What Cookie Consent Notices Do Users Prefer: A Study In The Wild

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Laws like GDPR in the EU mandated all websites operating in their jurisdiction to obtain users' informed consent before tracking those users and collecting their data. Today, this is achieved by showing users cookie consent notices. These notices are ubiquitous (often permeating the geographical boundaries of GDPR enforcement), even though their exact user interface (UI) designs vary. These designs are provided by Consent Management Platforms (CMPs) to different websites, effectively resulting in a handful of cookie consent notice designs being shown to a majority of internet users. Naturally, not all designs are uniformly liked by the users. Thus the first step of improving cookie consent notice UI design and moving to a better consent mechanism is to understand whether users prefer one design over another in the wild and why. To answer these questions, in this work, we conduct an in the wild comparative survey with 98 participants where 64.3% of the participants were from the EU (i.e., GDPR is applicable), and the rest were self-reported to be located outside of the EU. In this within-subjects study, our participants ranked five different popular cookie consent UI designs (leveraged by CMPs used in Alexa UK Top500 websites) and gave rationale for their choices. Our analysis found that the *slider design* is statistically significantly better ranked (and thus most liked) than all other designs. Our further qualitative analysis identifies and unpacks five key design factors which impacted our participants' liking/disliking of consent notice UI designs (as captured by the ranks given to these designs by our participants) – ease of use, amount of information, customisability, decision-making time, and clarity/transparency. We conclude this work by discussing the implications of our findings on future cookie consent notice UI designs.

CCS Concepts: • **Security and privacy** → **Usability in security and privacy**.

1 INTRODUCTION

Since the advent of the General Data Protection Regulation (GDPR) in May 2018, websites serving users in the EU, i.e., European Union (and a few other countries such as the UK) have been required to obtain the users' explicit consent before collecting data about them. 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.

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Specifically, as a consequence of GDPR (and the older ePrivacy directive), websites that collect information about users (often for tracking and advertising) are required to present users with a consent notice before collecting data about them. Such notices are typically presented to the user as 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.

This workflow of user consent has led to a burgeoning industry of *Consent Management Platforms* (CMPs) [31]. CMPs are solutions (pieces of code) that websites can buy and simply include in their website codebase. CMPs allow websites to show cookie consent notices to users, collect users' cookie preferences (e.g., whether users consent to tracking), and set cookies on their site accordingly. The ease of this approach (as opposed to creating cookie consent management platforms for individual websites) has led to widespread use of CMPs, and a handful of templates built by a small number of CMPs such as OneTrust and Quantcast have become ubiquitous. For example, we manually looked at all the Alexa UK Top500 websites (as of August 2021) and found that only 25 CMPs are used by the 202 websites among the Alexa UK Top500 websites that request cookie consent. Moreover, we also found only 8 CMPs among the 40 out of Alexa UK Top100 websites that request consent. These numbers identify the relatively low number of CMPs that create cookie consent notice designs for most popular websites.

This consolidation of consent templates (created by a handful of CMPs) has had a mixed impact on web privacy [10]. On the positive side, the dominance and ubiquity of a small number of consent templates have led to an informal design language for how consent is obtained by websites, which might make them easier to use and understand for those who have become familiar with them through repeated exposure. On the negative side, this consolidation sometimes also helps to quickly spread dark patterns [28], such as a pre-selected "Accept and Continue" button to nudge users to consent to tracking.

In fact, Kulyk *et al.* [18] found that users might dislike cookie consent notices today and found them annoying while browsing, leading to users making sub-optimal choices when dealing with cookie consent notices, effectively compromising their privacy. Thus, there is a need to understand what cookie consent notice designs users in the wild like or dislike and why. We take a step forward to address this need in this work — we identify major design factors which lead to some cookie consent notice designs being (dis)liked significantly more than the others.

Specifically, we assess the overall response and behaviour of users towards cookie consent notices via two crucial research questions using popular cookie consent UI designs:

RQ1 What design(s) for cookie consent notices do users prefer in the wild?
RQ2 What design factors contribute to users' preferences of design(s) for cookie consent notices?

To answer these questions and uncover user perceptions and preferences regarding the consent templates, we developed and deployed an IRB-approved survey in the wild as part of a browser extension. The extension was designed to assist users in automatically managing cookie consents. Our survey elicits relative user preference for five consent notice patterns (*cf.* Fig. 1) — specifically, we asked our participants to rank these consent notice patterns based on their liking/disliking. These consent notice patterns were identified via analysis of Alexa UK Top500 websites (as of August 2020), spanning the 25 most popular CMPs. We further asked the participants to select which consent options (*e.g.*, "allow all" or "reject all") they would normally choose for each of the consent notice patterns. Finally, we asked about participants' perceptions and understanding of consent notices as well as their general privacy preferences.

Our survey was answered by 98 people from 30 countries. In total, 63 out of these 98 (64.3%) were located in the EU, and the rest were outside of the EU. Thus, we effectively examined a population where a non-trivial section was not under the protection of GDPR and had the potential to perceive cookie consent notice designs differently.

Specifically, we make three contributions in this work to address the research questions. First, we conduct a survey wherein we show users five consent notice UI designs and ask them to rank these designs according to their preference. By observing the median ranks for each design and performing Mann-Whitney U tests, we conclude that the slider design (Fig. 1(a)) is most preferred by users, followed by the cookie categories design (Sec. 4.2). A few users also like to see the full list of vendors (Fig. 1(d)) and like the feeling of control it gives them. However, a remarkable 56 out of 98 users (57%) fail to complete the consent notice which gives a long list of vendors but without the "Reject All" button.

Second, we study what factors are correlated with users' preferences for consent notice UI designs (Sec. 4.3). We find that whether the user is from the EU (and thus already under the protection of GDPR) is not a statistically significant factor for our participants. However, the privacy stance of a user, their internet experience, and their response when shown a cookie consent banner seem to have some correlation with what consent notice designs they like or dislike.

Third, using qualitative open coding (Sec. 4.4), we identify five key factors which affect users' preferences for consent notice UI designs — ease of use, customisability, decision-making time, clarity/transparency, and amount of information. Further, we also found which factors have a comparatively higher impact on users' preferences as compared to others. The interface needs to be concise and customisable, the decision-making time should be low, and the interface should be clear on what all interface elements do. Very interestingly, "informative" is not a key reason to choose the consent interface of choice. In fact, "Too much information" is the most prominent reason for disliking cookie consent interface designs. Next, we present the related work (Sec. 2) in this space and then move into our methodology (Sec. 3), results (Sec. 4) and discuss the implications of our findings in a concluding discussion (Sec. 5).

2 RELATED WORK

We discuss the related work along three dimensions: User perceptions regarding third-party cookie-based tracking and current tools to protect from the tracking, the role of cookie consent notices in GDPR and finally, the impact of the design of cookie consent notices on user privacy.

User perception and defences regarding third-party cookie-based tracking: A study by Ha *et al.* [9] using focus groups identified a number of misconceptions among users regarding how and why cookies are used. The study showed that most users lacked a true understanding of the advantages and disadvantages of using cookies. In the same line of research, Chanchary *et al.* [3] conducted an online study to identify factors that affect users' willingness to share data with advertising companies. In their study, they found that participants' background, privacy attitudes, and frequency of visiting the websites were significant factors in their sharing willingness. Furthermore, to understand the third-party ecosystems better, Urban *et al.* [34] introduced the concept of third-party trees and studied the third parties and recursive dependencies which load when visiting a website. Some research efforts, as well as existing systems, attempted to defend normal users against this tracking. A few earlier works aim to simplify cookie consent notices and assist users in choosing privacy-preserving settings [4, 13]. Kulyk *et al.* [19] developed a privacy-friendly cookie setting interface which helped users to configure their cookie settings. The interface, with the help of an assistant, guided the users towards their preferred cookie settings via a series of questions while also allowing users to set their cookie settings manually. Additionally, in general, users also use third-party browser extensions to stop third-party cookie-based tracking [8, 11]. However, our work is complementary to this body of work — we ask when users are

presented with different available cookie consent notice designs in the wild, as mandated by GDPR, which designs do they like most (find most usable) and why.

User perception regarding cookie consent mechanisms: CMPs aim at enabling website owners to manage service providers and their corresponding cookies, empowering end-users with giving informed consent for setting cookies. Through a longitudinal measurement of 161 million browser crawls, Hils *et al.* [12] estimated that CMP usage has doubled annually since the introduction of GDPR in May 2018. Despite the increase in sites that use GDPR banners over the past few years, many of the same websites potentially tend to not place GDPR equivalent protection in non-EU regions [7]. O'Connor *et al.* [29] performed a study in order to understand how websites implemented the California Consumer Privacy Act (CCPA). They found that instead of displaying a privacy banner, most websites that implemented opt-out mechanisms did so with a "Do Not Sell" link rather. Previous works have identified a variety of suspected GDPR violations among the different consent notice banners [14, 26, 27]. Particularly, 89% of cookie banners violated applicable laws, and 61% of banners mentioned vague purposes for data processing [15, 32]. Sanchez-Rola *et al.* [30] evaluated the functionality of consent notices and opt-out mechanisms under GDPR. They manually visited 2,000 popular websites, tried to opt out of data collection whenever possible, and studied the effects on the website's cookies. They found that 92% of websites set a tracking cookie before providing any kind of notice to the user. Only 4% of notices provided an opt-out choice, and 2.5% of websites removed some cookies upon opt-out, indicating that the opt-out option was almost ineffective. We build on this prior body of research — in this work, we unpack which popular cookie consent notices (with their inherent strengths and weaknesses to protect user privacy) in the wild do *users* prefer and why.

Impact of cookie consent notice designs and dark patterns on users' privacy: Previous works [1, 2, 5] have shown how certain cookie consent notice designs can manipulate the choice of users. It has also been shown that the sentiment of the text in the cookie consent banner affects the users' choice [21]. Krisam *et al.* [17] analysed the cookie disclaimers on the top 500 websites in Germany and showed that more than 85% of the websites providing a cookie disclaimer actually nudge users to accept all cookies. Nouwens *et al.* [28] also found that dark patterns are highly prevalent by scraping the designs of the five most popular CMPs on the top 10,000 websites in the UK and analysed how they affect people's consent choices. One of their findings was when the users are presented with a list of vendors, most of them move ahead with bulk selection, i.e., Select All or Reject All. However, they were unclear about the specific reasons which led to this behaviour — we identify these reasons in our work. Soe *et al.* [33] manually analysed features of 300 cookie consent notices and identified eight new dark patterns. Machuletz and Böhme [22] showed that users consent to more purposes with a default highlighted button than without it. While previous work studied consent banners independently from design, legal and ethical viewpoints, Gray *et al.* [6] identified how these frequently conflict and that there is a need for transdisciplinary study including fields such as HCI, UX, psychology, ethics and law while studying consent mechanisms. Similarly, Mathur *et al.* [25] present a set of normative viewpoints to analyse dark patterns and their effect on users by studying them from the lenses of multiple diverse fields, including the ones mentioned before.

To this end, Utz *et al.* [35] studied CMP designs from the perspective of visitors of one popular website in Germany and checked the impact of different factors (including dark patterns). Their study was aimed at evaluating how the consent-related behaviour of users (e.g., interaction with consent notice, willingness to accept tracking) was affected based on cookie consent notices' position, choices and content. Meanwhile, complementary to this prior work, we do a comparative study of the different cookie consent notice UI designs available today in the wild and uncover user preferences regarding the cookie consent designs. A related work by Habib *et al.* [10] identified the impact of

(a) Slider Option   (b) Cookie Categories   (c) Binary Choice

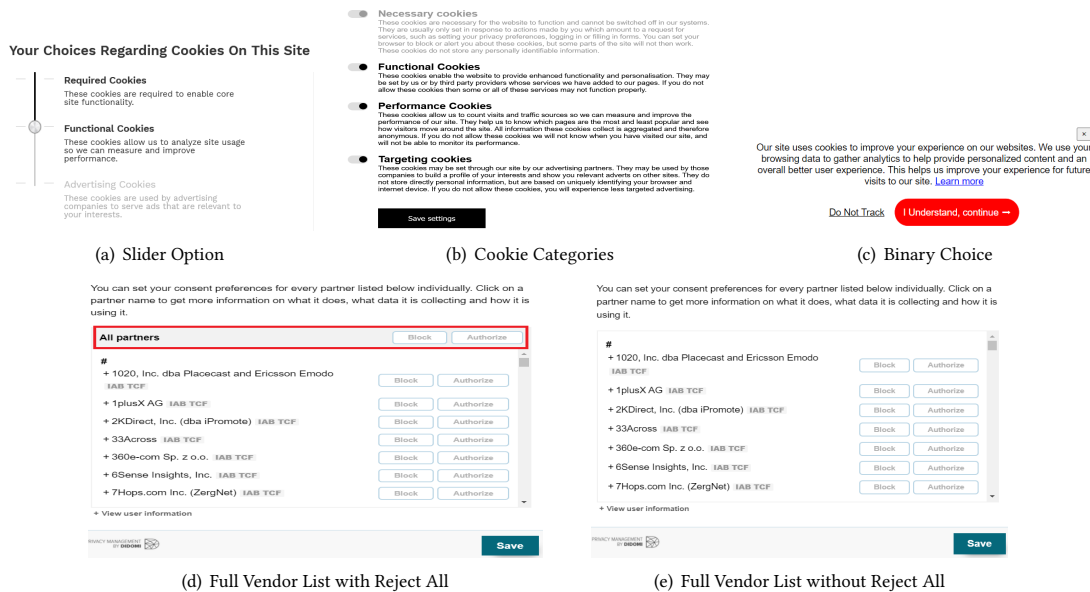(d) Full Vendor List with Reject All   (e) Full Vendor List without Reject All

Fig. 1.   Consent Notice UI Designs identified by thematic analysis of Alexa UK Top500 websites (as of August 2020).

dark patterns and design parameters on the user interaction with cookie consent notices. They examined 191 consent interfaces against five dark pattern heuristics, and they extracted 12 cookie consent notice UI variants in a between-subjects study — they exposed each of the participants in their study to one of these 12 UIs and analysed user perception regarding these UIs. In contrast, our comparison-based (within-subjects) study exposes each participant to all of the five most popular consent notice patterns selected for the study and obtained a ranking based on their preferences. Note that, unlike Habib *et al.*, we did not focus on any dark pattern but rather most popular cookie consent notices. In this work, we also identify through qualitative analysis which design factors underlie the user preferences for cookie consent and try to determine whether factors like privacy stance are correlated with their design preferences. With this background, we now present our study design to uncover users' preferences regarding the cookie consent notices.

3   METHODOLOGY

In this section, we describe our key taxonomy of consent notice UI designs and then describe our survey instrument.

3.1   Creating a taxonomy of consent notice UI designs

In order to uncover the key GDPR cookie consent notices or consent banners deployed in practice, we focused on the UK Top500 websites (according to Alexa, as of August 2020). Out of these, 307 sites used some form of GDPR consent banners that give users a choice on what data can be collected about them. 108 of these were custom banners unique to the website, and 202 were from 25 different CMPs. Collectively, these different banners could be divided into five different cookie consent UI templates (Fig. 1). These templates correspond closely to designs used in previous work [4, 35], with some differences (the number of vendors in the full vendor list is much larger than that used in previous work, see the size of the scroll bar in Figs. 1(d), 1(e)), which significantly increase the cognitive burden on users. We also consider the slider UI (Fig. 1(a)). Fig. 2 shows the distribution of the different kinds of UI designs among
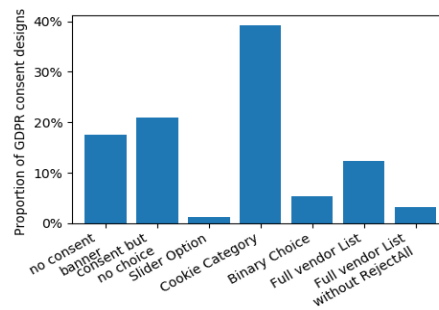
Fig. 2. Distribution of distinct UI designs for GDPR consent banners among Alexa UK Top500 websites (as of August 2020).

the Alexa UK Top500. 17.6% do not use any consent banner at all. 21% present a banner but only an "accept tracking and continue" option, not giving the users any real choice. The remaining websites can be aligned with five consent UI templates (shown in Fig. 1):

(1) **Slider Option** (Fig. 1(a)): Provides medium-grained control over the cookie consents by allowing users to customise their cookie consent settings and preferences using a slider. The position of the slider represents the consent to all the categories previously listed. There are three options listed on slider, so users can choose any of three sets of cookies: only required cookies, required + functional cookies, or required + functional + advertising cookies.

(2) **Cookie Categories** (Fig. 1(b)): Provides fine-grained control over consents, allowing users to select or deselect each individual category. Unlike the *Slider Option*, different categories of cookies can be selected in parallel. However, "Necessary" cookies cannot be unchecked, as is common practice.

(3) **Binary Choice** (Fig. 1(c)): Provides coarse-grained control via a "Continue" button. The "Continue" button is emphasised to entice users to accept cookies by default.

(4) **Full Vendor List** (Fig. 1(d)): Enables users to allow (authorise) or deny (block) each cookie and related tracking entity separately or to block all trackers using a "Reject All" button.

(5) **Full Vendor List without Reject All** (Fig. 1(e)): Same as *Full Vendor List* but without the "Reject All" button.

We present the relative frequency of each of these UI designs in the UK Top500 websites in Fig. 2. Interestingly *Cookie Categories* is the most common consent template across the UK Top500 websites. Each of these designs may also nudge users into accepting tracking (for example, the binary option with the "I understand, continue" option selected, or the *Slider* and *Cookie Categories* designs with more cookies selected by default than the strictly necessary cookies).

3.2 Survey creation and deployment

We leveraged the taxonomy of the five consent notice UI designs to create a survey, where we aimed to measure the relative acceptance of each of these designs. In this survey, we start by asking participants to first interact with each design (by clicking on the presented designs and trying to select their preferred cookie consent) and then elicit their relative preferences for each design (by ranking these five designs from most preferred to least preferred). Finally, we presented a questionnaire regarding the participants' background, expertise, privacy stance, privacy-oriented actions, and their manner of dealing with GDPR cookie consents. In the initial development phase, we ran pilots with around five participants to improve the survey iteratively and remove ambiguities from the questions. The survey instrument

for identifying participant background and expertise as well as their privacy stance and behaviour is in Appendix A (These questions are inspired by earlier works on behavioral tracking and privacy [23, 36]). This survey was included as part of a browser extension available in Google Chrome, Mozilla Firefox, and Microsoft Edge. This browser extension assisted users in choosing good cookie preferences irrespective of the exact consent template. The participants were requested on their very first installation of the extension to take this survey — this is to minimise potential user bias due to interaction with the extension. Note that, even if the extension users chose not to take part in the survey, it did not affect their use of the browser extension. In total, 248 users installed the extension by June 2022, out of which 98 users completed our survey. Since our survey was deployed at the extension stores available for users across the world, we chose not to collect any information which can be deemed potentially sensitive in a different context. This included gender and any personally identifiable information (PII) from the users. Our pilot participants took, on average, 10 minutes to complete the survey (note that we did not collect the timestamps from actual deployment for ethical data collection). Our survey protocol was approved by the University of Surrey ethics board in the UK (Application No. 514292-514283-64690499).

3.3 Limitations

Our study has a few limitations. First, our sample consists of the users who installed our browser extension and gave us feedback of their own volition, i.e., users who possibly are interested in consent management interfaces. However, we argue that this population is still valuable for our study — our findings seem to imply underlying important and general usability features, which are likely to be valid for a wider population. Second, we have considered only the five consent notice designs, as these were the ones found on the Alexa UK Top500 websites. However, in practice, there are a number of different customised consent notice UI designs, which might introduce new factors for users' preferences.

3.4 Analysis Plan

Quantitative Analysis: To answer RQ1, we look at the distribution of ranks for each consent notice design and the median rank for each design. To test if the ordering of the designs is statistically significant, we perform a Mann-Whitney U test on each pair of designs. The ranks assigned to each design by the users (acting as a proxy of which design they liked/disliked) act as ordinal data, and hence, we perform ordinal regression and check which factors act as explanatory variables for the ranks assigned to each design. This helps us to determine whether factors such as the internet experience, privacy stance, and actions of users have any correlation with their design preferences.

Qualitative Analysis: We performed qualitative open coding [20] to analyse the reasons shared by participants as to why they chose a specific preference order and prepared a codebook. Using this codebook, we coded each of the qualitative reasons given by the users. We further analysed the assigned codes (by checking the fraction of users whose reasons are captured by each code as presented in Section 4.4) to identify the relative importance of reasons which decide if users like/dislike a consent notice interface design.

3.5 Participants

We received a total of 98 responses between 16th October 2020 and 31st May 2022. Out of these, 77 had a preference order for the consent notice designs (section 4.2) — the remaining 21 users skipped the questions regarding preference order. 30 users out of the 77 also gave a qualitative response mentioning why they chose that order. The participant pool had a slight bias of users from Europe, with 63 responses coming from Europe and 24 from North America (out

Table 1. Distribution of our participants over EU and non-EU.

	No. of participants who sent a non-empty response	No. of participants who sent a ranking of interfaces
EU	63	45
non-EU	35	32

(a) Slider Option

(b) Cookie Categories

(c) Binary Choice

(d) Full Vendor List with Reject All
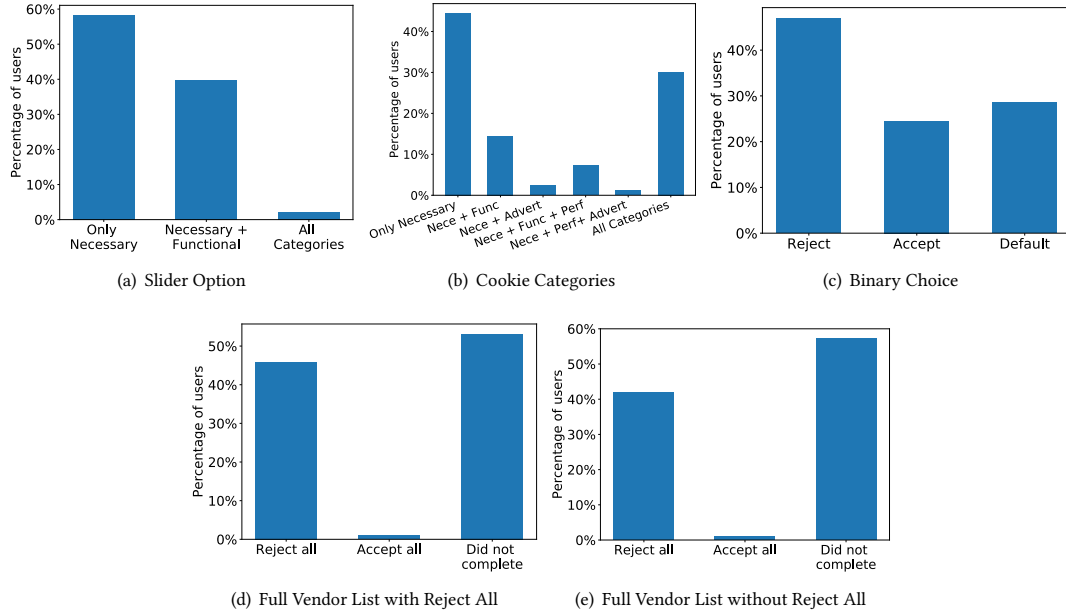
(e) Full Vendor List without Reject All

Fig. 3. Distribution of users choosing different options in 5 GDPR-enforcing UIs of Fig. 1.

of 98). We did not collect demographic information such as gender, race, or ethnicity out of privacy concerns. Our participants were spread across 30 different countries spanning 5 continents. Out of these users, the majority were from the EU (where GDPR is applicable). We also considered UK as part of the EU in this work, since GDPR still applies there. However, a non-trivial fraction is from outside of the EU (*cf.* Table 1). In fact, 24 of our 35 non-EU responses were from North America, where there exist areas with different privacy laws than GDPR.

4 RESULTS

4.1 User preference for setting cookies

We seek feedback from our participants regarding their choice of cookie consent notice interfaces. However, in addition, for each interface, we also asked what their *preference* for setting cookies is (e.g., selecting 'Accept All' in a given interface). We start with checking this basic question: What is the most chosen preference in each consent notice design? The result is shown in Fig. 3. We observed that the most frequent choice in each consent notice design is typically the most private option. This result implies that our users seem to understand the consent notice designs

(a) Slider Option   (b) Cookie Categories   (c) Binary Choice

(d) Full vendor list with Reject All   (e) Full vendor list without Reject All
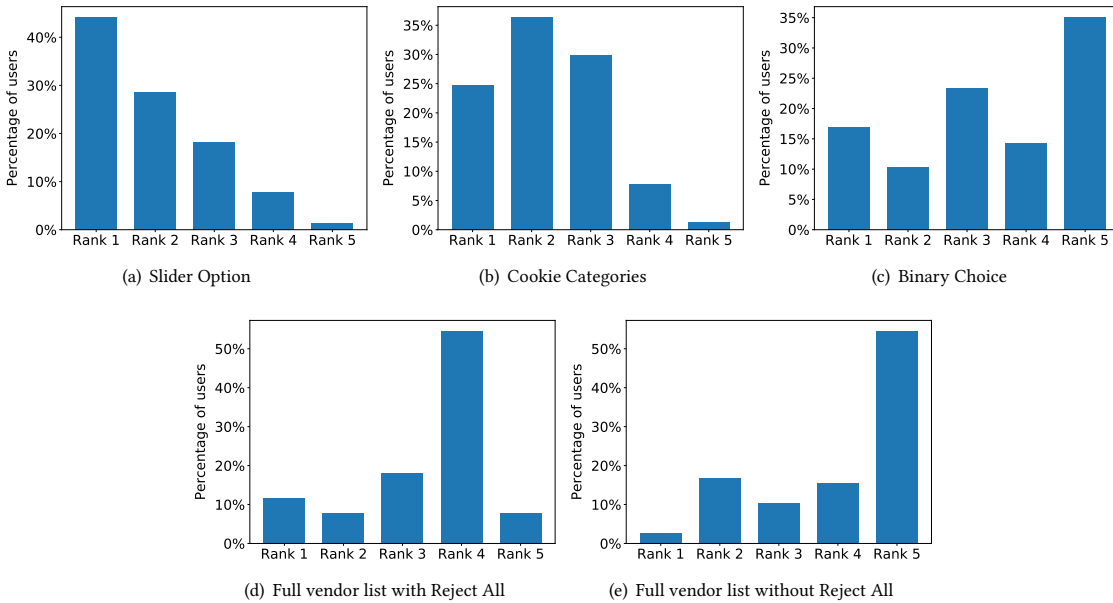
Fig. 4. User preference rankings of Fig. 1 UIs. Lower ranks are most liked.

well enough to be able to choose the most private option for each design. Furthermore, we note that more than 50% of users fail to complete all choices in both the *Full vendor list* designs, underlying the possible inherent difficulty of enforcing user preference in this design. With this background, now we seek the answer to our RQ1: Which cookie consent notice UI designs do users prefer?

4.2   User preferences for consent notice designs in the wild (RQ1)

We asked for comparative feedback from our users for each of the five design interfaces shown — the users ranked them from 1 (best) to 5 (worst). We present the distribution of ranks assigned by the survey participants for each interface in Fig. 4. In order to understand which consent notice UI design is preferred most by users, we checked the median rank for each design (Table 2). Interestingly, *Slider Option* and *Cookie Categories* get a better (numerically lower) rank as compared to *Binary Choice*, followed by *Full Vendor List with Reject All* and *Full Vendor List without Reject All*. So we hypothesise that the *Slider Option* is possibly preferred most by our participants.

To investigate further, we use the Mann-Whitney U test [24] to assess whether there is a statistically significant difference in the ranks assigned to each pair of cookie consent notice designs. The results can be found in Table 3 (α = 0.05). We noted that only the pair *<Binary Choice, Full Vendor List with Reject All>* is not statistically significantly different, signifying a similar ranking. Combining these results with the median values of ranks for each design (to ascertain which design is better ranked in a pair), we ascertain the following overall ranking for cookie consent notice designs in terms of user preference:

(1) **Slider Option** (most preferred) (2) **Cookie Categories** (3) **Binary Choice and Full Vendor List with Reject All** (4) **Full Vendor List without Reject All** (least preferred).

Table 2. Median ranks assigned to each consent notice UI design.

Design	Median Rank
Slider Option	2
Cookie Categories	2
Binary Choice	3
Full Vendor List with Reject All	4
Full Vendor List without Reject All	5

Table 3. p-values for the Mann-Whitney U test performed on each pair of consent notice UI designs.

Design 1	Design 2	p-value
Slider Option	Cookie Categories	< 0.05
Slider Option	Binary Choice	< 0.001
Slider Option	Full Vendor List with Reject All	< 0.001
Slider Option	Full Vendor List without Reject All	< 0.001
Cookie Categories	Binary Choice	< 0.001
Cookie Categories	Full Vendor List with Reject All	< 0.001
Cookie Categories	Full Vendor List without Reject All	< 0.001
Binary Choice	Full Vendor List with Reject All	0.31
Binary Choice	Full Vendor List without Reject All	< 0.01
Full Vendor List with Reject All	Full Vendor List without Reject All	< 0.001

Table 4. Ordinal regression on the preference ranking of different UI designs (showing only significant correlations).

Design	Factor	Coef.	p-value
Cookie Categories	Read banner to choose most privacy-oriented setting	3.99	< 0.05
Binary Choice	Privacy stance	-1.95	< 0.05
Full Vendor List with Reject All	Use of a privacy-oriented search engine	3.87	< 0.001
Full Vendor List without Reject All	Internet experience	-1.50	< 0.01
Full Vendor List without Reject All	Frustration when difficult to choose a privacy-oriented option	-1.14	< 0.05

Thus, the *Slider Option* is most preferred, which is also supported by the fact that a maximum number of people chose the slider as their first preference (*cf.* Fig. 1). The *Cookie Categories* design is the second most preferred. It is then followed by *Binary Choice* and *Full Vendor List with Reject All* (there is no statistically significant difference in the ranks of these two according to the Mann-Whitney U test), and *Full Vendor List without Reject All* being the least preferred.

4.3 Factors influencing consent notice design preferences

Next, we checked if the jurisdiction of a user (whether they are from the EU or not), their privacy stance, or background have any correlation with what consent notice UI design they prefer. So we took the responses to the respective questions as independent variables, the ranking of each consent notice design as the dependent variable and created five ordinal regression models (one for each design). Surprisingly, we find that whether the participant belonged to the EU has no correlation with the ranking for any design (p-value > 0.05 in all five ordinal regression models), indicating that a well-designed GDPR consent notice may be suitable for our population without worrying about a specific jurisdiction

(*i.e.* whether from the EU or not). We also observe a weak correlation with privacy knowledge, privacy-oriented actions and internet background in the case of some designs (presented in Table 4). We present each of these user-centric features, which are correlated with choosing different designs.

- **Reading cookie consent notice banner to choose the most privacy-oriented setting**: Whether the user reads the GDPR cookie consent banner to choose the most privacy-oriented setting (whenever they are presented with one) is positively correlated with choosing *Cookie Categories* design. So the users who read the consent notice and choose a privacy-oriented option give more preference to the *Cookie Categories* design.
- **Privacy stance**: There were six 5-point Likert scale questions under the section "Understanding your stance on privacy" in the survey instrument (adapted from the IUIPC scale [23]), for each of which every user could select a response on the 5-point Likert scale. We took the mean of their responses as participants' privacy stance. The negative coefficient indicates that users with a higher "Privacy stance" score (or users who are more privacy-oriented) generally assign lower ranks to the *Binary Choice* design. So they possibly wanted more detailed choices.
- **Use of a privacy-oriented search engine**: Interestingly, users who use a privacy-oriented search engine like DuckDuckGo, Qwant, etc., prefer the *Full Vendor List with Reject All* design more, as compared to other designs.
- **Internet experience**: The negative correlation indicated that users who have been using the internet for a longer period of time disliked *Full Vendor List without Reject All* and hence assigned lower ranks to it.
- **Frustration due to difficulty in choosing a privacy-oriented option**: This variable indicates whether users get frustrated or angry when websites make it difficult to choose a privacy-oriented option, and the responses were on the 5-point Likert scale. Users who agree to this obviously disliked the *Full Vendor List without Reject All* design, as the process of blocking every cookie caused fatigue, indicated by the negative value of the coefficient.

Next, moving ahead of the quantitative analysis, we now investigate *why* our participants ranked some designs higher and others lower using the qualitative data.

4.4   Unpacking factors affecting the choice of cookie consent notice designs in the wild (RQ2)

In order to understand the underlying factors stated by the participants for their like/dislike ranking of cookie consent interfaces, we used open coding. An author analysed the qualitative responses and created a codebook of six features responsible for liking a design (ease of use, conciseness, ability to customise, speed/decision-making time, clarity, informative) and four reasons for not liking a design (too much information, tiring and time-consuming, lack of clarity/transparency, lack of customisability) as stated by the participants. Next, two authors assigned codes to the reasons given by users for their choice. The value of Krippendorff's Alpha [16] came out to be 0.84, signifying good agreement. The authors resolved the few disagreements after discussion.

While users appreciated the presence of few features, some users also mentioned the lack of one or more of them as a reason to not give a particular consent notice UI higher preference in their ranking. Based on this, we created 2 heatmaps (Fig. 5(a) and Fig. 5(b)) -=- for reasons of liking and disliking, respectively (darker color implies higher frequency and thus more support for that reason of liking/disliking). Fig. 5(a) presents the frequency of the reasons for liking given by users when they marked a particular design as rank one. Fig. 5(b) presents the frequency of the reasons for disliking given by users when they did not mark that design as rank one.

Reasons for liking the consent notice designs: With these underlying reasons for liking/disliking a design, we now analyse individual designs to check why they are liked/disliked by our users in the wild.

(a) Heatmap with reasons for liking a particular design

(b) Heatmap with reasons for disliking a particular design

(c) Flattened heatmap with reasons for liking a particular design

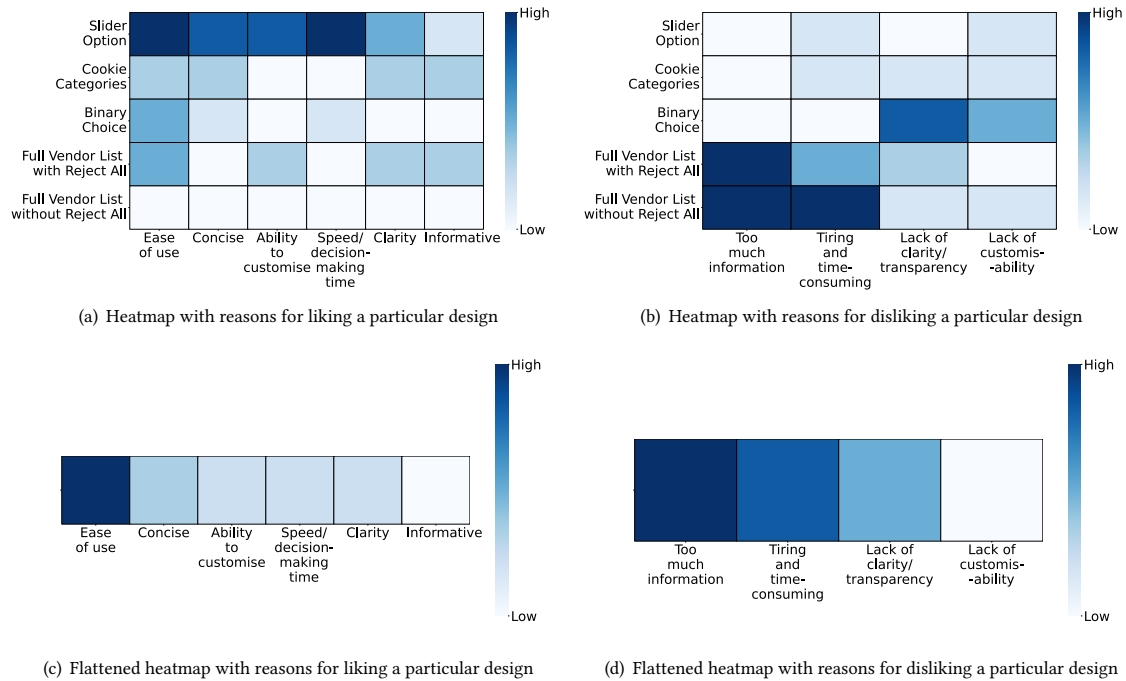(d) Flattened heatmap with reasons for disliking a particular design

Fig. 5. (a) and (b) – User preference reasons heatmaps (the rows are the cookie consent notice UIs and the columns are the reasons for liking/disliking given by the participants). A darker cell in (a) indicates a high fraction of participants gave the corresponding reason to rank the UI in that row as their first preference. A darker cell in (b) indicates a high fraction of participants gave the corresponding reason to not rank the UI in that row as their first preference. (c) and (d) – Flattened heatmaps highlighting the relative frequency of reasons given by users to for liking/disliking the designs accumulated across different UIs.

(1) **Slider Option**: This is the most preferred UI design among users and the reasons for this preference span almost all the codes we identified for liking a consent notice design. Key reasons for this design to rank first (i.e., being most liked by participants) are that it is easy to use, less time-consuming, customisable and concise. Several participants quoted that it is *simple and fast* and that they don't want to deal with *countless entries.*

(2) **Cookie Categories**: In terms of information, participants provided mixed reviews for this UI, with some finding it concise and some informative. No participant specifically liked this design for speeding up decision-making. Instead, few disliked it for being time-consuming. However, users did find it easy to use.

(3) **Binary Choice**: While this design was liked by many participants for being easy to use, less time-consuming and concise, it failed to be the first choice of users because of its lack of clarity (participant 18 says – *Binary choice is too vague and is possibly open to interpretation, potentially leading to unwanted cookies being accepted*) and customisability (participant 9 quotes – *I'll allow functional cookies if I feel that I can trust that is what they are, so binary choice comes third*).

(4) **Full vendor list with Reject All**: It made sense that this UI ticked the informative, clarity and customisability boxes after providing the users with a comprehensive list of options to choose from. While users did find it easy to use because of the Reject All functionality, it did not receive higher preference because of being *overly*

informative and, surprisingly, *time-consuming*. This is because, with a full vendor list, customisability comes at the cost of time.

(5) **Full vendor list without Reject All**: No user selected this design as their first preference, thus we could not identify any reason for liking this design. Looking at the heatmap with reasons for disliking makes it clear that excessive information without an Reject All option made it very tiring and time-consuming for the users.

Next, in order to generalise our results and help future designers, we present an analysis of which of these liking/disliking reasons were most supported by our participants.

Assessing the relative impact of factors for choosing a design: We flatten out the heatmaps by accumulating the frequency of each reason across the different UI designs (Fig. 5(c) and Fig. 5(d)). Focusing on Fig. 5(c) shows the very interesting relative importance of different factors. Four of the six reasons (conciseness, customisability, decision-making time and clarity) have a near equal impact on the decision of the users.

(1) **Ease of use is highly important**: Ease of use has a significantly higher frequency than any other reason, but that is very subjective and, for several users, dependent on the other reasons, *e.g.*, a design may be simple to use because of its conciseness or the speed with which a user can act on it. As participant 5 says for Slider Preference — *easy and speed*. Similarly, participant 30 says about the Binary Choice — *It must be easy to reject anything I don't want.*

(2) **Conciseness/Regulating amount of information is important**: A strong bias was observed towards concise cookie notices, with excessive information being the most frequently occurring reason for disliking a design. The amount of information affected the usability of the cookie banner with participant 8 quoting — *I don't like the full vendor list. It's too long, full of clutter and not easy to use.* On the other hand, overly concise designs like Binary Choice lead to a lack of transparency and clarity, with participants feeling that it is not easily observable, vague and open to interpretation. Participant 16 quotes for Binary Choice — *simple but tries to fool the user into giving consent.*

(3) **Users appreciate the ability to customise**: Some participants want a certain level of control over the cookies they select. Participant 13 quotes for Slider Option — *Simple, but still some control is preferred over a simple all or none.* An interesting point to take from the study is that vendor lists are not truly customisable. If we compare the Slider Option row with that of Full Vendor List with Reject All, we observe both receive ease of use, customisability and clarity as positive feedback from the participants. While Full Vendor List with Reject All has a higher frequency of users liking it because of its informative nature, the Slider Option is liked because of its conciseness. However, the surprising part is users who did select Full Vendor List with Reject All did not do it for its speed despite it having the Reject All button. The Slider Option gives sufficient customisability (by enabling users to easily choose any of the following sets of cookies: only required cookies, required + functional cookies or required + functional + advertising cookies) and also does not sacrifice the speed factor. As participant 14 quotes — *some choice is better than all or none, but if I had to manually go through a list of 100, then I would much prefer a single block all button.* Hence, if customisability comes at the cost of time, users won't prefer it.

(4) **Higher speed and lower decision-making time are useful to participants**: Participant 29 quotes for Binary Choice — *less time spent = better*. The time-consuming nature of vendor lists is one of the primary reasons that they are not ranked higher in the preference order of most users and generally disliked. Users did not find the Cookie Categories UI fast enough due to the way it is designed, requiring separate clicks to turn on/off each

category. Participant 4 quotes for Cookie Categories — *need to click it multiple times, leaving the availability (sic!)*
for error.

(5) **Clarity/Transparency**: A simple UI which was clear to understand and not ambiguous or misleading was
highly preferred. It instilled a sense of trust and confirmation of not being tracked in the user. Participant 24 says
— *I like visual confirmation that every possible cookie has been blocked.*

Assessing the relative impact of factors for disliking a design: The heatmap highlighting the relative importance
of reasons for dislike (Fig. 5(d)) covers a broader spectrum of a design being anywhere in the preference order of the
user but the first. This heatmap shows why a user preferred some design over the other, and this, when accumulated
over the different designs, helps us identify the strongest drawbacks from the perspective of the participants. The
drawbacks, in order of decreasing impact are *Excessive Information > Time-Consuming > Lack of Transparency > Lack*
of Customisability, which aligns with the reasons presented above.

5 CONCLUDING DISCUSSION

We have identified which consent notice UI designs are preferred by users and which are not. We find that most users
prefer a simple and concise consent notice like the slider design or the cookie categories design. However, the usability
factors that contribute to a specific design being preferred more over others are more important than the exact designs
themselves, as they help generalise the idea of what a regular internet user likes and would want to see. These factors
include customisability, decision-making time, clarity/transparency, and the amount of information provided. We
believe these factors will help CMPs and websites while designing a new customised consent notice design by finding
the right balance between all of them. Our study has a respondent pool from 30 countries with a non-trivial fraction
outside of the EU who might not even be familair with these cookie consent notices. We find that this international
audience is able to choose settings that maximise their privacy, and we believe that this international nature of our
participants will also make this study relevant for other countries that are exploring privacy regulations.

5.1 Power of defaults

Similar to previous work [28, 35], we found that defaults do seem to have a non-trivial effect in most consent notice UI
designs. The default option is the second most frequently chosen option for the slider design, the cookie categories
design and the binary choice design (Fig. 3). In the slider (Fig. 1(a)), the functional cookies are enabled by default in
addition to the strictly necessary cookies, and nearly 40% of our participants end up choosing this option. In the cookie
categories design (Fig. 1(b)), all categories are enabled by default, and almost 30% of users opt for it. In the binary choice
design (Fig. 1(c)), the "Accept all cookies" option is enabled by default. Although we allowed users to simply dismiss the
dialogue box by clicking on the X cancel button at the top right, as much as 30% of users select the default option.

Websites can exercise the power of defaults to influence users and nudge them into consenting to be tracked using
dark patterns. Such practices can be prevented by the existence of a regulation, whereby either a consent notice
would either have no default option selected, or, in the case of a default option set, it should be the one which is most
privacy-preserving and leads to the least (preferably none) amount of tracking.

5.2 Do users realise the impact of their choices?

We have seen that users seem to be able to choose the most private option in general. However, it might not imply that
users understand what is happening behind the scenes. Consequently, to evaluate a deeper understanding of users, we

use the following fact — users who explicitly agree to be tracked are legally (under GDPR) allowed to be tracked. Thus, we show a consent notice which has only two options — Agree (agreeing to let the website collect information about them) and Disagree (the opposite). Then we asked what users *thought* would happen if they did not click on "I agree". i.e., if they either clicked on "I don't agree" or if they simply ignored the cookie consent request. In this case, GDPR is very clear that information about the users *cannot* be collected as the website has not obtained explicit and freely given consent from the users. However, many (71%) users believed that they would still be tracked, suggesting high levels of suspicion about the websites. We should also mention that our users were probably right in their low levels of trust (and in being cautious); through a manual examination, we find that 63% of Alexa UK Top500 websites which ask for user consent actually place tracking cookies in the user's browser even before explicit consent is obtained.

To conclude, we strongly feel that our study sheds light on what consent notices users prefer in the wild. More importantly, we believe the underlying factors uncovered by our study have the potential to guide future researchers and designers. Specifically, a thorough understanding and operationalisation of these factors into designs can help future designers take a principled approach to design and evaluate more usable cookie consent management interfaces.

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A   APPENDIX: SURVEY INSTRUMENT

To see whether the respondents' preferences (rankings) of different CMP designs were dependent on their background and expertise as well as their privacy stance and behaviours, we asked the following questions.

Background or Expertise

(1) How long have you been using the Internet regularly?

    ○ less than a year   ○ 3 - 4 years   ○ 5 - 10 years   ○ more than 10 years

(2) Are you majoring in or do you have a degree or job in computer science, computer engineering, information technology or IT related fields?

    ○ Yes   ○ No   ○ Prefer not to answer

(3) How many hours do you spend on the computer on an average day?

    ○ less than 1 hour   ○ 1 - 5 hours   ○ 5 - 10 hours   ○ 10 - 15 hours   ○ more than 15 hours

Understanding your stance on privacy

(1) I believe companies seeking information online should have a detailed online privacy policy (clearly disclosing the way the data are collected, processed, and used).

    ○ Strongly agree   ○ Agree   ○ Neutral   ○ Disagree   ○ Strongly disagree

(2) I should be made aware of how my personal information will be used.

    ○ Strongly agree   ○ Agree   ○ Neutral   ○ Disagree   ○ Strongly disagree

(3) It usually bothers me when online companies ask me for personal information.

    ○ Strongly agree   ○ Agree   ○ Neutral   ○ Disagree   ○ Strongly disagree

(4) I am concerned that online companies that collected personal data is sharing it with other companies I don't know about.

    ○ Strongly agree   ○ Agree   ○ Neutral   ○ Disagree   ○ Strongly disagree

(5) I find that online ads are sometimes useful and I dont mind being tracked if it gives new and useful information.

    ○ Strongly agree   ○ Agree   ○ Neutral   ○ Disagree   ○ Strongly disagree

Privacy oriented actions

(1) Do you clear your Internet browser history regularly?

    ○ No, I don't bother clearing my browser history.

    ○ No, I don't manually clear my browser history, but I set my browser to clear at regular intervals.

    ○ Yes, I manually clear my browser history at short intervals (e.g., every day/week or month).

    ○ Yes, I occasionally clear my browser history (no regular intervals).

(2) Do you clear your browser cookies regularly?

    ○ No, I don't bother clearing my cookies.

    ○ No, I don't manually clear my cookies, but I set my browser to clear at regular intervals.

    ○ Yes, I manually clear my cookies at short intervals (e.g., every day/week or month).

    ○ Yes, I occasionally clear my cookies (no regular intervals).

(3) Do you have any of the following ad blockers installed?

    □ Ghostery   □ AdBlock (Plus)   □ uBlock Origin   □ AdGuard   □ Privacy Badger

(4) Do you use any of the following privacy oriented browsers?

    □ Firefox Focus   □ Opera   □ Brave   □ Tor

(5) Do you use any of the following privacy oriented search engine?

    □ Duckduckgo   □ Qwant   □ Startpage   □ Swisscows   □ Ecosia

Deal with GDPR cookie consents

(1) Do you make sure to check the privacy policies of the websites you visit?

    ◦ Yes, I always check

    ◦ I make sure to check for important sites like banks or when I share credit card information

    ◦ I rarely check

(2) When you see a GDPR cookie consent banner, what is your usual action.

    ◦ go through the banner and choose the most privacy oriented setting

    ◦ accept default

    ◦ carry on with the cookie banner showing

(3) I get frustrated or angry when websites make it difficult to choose a privacy oriented option.

    ◦ Strongly agree   ◦ Agree   ◦ Neutral   ◦ Disagree   ◦ Strongly disagree

(4) Do you feel tired by having to choose all the different cookie consent options on all the sites you visit?

    ◦ Yes   ◦ No