Theory/Practice Transfer Paper

Matriculation number:	8240
Accepted topic:	Effect of cookie banner design on user click-through rate
Bachelor's programme, centuria:	Bachelor of Science, Angewandte Informatik, A17a

Contents

List of Figures

1 Introduction

Data privacy has a long history for both companies and states as well as users. With the advent of the internet it became easy — relatively speaking — to collect data about individual users to analyze their behavior. This data could be used for a multitude of purposes by different parties: Website owners could use it to analyze the traffic on their page in order to optimize it, advertising networks can employ this data to create user profiles aiding personalized and targeted advertising. Other uses include selling the data to interested parties for revenue.

In the early days of the world-wide web these practices became widespread and relatively murky and the choice of providing options regarding data privacy to the user was with the website providers. This was less than ideal and by the late 20th century and early 21st law enforcement agencies began to regulate the collection of personal data.

Over the years many levels of regulations have been employed ranging from a simple notice that data was being collected to a full consent request pop-up. Modern regulations like the General Data Protection Regulation (GDPR) require websites to explicitly ask the user for consent before employing tracking technology. These consent flows come about in two major forms: Banners and Modals. Banners block a certain region[1] of the viewport, usually at the bottom, and tend to have two buttons to either reject or accept monitoring of user activity. Modals take the same basic concepts employed by banners but block access to page before a decision is made. Both solutions can fulfill the GDPR's requirements but at the same time both are capable of missing the mark. It is highly debatable and up to the jurisdiction whether techniques like auto-dismissing consent banners are compliant. This cite from the regulation states the requirements for the consent mechanism:

> Consent should be given by a clear affirmative act establishing a freely given, specific, informed and unambiguous indication of the data subject's agreement to the processing of personal data [. . .].

With users being exposed to cookie notices, opt-in banners, and consent modals for over two decades and companies attempting to walk a tightrope in the legal gray area, the question comes up how many users actually notice and interact with these data privacy related page elements. This includes the question of how much of an effect different sizes of banners have on the results.

Given that question this paper will focus on the following two research questions:

1. How did consent requirements evolve in the EU over the last two decades?
2. What effect does the size of a consent banner have on the number of users interacting with it?

The first question will be answered by researching documents regarding the legislation surrounding data privacy. The second question will be evaluated through a survey which guides users through a few websites with different consent mechanisms.

---

[1]commonly ranging between 5% and 25%

2   History of online data privacy in the EU

At the beginning of the 21st century the world-wide web was a wild-west of tracking and personal data collection. In 2002 the EU took action to counter this development and published the so-called ePrivacy directive (Privacy and Electronic Communications Directive 2002/58/EC). It acknowledged both the importance and usefulness of cookies but also the danger they could pose to a users privacy [1]. While the directive was designed to make opt-in a requirement, it could be interpreted differently so that it allows opt-out to be used[2].

As a matter of fact, the ePrivacy was only a directive and thus considered a guideline for member states of the EU instead of a mandatory word-by-word legislation that applied. This resulted in many countries interpreting the directive differently: Some countries followed the originally intended notion of opting in while others like e.g. Germany incorporated an opt-out mechanism into their local laws [2]. A few members even considered the browser provided tracking prevention preferences to suffice, treating the installation of a browser by the user as general consent [3].

In the following years multiple cases of local law enforcement agencies ignoring this deviation and concerns from users followed [4]. Close to two decades after the original publication of the directive the European Court of Justice (ECJ) decided that the German law was not properly following the directive and requested changes [5]. To counter these misinterpretations of the directive, the EU published a new version (2009/136/EC) seven years later to make the requirement for opt-in more explicit amongst other changes [6] [7; section 66].

While promising, the change did not have the desired effect and member states were still not following the directive as expected [3]. However, users were still concerned about their privacy as a number of representative surveys proved. A survey by the University of Pennsylvania from 2009 showed that 87% did not want target advertising based on user tracking [8]. The following year Gallup found out that 67% thought that behavioral targeting should be outright illegal [9]. In 2011 a survey by TRUSTe estimated that about 85% of users would not consent to tracking if given the choice and 78% would reject analytics cookies [10]. The year after, an independent survey showed that 68% are still "not okay" with behavioral advertising [11]. Despite all this, research by J. R. Mayer et al. uncovered that many websites were still forwarding tracking information without explicit opt-in. Not only does this act against the users' choice and is considered illegal but it may also harm the users' privacy as non-anonymised data is forwarded to third parties [12].

This did not go by unnoticed and the EU commissioned the GDPR which, as opposed to the ePrivacy directive, was set out to be a regulation to prevent re-interpretations by the members and making the incorporation into local law mandatory [13]. Six years later the regulation was published and taking effect, requiring websites to request explicit consent before enabling any tracking software [14; section 32].

Even though the GDPR restricts user tracking without explicit consent (opt-in), many websites are ignoring the regulation for a variety of reasons. A non-scientific survey found that up to two thirds of German news websites employ Facebook tracking software without requesting consent [15]. While the source can not be considered reliable, samples taken from sites mentioned in the blog article do reveal that the pages are in-fact using such software without consent. More examples can be found in the list of websites selected for the survey in this paper (see table 1). According to a survey by the Ponemon Institute, about 40% of companies are expected to miss the deadline of the GDPR taking

---

[2]opt-in describes the process of explicitly requesting consent to e.g. track a user before doing so while opt-out implies consent and instead allows the user to disable tracking at a later point in time

effect to become compliant, while an additional 8% stated that they do not know when and if they will ever reach this state. They discovered that the average annual budget for compliance is about 13 million US dollars, which could explain why many companies are lacking behind [16].

3 Survey

As mentioned in the introduction, an interactive survey will be used to answer the second research question. This method has been chosen because it allows for a fully controlled environment and, depending on the survey design, relatively unbiased insights into the users' behavior.

3.1 Design

To ensure consistent results and avoid any bias that might come from different device aspect ratios, screen resolutions or other hardware/software factors a fully controlled environment will be employed. Surveys will be conducted on Apple iPad Pro's running iPadOS 13. This is a trade-off towards improved result accuracy at the cost of the reach as many users do not own a matching device. The users will be guided through the data collection process by a custom mobile App that will be purpose-built for this research. It will record the device screen for later analysis of the users behavior and will make use of the ResearchKit Framework framework to simplify the implementation. The source code can be found on GitHub[3]. The survey will be written in German and mostly German websites are used to extend the participant group beyond just bilingual people.

The first section will introduce the user to the survey, instruct him regarding data privacy and ask for optional permission to publish the raw results. Additionally, it will run the setup which starts the screen recording and creates necessary files on disk. Then the user will be shown a list of six assignments[4] which ask him to fulfill a task on a web page. The task has been put in place to distract from the actual goal of the survey and guide the user to interact with each of the predetermined sites. For each assignment an isolated browser with its own set of initially empty cookies and preferences will be created. It contains a list of pre-defined bookmarks that are needed to navigate the requested pages. In order to prevent any bias, the order of assignments will be randomized for each participant. The pages will be chosen so that cookie banners with a wide range of different sizes and contrast ratios are included.

At the end of the survey a set of questions will be presented. These primarily cover demographics like occupation and whether the person is working in the Information Technology (IT) sector. Additionally, the participant will be asked to estimate his computer knowledge and whether he values privacy over comfort. These questions will be used later to determine whether various demographic groups behave differently. Finally, the participant will be presented with an option to share his E-Mail address if they wish to receive the final results.

---

[3]The link has been excluded in this version of the document for the author to remain anonymous
[4]This number has been chosen so that the survey takes approximately ten minutes

3.2 Distribution

To fit within the time constraints of this research format, the survey will be live for roughly two weeks. As the survey has very specific hardware requirements, a personal distribution method will be used. This involves loading the application onto devices of family, friends and acquaintances. These people are then asked to conduct the survey with others they encounter using their device and send the results, which will be collected and archived by the application automatically, back. As the iOS/iPadOS ecosystem does not support direct installation of an application from a file, the TestFlight beta testing service will be used to install the app.

3.3 Data collection

After the raw survey results have been collected, the data has to be interpreted. For this to happen a few preprocessing steps are necessary. The question results will be exported by ResearchKit as JSON and reshaped into CSV by a NodeJS script which is included in the GitHub repository. This table will then be augmented through a manual review of the screen recordings. Each assignment and thus page interaction will be rated as follows: What action did the user take? This can be either *Accept* (did accept the cookies), *Reject* (did reject the cookies) or *Ignore* (ignored the banner). If he interacted with it, the time will be recorded as either *on-load* (directly after loading the page) or *after-navigation* (after interacting with the page).

4 Parameters

To begin with, as outlined in section 3.1, a set of websites with varying cookie banner sizes have to be chosen for the survey. An overview with important key factors can be found in table 1. Each page, why it has been chosen, and what the assignment will be is described below. All pages listed have been submitted to the Internet Archive at the time the survey was published to retain a reproducible record of how they looked as the web is constantly changing. The links are provided in the footnotes. Additionally, screenshots of the survey interface have been captured for each page.

Table 1: Websites evaluated[5]

Website	TC	CC	CR	Size	Color
Backblaze	No	Yes	1.00:1	22.0%	White / White
IKEA	Yes	Yes	1.00:1	17.3%	White / White
Mindfactory	Yes	Yes	1.10:1	16.6%	Orange / White
Flüge.de	No	No	2.58:1	12.6%	White / Blue
Netflix	Yes	Yes	16.82:1	9.6%	White / Black
Twitter	Yes	No	5.61:1	5.0%	Grey / Black

[5]TC: No tracking takes place before consent is given, CC: Consent flow is compliant, CR: Contrast ratio

4.1 Backblaze[6]

This page has been chosen for its very large popup at roughly 22% as seen in figure 9. Since it does not block the page modally, it is still considered a banner even though it could be interpreted otherwise. At this size it is considered a major hindrance to the usability of the website but despite that the task has been designed carefully to permit solving without interacting with the banner. It has the same color as the page background, yielding a theoretical contrast ratio of 1:1. However, a drop shadow is present separating it visually from the page.

Assignment: The task on this page will be to retrieve the maximum storage limit for the personal backup plan. To obtain this information the user has to navigate to the product page using one of two possible links. On the following site the information can be found in multiple places. While still solvable this task has been chosen to potentially seed confusion as the answer — that there is no upper limit to the backup storage — may not be obvious which might trick users into thinking the information is obstructed by the cookie banners.

4.2 IKEA[7]

This online shop has been selected for its sizable banner at approximately 17.3% which manages to blend into the background with a very slight drop shadow and the same white color as seen in figure 12. Additionally, this shop provides the opportunity to design a task which forces the user to interact with the banner on one of the two possible navigation routes.

Assignment: The objective for this web shop is to obtain the price of a picture frame called "*RIBBA*". An additional constraint is that the exact size of 61x91cm has to be found, which has been chosen deliberately as it creates two possible navigation paths. While the first one uses the search and scrolling to get the result, the second one requires the user to visit the product page of the picture frame and open the size dropdown. The last option in the dropdown (61x91cm) is covered by the cookie banner, effectively forcing the user to interact with it.

4.3 Mindfactory[8]

This computer shop has been elected for its use of orange on white colors, which is expected to increase noticeability of the banner. It blocks the main navigation, which opens up the possibility for forced interactions. As the background is white and the banner orange it is very prominent and thus expected to not be overlooked by any user. A screenshot can be seen in figure 13.

Assignment: To direct the user through a path which requires a forced interaction the task calls for the number of 1 TB USB Stick models currently in the shop. To find this number the user has to open up the navigation menu called "Hardware" and click "USB Sticks" which directs him to an overview. A new hierarchical navigation opens up on the left which has a subcategory for 1 TB sticks. Once selected the user can either count the sticks as the amount is very low or read a label at the very top of the list.

---

[6]Backblaze snapshot
[7]IKEA snapshot
[8]Mindfactory snapshot

4.4   Fluege.de[9]

Intriguingly this page is not only colorful but also non-compliant in all aspects. While it does maintain a high contrast with white on blue and a drop shadow (ref. figure 10), the popup manages to disappear when the user interacts with any text inputs on the page. Not that it matters, as this page does not honor any consents and tracks the user regardless, enabling even more external trackers when consent is actually given. At roughly 12.6% it is covering the middle field in terms of screen space occupied.

Assignment: Since this page dismisses the consent popup as soon as the user interacts with the page, there is no point in staying on this page for prolonged periods of time. Thus, to keep the interaction short, this task asks the user to enter a few route details and retrieve the departure time of the first flight listed in the results. While the result list is loading, the banner is briefly visible for a few seconds as seen in figure 11.

4.5   Netflix[10]

This popular page has been included because it is compliant in all aspects and very simplistic. Its banner covers roughly 9.6% of the screen and has a high contrast ratio of approximately 17:1 (ref. figure 14). Due to the relatively small size and inverted colors it is an interesting contender which could shed light on the importance of color contrast.

Assignment: As this page has not much to interact with, the assignment here is to scroll down to the FAQ on the bottom of the site and find the price of the most expensive subscription available.

4.6   Twitter[11]

The last page is a social network with a semi-compliant grey on black banner which notifies the user that they will be tracked if they continue (ref. figure 15). It covers a paltry 5% of the screen. While they do not track before the user navigates around the site, they are not providing a means of rejecting tracking and have an implicit accept[12] which is strictly speaking non-compliant.

Assignment: To complete this task the user has to visit a users profile and search for the age of the latest tweet. While rather simplistic, this task shows whether the user interacts with the banner before it is too late.

---

[9]Fluege.de snapshot
[10]Netflix snapshot
[11]Twitter snapshot
[12]Although on Twitter they keep the banner around until the user actively dismisses it as opposed to Fluege.de where it is dismissed automatically

5 Findings

The survey has been conducted over a period of two weeks and 27 people did participate. Out of those, three results were invalid due to file corruption and/or circumvention of the survey mechanisms. A total of 15 persons gave consent to share their results publicly and the corresponding files will be published in the accompanying GitHub repository[13].

5.1 Overall

Even though the overall interaction results are not related to a specific page or cookie banner style, they may still contain valuable insights. As seen in figure 1 a majority of cookie banners were ignored with a CTR of 45%[14]. This indicates that they are only mildly effective in capturing the users' attention in general. However, it has to be taken into consideration that participants may have been conditioned to specifically ignore such banners as the concept has been in use since the early 21st century (for more details, refer section 2). It could also be caused by the short-term nature of the interaction of this survey. Users who interact with a page more frequently and for longer durations are expected to behave differently. These questions are ideally suited for future research into the topic.

Another interesting metric is the time at which the users interacted with the banner. Almost half of the interactions (30 out of 63) happened after the user navigated around the page. This might be caused through forced interactions (e.g. IKEA), by the user suspecting content being obscured by the banner, or because they encounter some waiting periods while the website processes information (e.g. fluege.de[15]). However, based on the data present it can not be determined with certainty. An alternative theory would be that users do not exhibit learned behavior but rather selective vision of the interface elements necessary to achieve the goal. To answer this question further research into the topic is required.

Of all interactions a slight trend towards accepting the policy is visible.

5.2 Demographics

Next up are participant demographics and whether they affect the overall results. Rather surprisingly, the effect on the CTR and type of interaction, while not negligible, is minor.

Subjective knowledge: The participants were asked to estimate their computer knowledge on a scale from 1-10. While there is a slight fluctuation (±1) in the CTR — as expected with the low sample size per knowledge — a positive correlation between the two can be seen in figure 8. However, it seems that the ratio of accepted vs. rejected policies changes towards the former instead of staying equal. A major bump in the graph can be seen at a knowledge level of 9. While it could be valid data, the low sample size of just two individuals makes this statistically insignificant.

Occupation: Out of the available groups (Student, Working, or Pensioned) students tend to be most aware of the banners and interact with them the most as seen in figure 7. Pensioned did not interact with any, however the sample size is too low to make this result statistically relevant.

---

[13]Link excluded in this version of the document
[14]This states that of all displayed cookie banners only 45% were interacted with
[15]During search only a loading indicator and the cookie info is displayed

Subjective privacy awareness: Similar to knowledge, the participants were asked to estimate whether they tend towards comfort at the cost of privacy or the other way around. The numbers in figure 6 correlate to a scale from 1-6 where one indicates full comfort and six full privacy. While the CTR increases from two to three, it stays constant above that and only the type of interaction changes. As expected, the number of accepted cookie policies decreases as subjective privacy awareness rises.

Workplace: The last demographic is whether a person works in the IT sector. The data in figure 5 indicates that the workplace has no significant effect on the behavior.

5.3   Time of interaction

Another metric is the time at which the user did interact with the banner. It can give an indication of whether the users' attention is captured by a banner as soon as it is displayed. Figure 3 shows the ratio of interaction times for each page. Purple indicates that the first interaction of the user with the page was to accept or reject the cookie policy while blue means that other interactions (e.g. navigating to sub-pages or using a search) took place beforehand.

The three pages that captured the most attention — namely Netflix, Mindfactory and Backblaze — have a roughly 50% split between the two possibilities. fluege.de, despite capturing overall less attention, has a similar ratio. Video analysis showed that most after-interaction clicks took place during the search process where the page was just displaying a loading indicator and banner. Twitter had only one interaction and the time of interaction results are not representative. IKEA is on the other end of the spectrum where users only interacted after navigation. As shown in section 5.4 it had a seemingly low noticeability and according to the video recordings half the interactions were forced, while the others took place at the end where the assignment had already been completed but not submitted.

Ignoring the pages with low sample counts, roughly half of all interactions took place after the user had interacted with the page. Given that the goal is to collect user consent before valuable tracking data is produced, this is a diminishing return. As seen in figure 1 only half the users interact with banners in general and of these only half will do so after navigating the page, yielding a theoretical CTR of just 25%.

5.4   CTR by website

This section will evaluate the CTR for each page and take a look on the effects of their respective banner design. The data from figure 2 will be referenced throughout this section. Each bar represents all interactions with one page, split into up to three areas. The bars will be discussed individually below. Each page is compared to its predecessor in the list.

Twitter: This page does not have any rejections because it was not possible to do so. Besides that, only 4% interacted with it and this interaction is statistically insignificant with only one matching sample. This result is presumably due to the very low contrast and size.

Netflix: Compared to the previous one the CTR increased significantly from 4% to 67% even though the banner grew only slightly. However, the contrast ratio increased manifold to approximately 17:1 from roughly 6:1 indicating that contrast plays a significant role in noticeability. Note though that the density of relevant content decreased and it is unclear whether this had an effect, opening the possibility for future research.

fluege.de: Despite a size increase to 12.6% the CTR decreases by 56%. Similarly, the contrast ratio decreased from roughly 17:1 to 2.58:1. Additionally, the disappearing of the banner as mentioned in section 4.4 may have an adverse effect as the duration of it being visible is significantly reduced. However, as seen in figure 3 almost half the interactions happened after navigation. The video recordings revealed that all of those happened during the loading phase of the search results. During this the screen is almost blank (ref. figure 11), the contrast ratio changed and users were effectively idle. This likely increased the interaction count, rendering results from this page close to unusable.

Mindfactory: In this web-shop almost 80% interacted with the banner surpassing Netflix slightly. Despite the low contrast ratio of just 1.1:1 it achieved the highest CTR. This might be due to the size increase and potentially the use of a signal color (orange) not used elsewhere. How strong of an impact different colors have regardless of contrast ratio requires further research.

IKEA: Even though IKEA had a banner that is larger than four other contenders it had a surprisingly low CTR of just 12.5%. This equals three participants out of which one was forced to interact with the banner to complete the assignment. This result is likely caused by the missing contrast, drop-shadow and no use of signal colors in either the background or buttons.

Backblaze: This service tied with Mindfactory in terms of CTR. While the popup has no color contrast it stands out due to the drop shadow and signal colors (red, green) on the buttons. This suggests that missing contrast can be made up by a shadow and size. A noticeable detail is the change in the accept/reject-ratio with more users rejecting the policy. It is possible that the clear use of signal colors for the buttons had an effect on this, however further research needs to be conducted in this area.

The results above show that multiple factors like size, contrast ratio, use of signal colors and shadows have an effect on the CTR. While no clear importance ranking is possible it seems that shadows and a high contrast ratio can be interchanged. Additionally, the use of signal colors appears to have a profound impact in steering the user focus. This theory is backed by Gama et al. [17].

Another takeaway is that the most prominent pages only gained rejections beyond a certain point (around 38% for this data set). This can be caused due to pages making it hard to reject their policy or by the possibility that users that tend to reject also have a higher bar for noticing banners. To answer this with certainty, further research focused on this has to be conducted.

5.5 Interaction by user

To determine whether individual users have a tendency towards a specific behavior, a ternary plot has been employed. In figure 4 each user is represented by a dot, overlapping dots are shown by an increase in saturation (up to four users are overlapping in this data). Each corner of the triangle corresponds to a type of action (accepting, rejecting or ignoring a banner). Dots are placed along the line from the center of the opposing edge to the corner depending on how many pages this specific action has been taken on by a user. To give an example, a user who only accepts will be located in the bottom left while one that accepts and rejects equally and ignores nothing is placed in the bottom center.

First off all, there are few extremes. Two users ignored every banner but other than that nobody just accepted or just rejected. It has mostly been a mix. Additionally, no user rejected more than 50% of the pages and few (5/24) ignored less than 50%. A cluster of users can be found in the top half of the triangle which correlates with the data from figure 1. This shows that the group of participants is not comprised of strongly opinionated users. Effectively, results that are applicable to a group of users are expected to apply to most individuals as well.

6   Conclusion

The key takeaway is that there is no clear winning factor to noticeability. How many users interact with a banner is strongly influenced by size, shadows & contrast ratio, and the use of signal colors. Each piece contributes to the overall CTR and no clear weighting of the factors emerged from the data collected. It is notable how many users have a selective vision and only notice parts of the page that are relevant to the task. A secondary takeaway is that on average roughly half of the page visitors notice a cookie banner. Only approximately 25% actually agreed to the cookie policy presented with no one actually taking the time to read it. Making matters worse, half the users interact with the policy popup only after navigating the page. This leads to an even higher loss in potential tracking data. Overall, cookie banners are an ineffective medium to notify users about the data being collected and to acquire their consent.

A worthwhile metric collected from the video recordings is that some users attempted to reject the policies repeatedly but failed to do so for various reasons (e.g. not hitting the button on the touch screen or the consent flow being misleading) and finally resorted to accepting it. This could potentially be abused by websites by temporarily disabling the reject button or designing complex and misleading consent flows. However, whether or not this is being applied in practice is unknown.

The reasons for the selective vision of users mentioned above remain unknown. Further and more focused research has to be conducted in this area to gain a better understanding whether or not conditioning, trained behaviour or yet unknown processes lead to this.

An additional area of research that was discovered during this work is the duration of the interactions. In the survey users only visited pages briefly to fulfill a very focused task and it remains unknown how their behavior might change with prolonged exposure or repeated visits.

Also mentioned above were colors and consent flow complexity. Both impact the CTR and decision made by the user and the full extent of their influence is yet unknown. Further research opportunities arise to improve the knowledge on which colors capture the users attention most and how complex workflows affect the users reasoning.

Regarding demographics, it remains unknown whether users that tend to reject policies also have a high bar for interacting with these. The data suggests that this is a possibility but the results are not conclusive. Future work may build on this to obtain a clearer picture.

One aspect that was not analyzed in detail is the content density on websites. Some edge cases during the survey might indicate that sites with a higher density and thus more complex layouts have a lower CTR. With all other factors at play, however, it is not certain what role this plays and further research has to be conducted.

Direct feedback from the participants showed that the bogus assignments fulfilled their intended purpose and distracted the users from the actual purpose of the survey.

An important lesson learned by reviewing the screen recordings was that humans are very creative and **will** circumvent almost any intentionally placed routes. Covering all possible routes and thinking about any user scenario is not possible and one should not rely on users taking a specific path through an application or survey. Some examples encountered include users knowing the answers to some questions and not even visiting the website or users noticing that no input validation is in place and just entering dummy data to pass the survey quickly.

During the evaluation it became clear that the chosen websites contained too many edge cases (like

Twitter not providing a way to reject the policy or fluege.de hiding the banner automatically) which complicated the process. Unaccounted differences like the structure or content density of websites introduced additional variability into the results which could have been avoided. Overall, there were too many variables which complicated the evaluation and reduced the applicability of the results especially due to the low sample size.

The distribution method used presented unique challenges in scaling the number of participants. For the purpose of this paper in the limited time frame it was acceptable but when conducting larger scale survey one should consider alternatives which scale better. One example is to rig a website that has a continuous stream of users to monitor user behavior.

Literature

[1] "Directive 2002/58/EC of the European Parliament and of the Council," 12-Jul-2002. [Online]. Available: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0058:en:HTML. [Accessed: 02-Sep-2020].

[2] "Telemediengesetz vom 26. Februar 2007 (bgbl. I s. 179)," 26-Feb-2007. [Online]. Available: http://www.gesetze-im-internet.de/tmg/__13.html. [Accessed: 02-Sep-2020].

[3] "Letter to the online advertising industry," Article 29 Data Protection Working Party, 2011.

[4] J. Nebel, "Cookies nur mit Einwilligung?" Sep-2019. [Online]. Available: https://www.lto.de/recht/hintergruende/h/eugh-c-673-17-cookies-aktiv-einwilligung/. [Accessed: 02-Sep-2020].

[5] J. Nebel, "Cookie-Einwilligung muss aktiv angekreuzt werden," May-2020. [Online]. Available: https://www.lto.de/recht/hintergruende/h/bgh-cookies-eugh-einwilligung-telemediengesetz-datenschutz-werbung/. [Accessed: 02-Sep-2020].

[6] "Opinion 2/2010 on online behavioural advertising," Article 29 Data Protection Working Party, 2010.

[7] "Richtlinie 2009/136/EG des Europäischen Parlaments und des Rates," 2009. [Online]. Available: https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32009L0136&from=EN. [Accessed: 02-Sep-2020].

[8] J. Turow, J. King, C. J. Hoofnatle, A. Bleakley, and M. Hennessy, "Americans reject tailored advertising and three activities that enable it," 2009.

[9] "USA TODAY/GALLUP POLL," Gallup, 2010.

[10] "Privacy and online behavioral advertising," TRUSTe and Harris Interactive, 2011.

[11] K. Purcell, J. Brenner, and L. Rainie, "Search engine use 2012," Pew Research Center, 2012.

[12] J. R. Mayer and J. C. Mitchell, "Third-Party Web Tracking: Policy and Technology," in *2012 IEEE Symposium on Security and Privacy*, IEEE, 2012, pp. 413–427.

[13] "The history of the General Data Protection Regulation," European data protection supervisor. [Online]. Available: https://edps.europa.eu/data-protection/data-protection/legislation/history-general-data-protection-regulation_en. [Accessed: 02-Sep-2020].

[14] "Regulation (eu) 2016/679 of the European Parliament and of the Council," Apr-2016. [Online]. Available: http://data.europa.eu/eli/reg/2016/679/oj. [Accessed: 02-Sep-2020].

[15] M. Eberl, "Facebook trackt Nutzer auf drei Viertel aller deutschen Nachrichtenseiten," Mar-2019. [Online]. Available: https://rufposten.de/blog/2019/06/03/facebook-tracker-auf-deutschen-medienseiten/. [Accessed: 02-Sep-2020].

[16] "The race to GDPR: A study of companies in the United States & Europe," Ponemon Institute, Apr-2018. [Online]. Available: https://iapp.org/media/pdf/resource_center/Ponemon_race-to-gdpr.pdf. [Accessed: 20-Aug-2020].

[17] S. Gama and D. Gonçalves, "Studying the perception of color components relative amounts in blended colors," in *Proceedings of the 8th Nordic Conference on Human-Computer Interaction Fun, Fast, Foundational - NordiCHI 14*, ACM Press, 2014.

Appendix

A Figures

All figures and screenshots below have been created/captured by the author for this research paper.
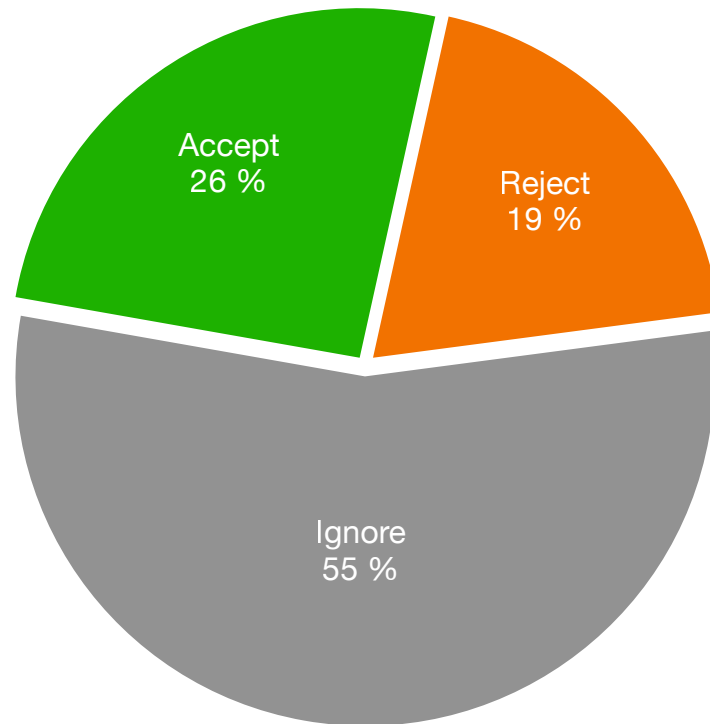

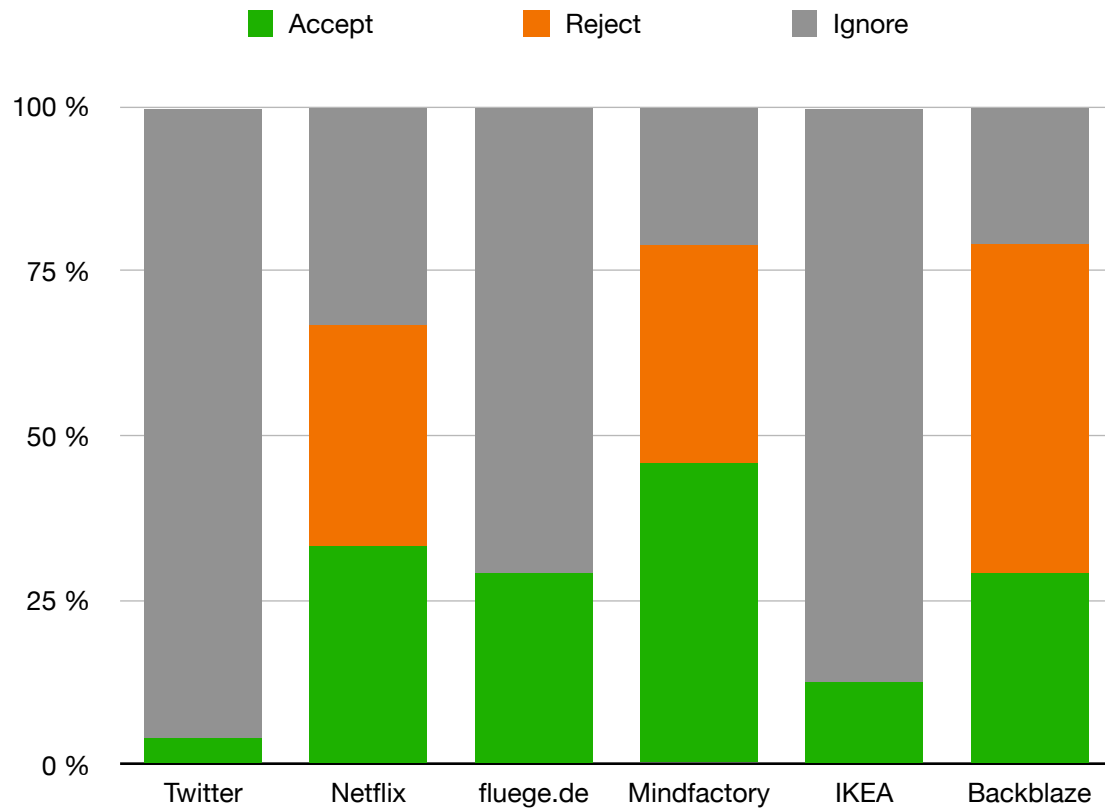Figure 1: Overall interaction with banners

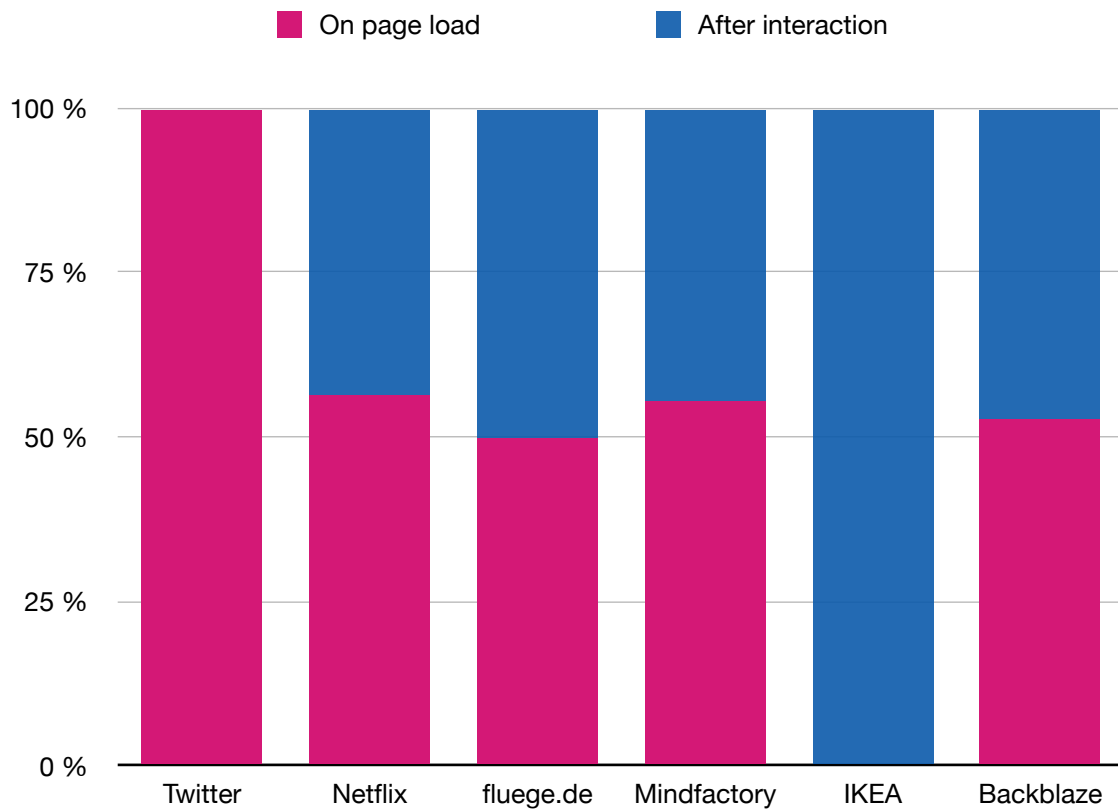Figure 2: User interaction with banners by page

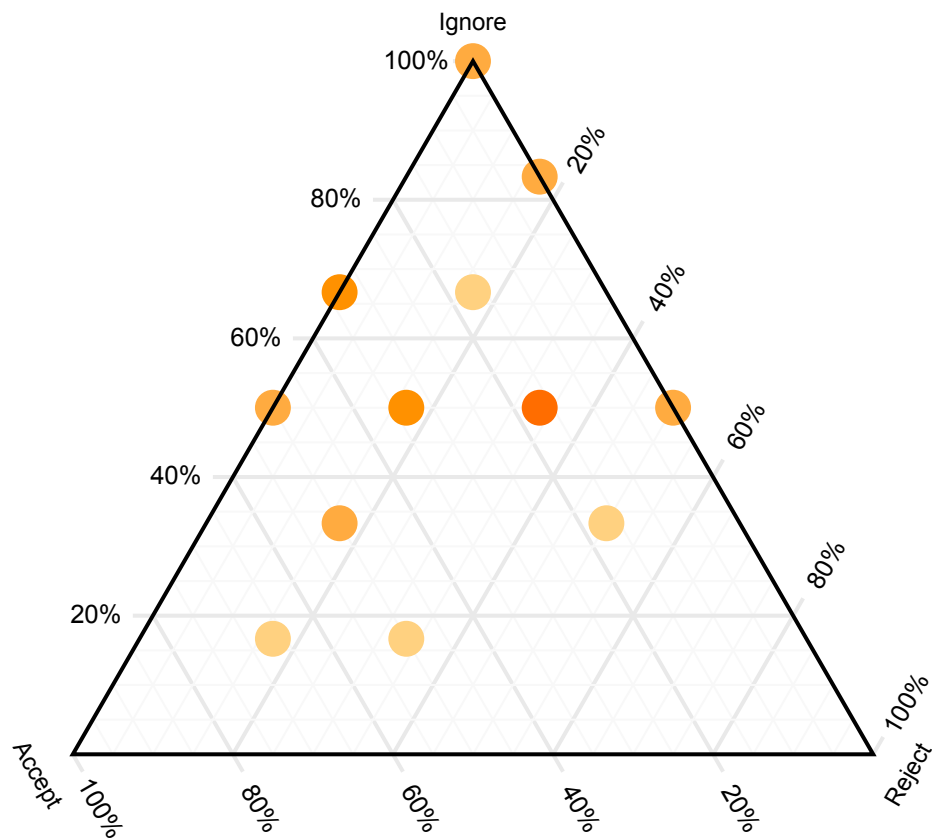Figure 3: Time at which users interacted with banners by page
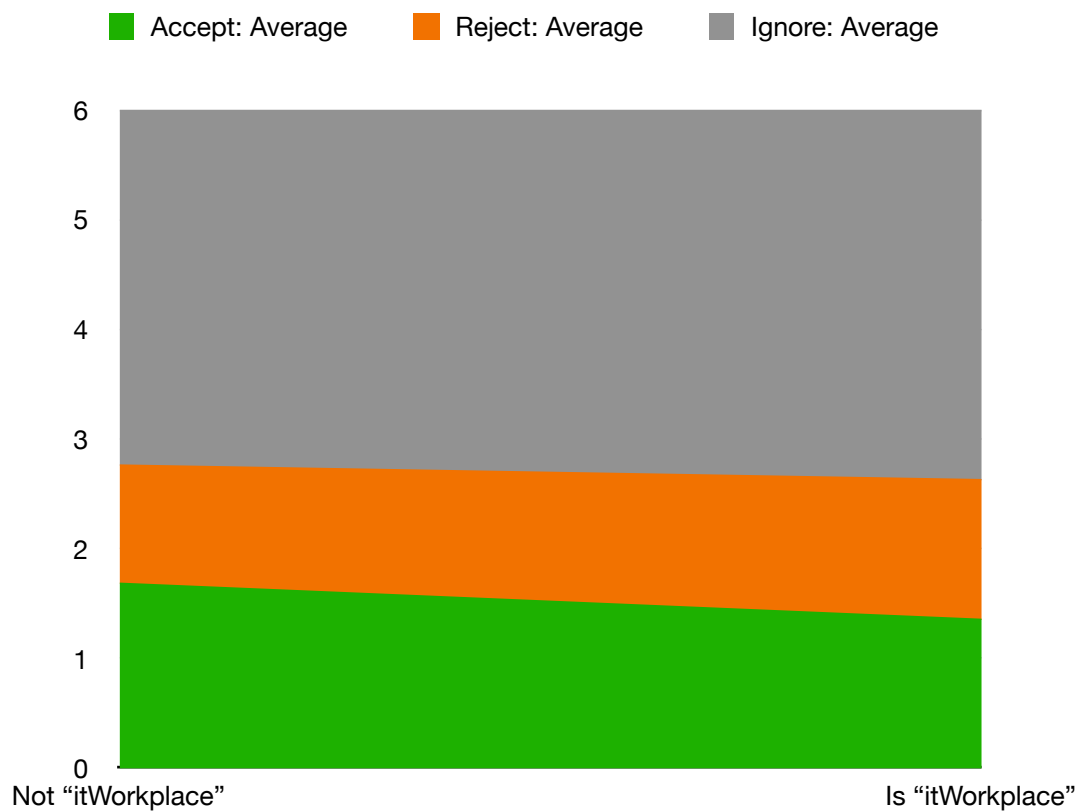
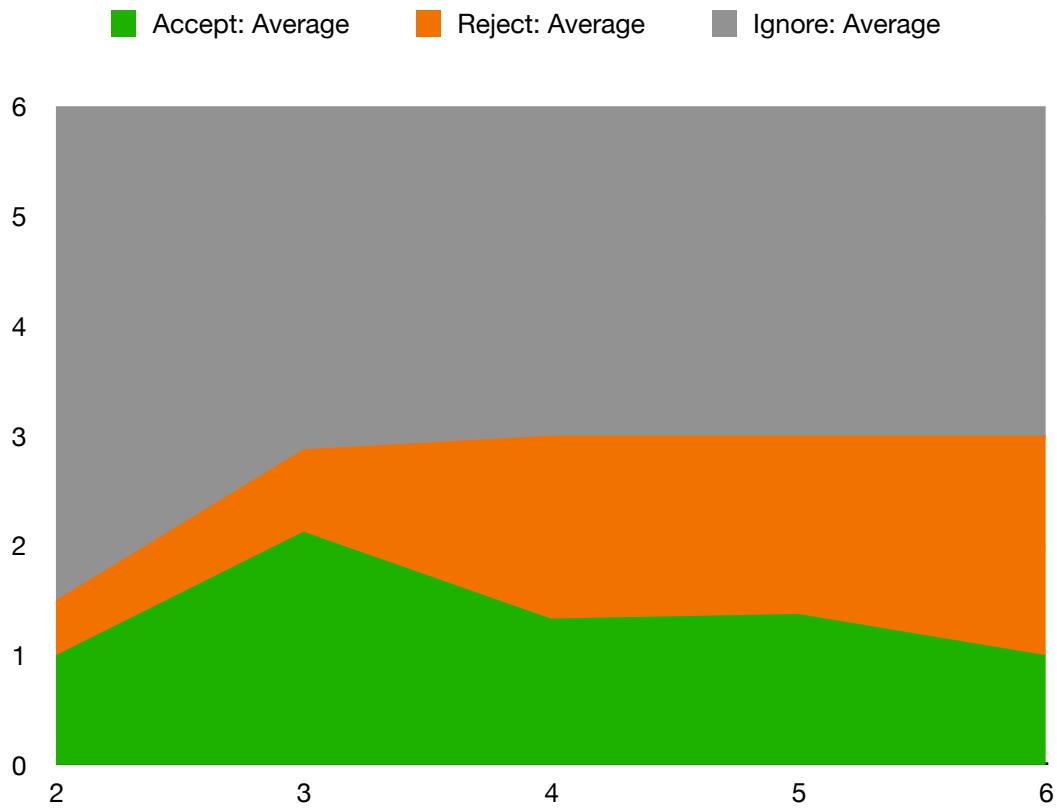Figure 4: Ternary plot of user interaction

Figure 5: CTR by workplace
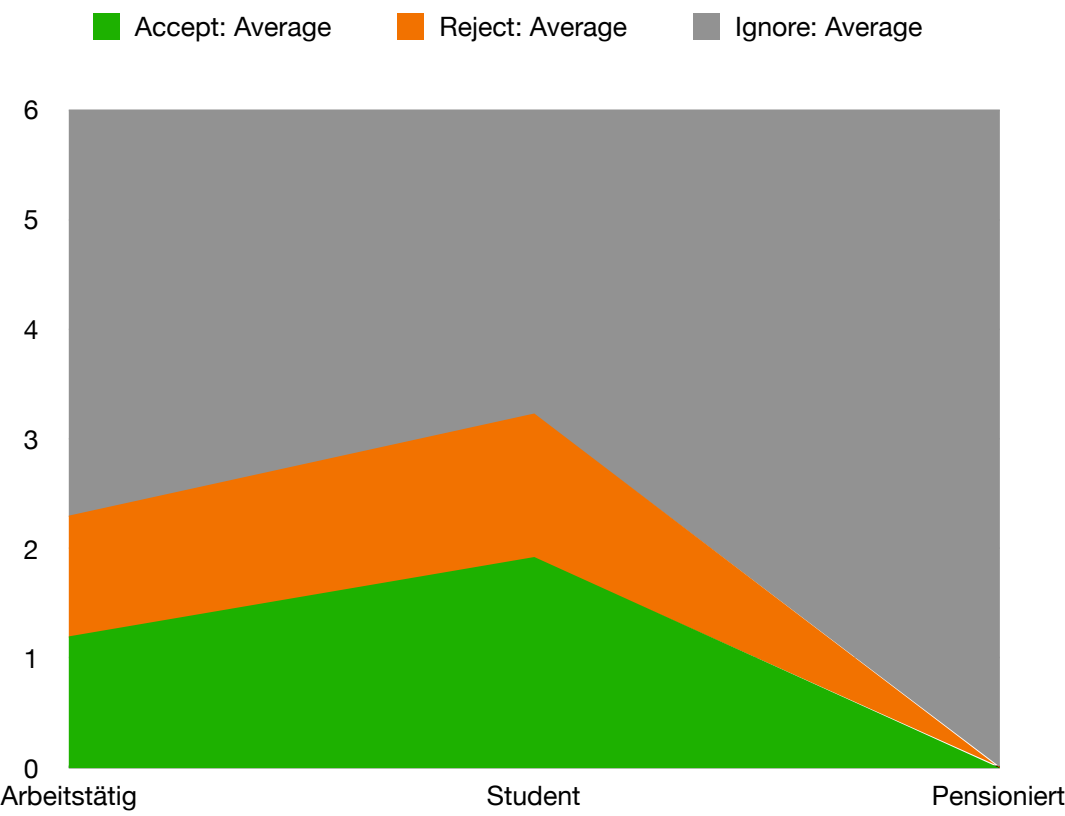
Figure 6: CTR by subjective privacy awareness

Figure 7: CTR by occupation
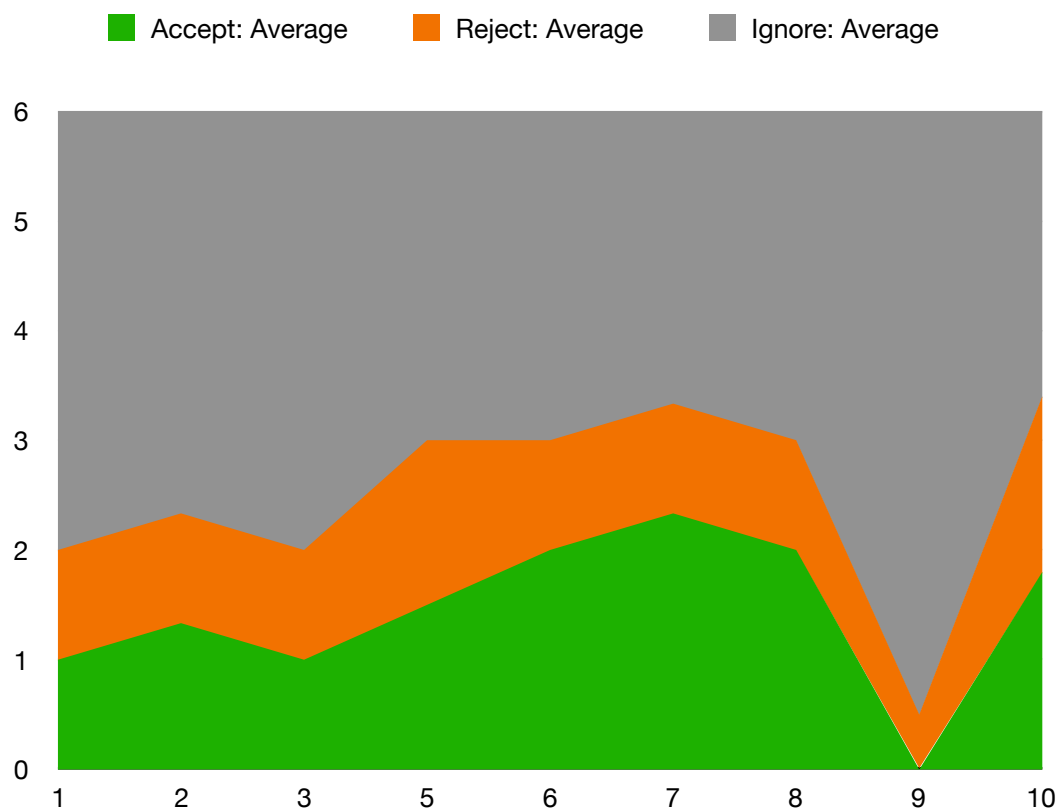
Figure 8: CTR by subjective IT knowledge
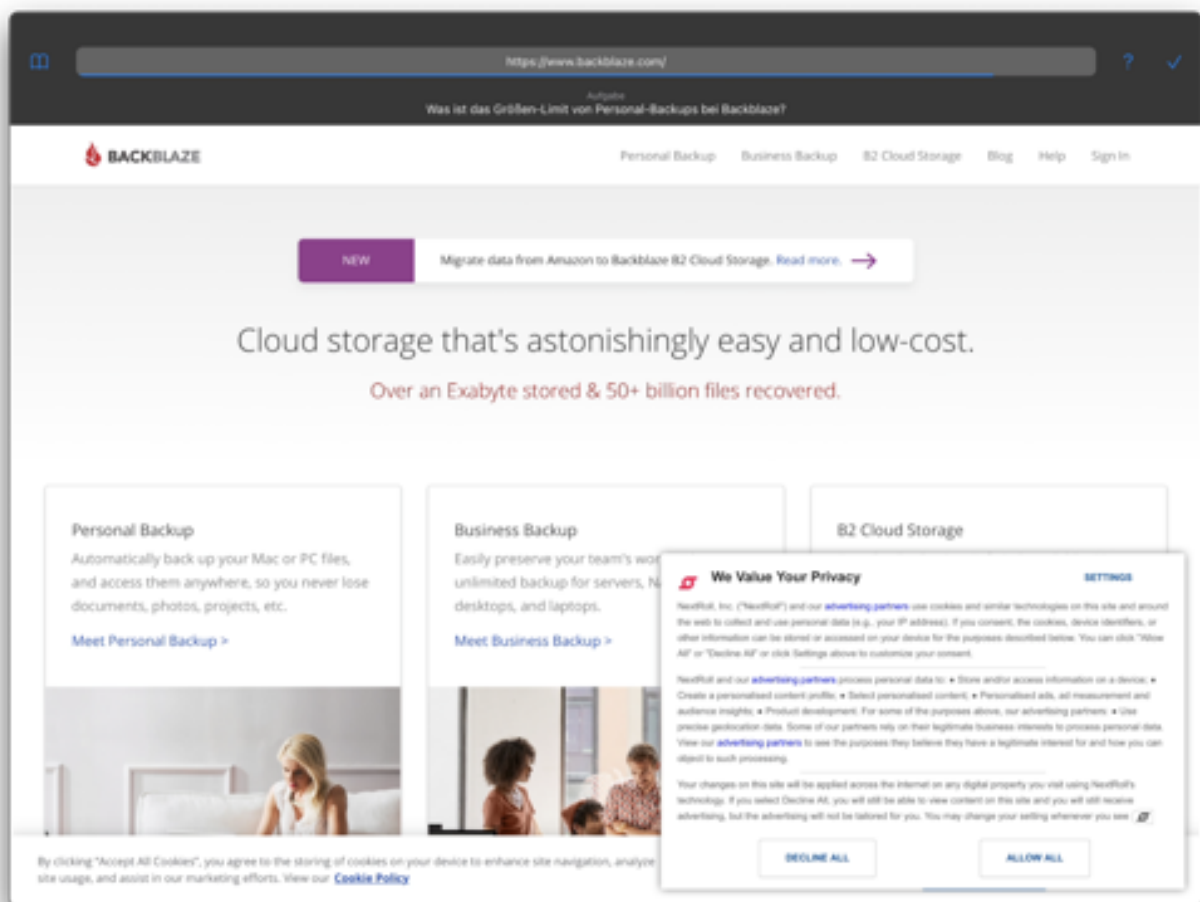
Figure 9: Survey snapshot — Backblaze
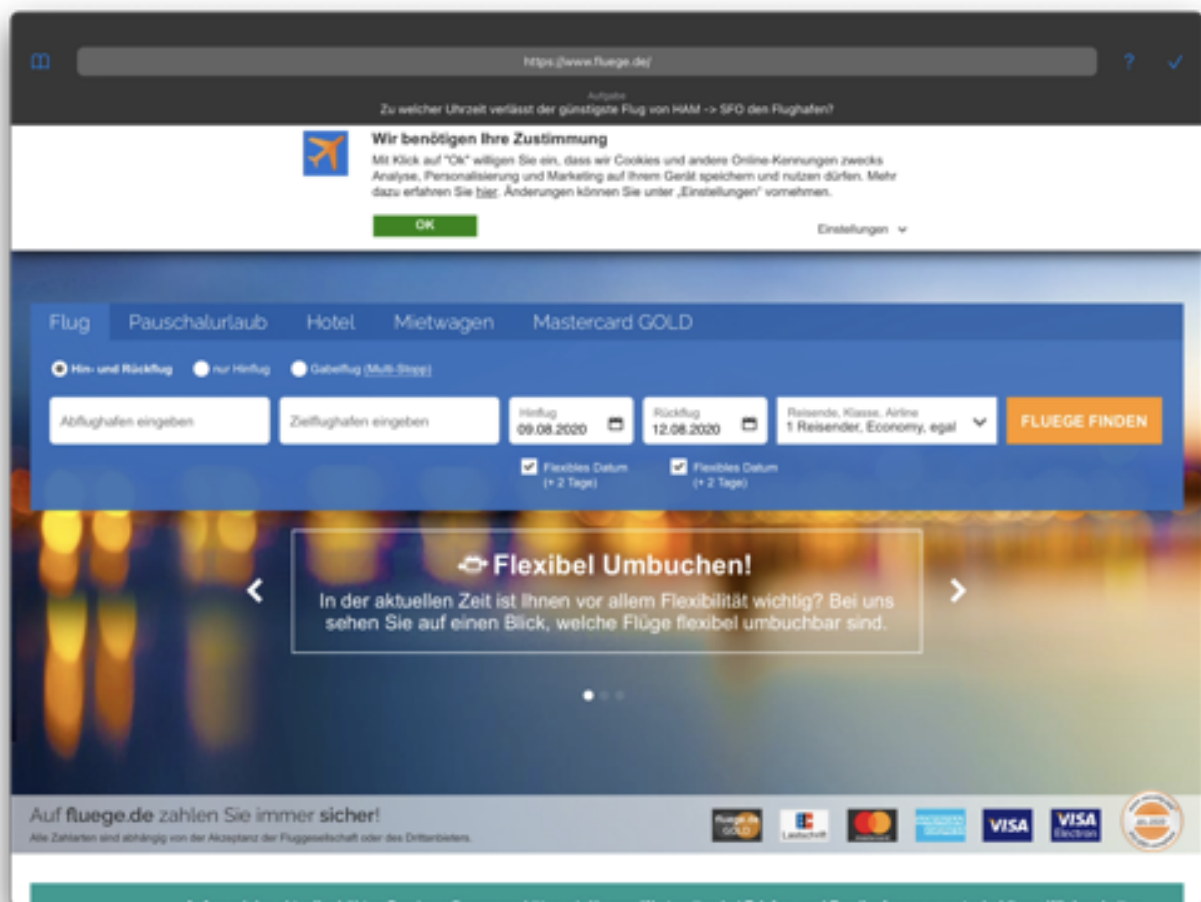
Figure 10: Survey snapshot — fluege.de
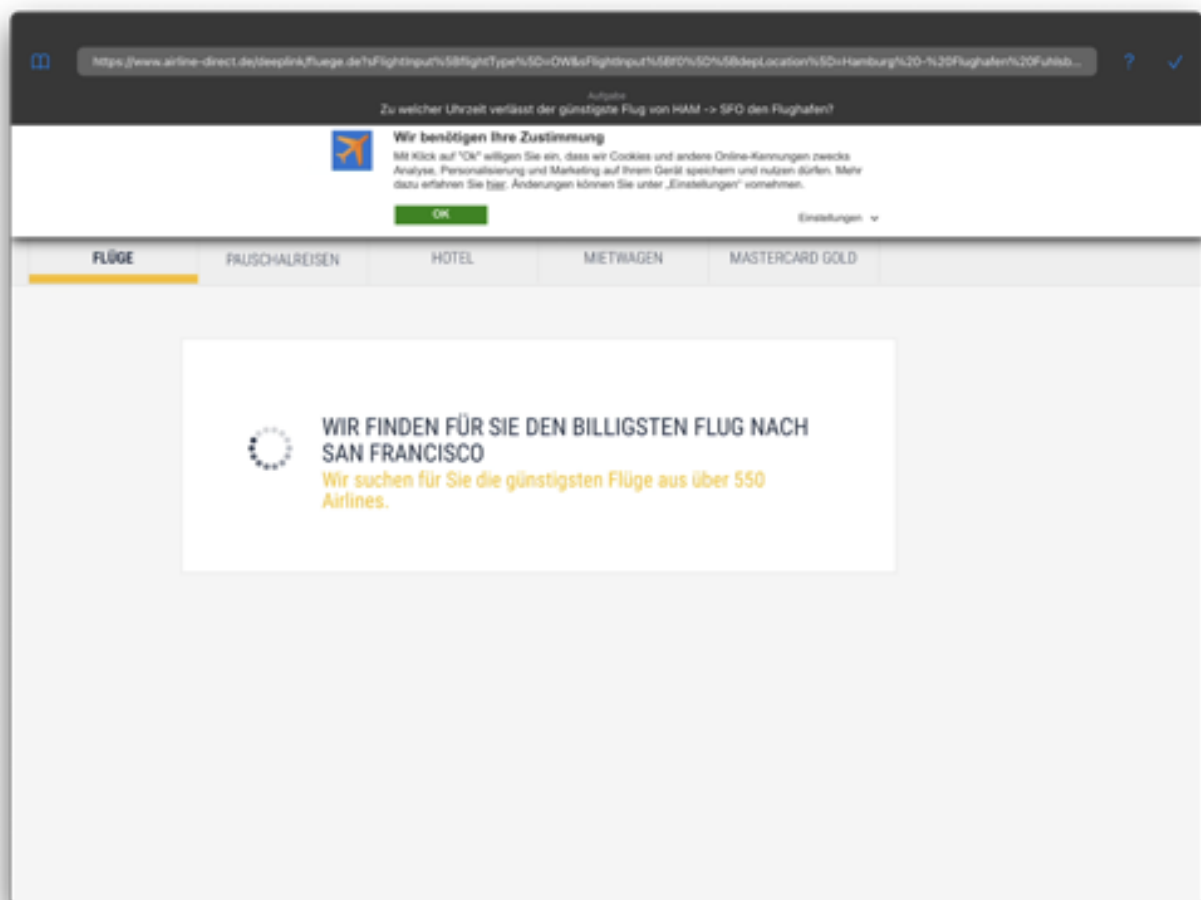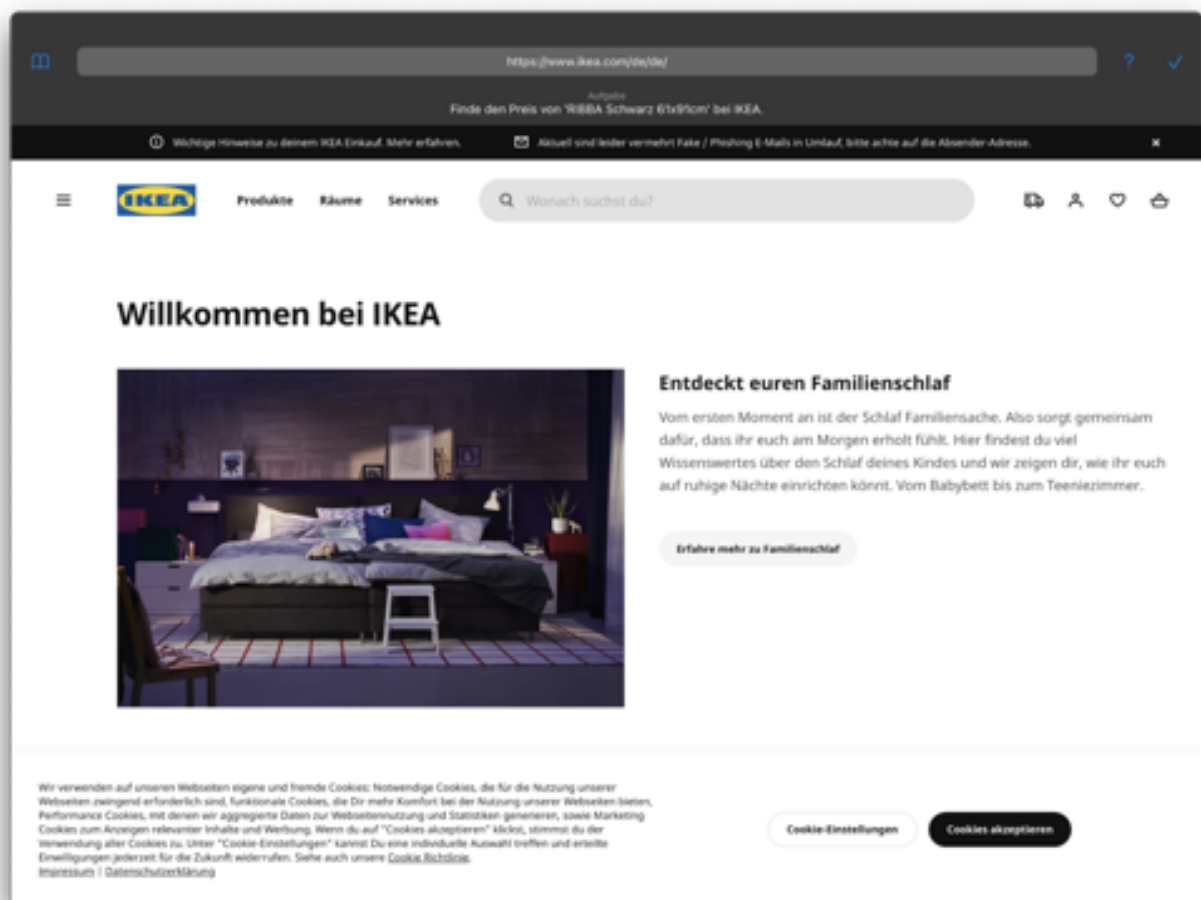
Figure 11: Survey snapshot — fluege.de (loading screen)

Figure 12: Survey snapshot — IKEA

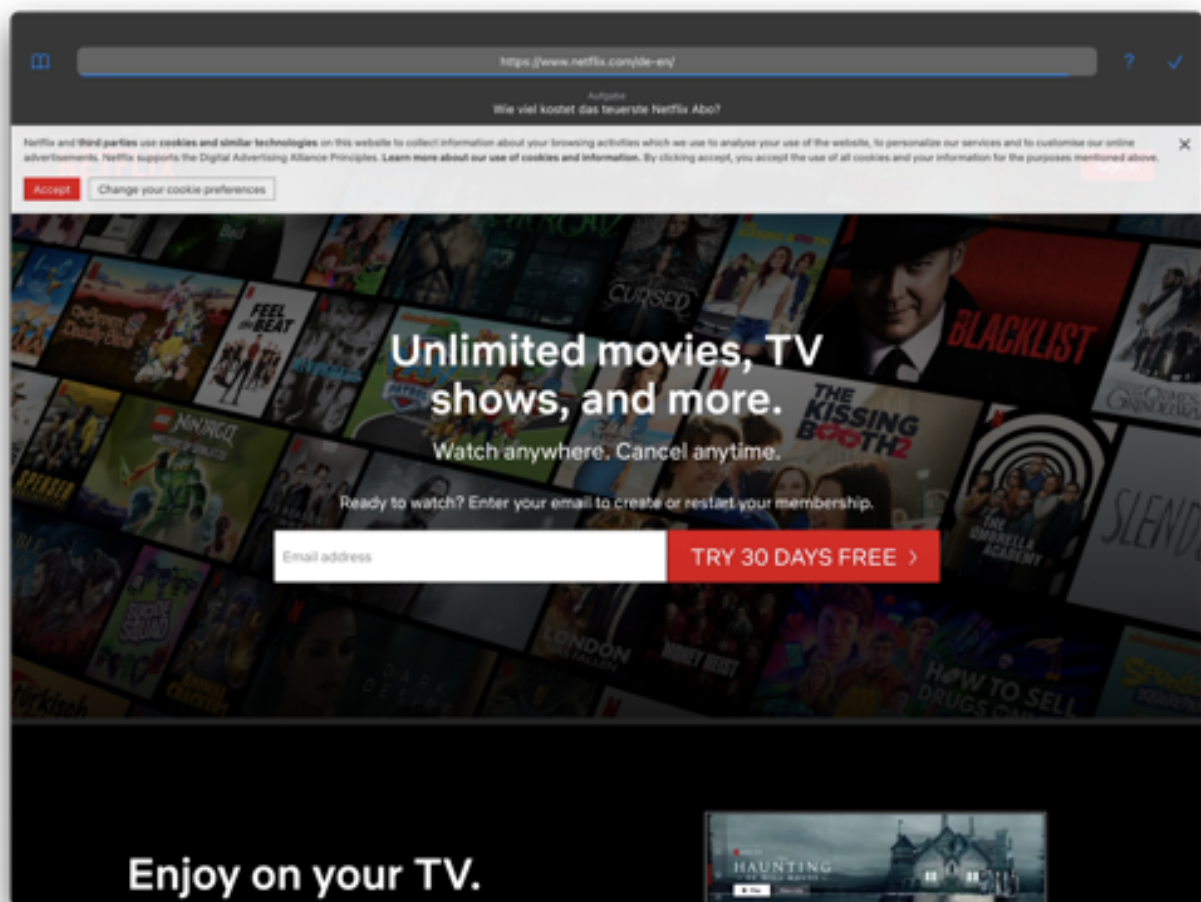Figure 13: Survey snapshot — Mindfactory

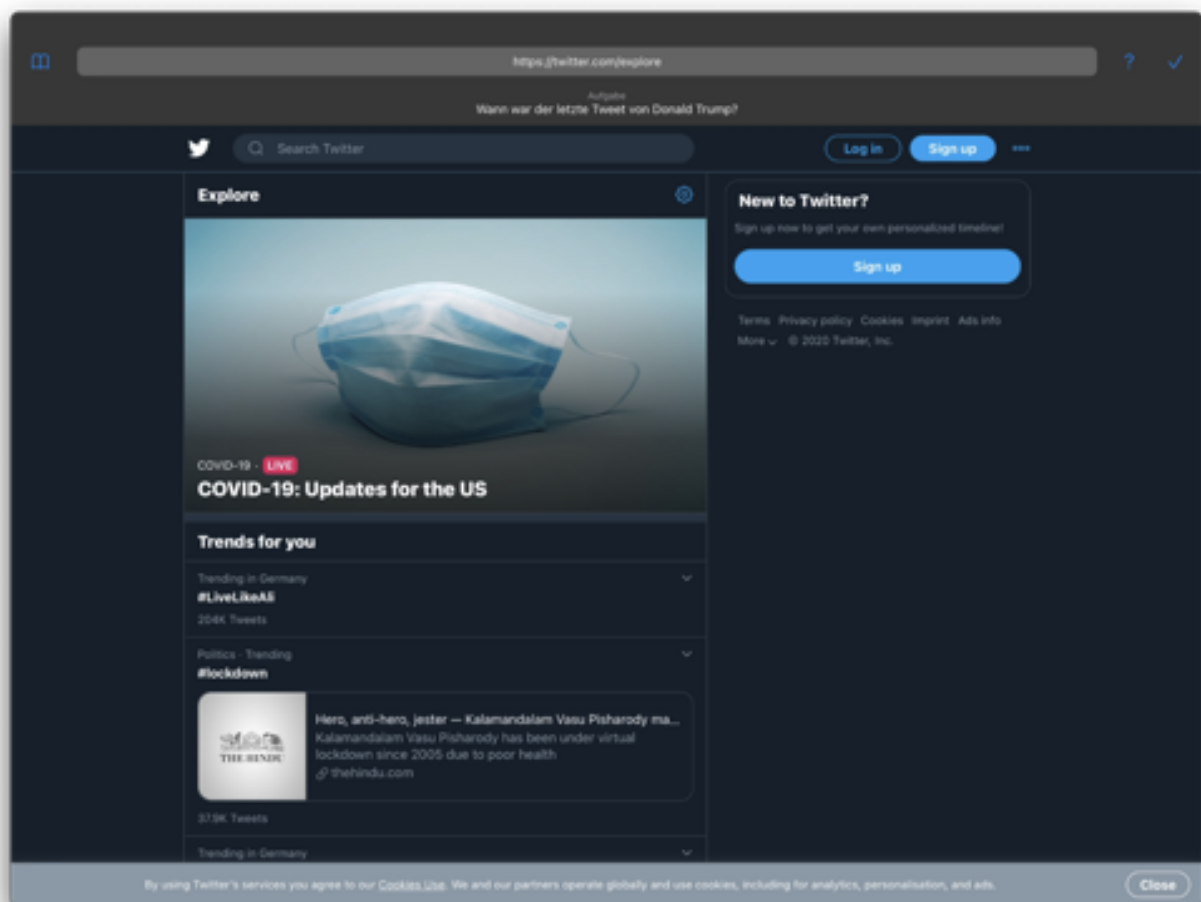Figure 14: Survey snapshot — Netflix

Figure 15: Survey snapshot — Twitter

Glossary

CTR Click-through rate. ii, iii, 7, 8, 9, 10, v

ECJ European Court of Justice. 2

EU European Union. ii, 1, 2

GDPR General Data Protection Regulation. 1, 2

IT Information Technology. 3

opt-out Implicit consent to tracking with the ability to reject data processing at a later date. 2

opt-in Explicit consent given before tracking and data collection takes place. 2