5] Jeanette Herrle and Jesse Hirsh. 2019. The peril and potential of the GDPR. In *Centre for International Governance Innovation, 2019*, Vol. 9.

[6] Xuehui Hu and Nishanth Sastry. 2019. Characterising Third Party Cookie Usage in the EU after GDPR. In *Proceedings of the 11th ACM Conference on Web Science*. ACM, Boston, USA.

[7] Midas Nouwens, Ilaria Liccardi, Michael Veale, David Karger, and Lalana Kagal. 2020. Dark patterns after the GDPR: Scraping consent pop-ups and demonstrating their influence. In *Proceedings of the 2020 CHI conference on human factors in computing systems*. 1–13.

[8] Emmanouil Papadogiannakis, Panagiotis Papadopoulos, Nicolas Kourtellis, and Evangelos P. Markatos. 2021. User Tracking in the Post-Cookie Era: How Websites Bypass GDPR Consent to Track Users. In *Proceedings of the Web Conference 2021* (Ljubljana, Slovenia) *(WWW '21)*. Association for Computing Machinery, New York, NY, USA, 2130–2141. https://doi.org/10.1145/3442381.3450056

[9] Takahito Sakamoto and Masahiro Matsunaga. 2019. After GDPR, Still Tracking or Not? Understanding Opt-Out States for Online Behavioral Advertising. In *2019 IEEE Security and Privacy Workshops (SPW)*. 92–99. https://doi.org/10.1109/SPW.2019.00027

[10] Aarhus University. 2022. *Consent-O-Matic*. https://consentomatic.au.dk/

A SURVEY INSTRUMENT

Pre-Usage Survey: Google Form Link

Post-Usage Survey:

- *CookieCutter*: Google Form Link
- *CookieBlock*: Google Form Link
- *Consent-O-Matic*: Google Form Link