Investigation on How Internet Users' read Online Cookie Consent and Subsequent Privacy Decision-making

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ABSTRACT

As the use of online platforms continues to grow, individuals are faced with an increasing number of privacy-related decisions. Balancing the benefits of sharing personal information with the potential risks of data misuse is a challenge for internet users. Informed privacy decision-making is crucial, yet these decisions are influenced by various factors and complex privacy settings. This study explores the concept of privacy nudges, which are designed to assist users in making privacy-conscious choices while respecting their autonomy. Presentation nudges, a specific type of privacy nudge, manipulate the presentation of information to guide user behavior. However, unethical use of presentation nudges can lead to unintended data disclosure. This research investigates the impact of presentation nudges on users' privacy decisions using eye-tracking technology. The current experiment seeks to understand how different presentations of online cookie consent influence user's privacy-related decisions and their level of engagement in reading privacy policy.

KEYWORDS

eye tracking, visual attention, privacy

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1 INTRODUCTION

With the increasing usage of online platforms for a wide range of activities, internet users are confronted with a growing number of privacy choices. On the one hand, disclosing personal information and consenting to online parties collecting their digital footprint is unavoidable for internet users to fully experience the benefits and services offered by digital platforms. On the other hand, data disclosure could expose users' private information to cyber risks, such as data misuse, potentially resulting in harmful consequences. To optimize the overall experience of internet users while safeguarding themselves from digital crimes, rational and informed privacy decision-making is essential. However, these privacy decisions are often dynamic, influenced by a range of situational and individual differences factors, in addition to the complex privacy regulations and privacy settings established by online organizations. Consequently, internet users may engage in uninformed information disclosure or make decisions that contradict their intentions. Therefore, privacy design solutions aimed at guiding internet users toward making privacy-conscious decisions and reducing their effort to preserve their privacy are necessary to enhance the overall users experience in the online environment. However, organizations sometimes have adopted dark pattern designs in digital interfaces that would nudge people away from privacy and leading individuals to disclose personal data for marketing purposes.

Dark pattern design for privacy refers to the unethical and manipulative techniques employed by digital platforms to coerce users into making privacy-related choices that may not be in their best interests [Kulyk et al. 2022]. These dark patterns are often designed to prioritize the interests of the platform or organization over those of the users, leading to users unconsciously sharing more personal information than intended or giving consent to policies they may not fully understand [Acquisti et al. 2017].

In the present study, we will empirically investigate the role of presentation nudge in privacy decision-making, specifically online cookie acceptance behaviors, using an experimental design. This experiment sought to address two research questions: (a) Are there differences in the amount of time spent reading online cookies when presentation nudge (e..g, highlight button) is used? (b) Will presentation nudges such as highlighting "accept buttons" prompt participants to select highlighted options more frequently? Based on the previous research finding [Acquisti et al. 2017; Kulyk et al. 2022], we hypothesize that:

H1: When "Accept all button" is highlighted in a cookie consent, users will spend less time reading privacy policy compared to no highlight.

H2: Participants will be more likely to accept all cookies when "Accept all button" is highlighted compared to online cookie consent without any highlight.

2 BACKGROUND

2.1 Privacy nudges

An extensively investigated privacy design strategy that seeks to aid internet users' privacy decision-making is privacy nudges. Privacy nudges are often integrated into user interfaces or applications to help users navigate complex privacy settings and provide cues

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that prompt privacy-conscious actions while respecting users' autonomy [Ioannou et al. 2021]. Over the last decade, a wide range of nudges (i.e., presentation, default, incentives, etc.) has been created to overcome different decision-making hurdles and cognitive biases [Acquisti et al. 2017]. Privacy scholars have extensively examined the impact of these privacy nudges on privacy behaviors across various contexts. Collectively, research has shown that privacy nudges could effectively provide internet users with a mental shortcut during the decision-making process, thereby significantly shaping individuals' behaviors regarding their privacy when interacting with online systems [Ioannou et al. 2021]. If nudges are implemented appropriately with ethical consideration, they have the potential to facilitate users in making privacy-protection choices. However, online organizations may take advantage of the powerful impact of privacy nudges in an unethical manner (e.g., opting in by default to enable data-tracking) to promote unintended personal information disclosure. Consequently, users might actually be nudged towards cyber risks by engaging in services that are against their interests [Knijnenburg 2013]. One widely used privacy nudge is nudging with presentation.

Presentation nudges involve a strategy that encompasses a range of presentation concepts, including information framing, the order of requests, and visual saliency. These design techniques are often utilized to manipulate the information and options presented to individuals to stimulate desired behaviors or outcomes [Acquisti et al. 2017]. For example, some research suggests that users may be nudged away from privacy due to unethical manipulation of the visual saliency of available options. When certain options, such as "Accept all cookies," are made visually prominent, users may be inclined to click that button because it attracts the most attention [Acquisti et al. 2017; Nouwens et al. 2020].

2.2 Eye-tracking and Privacy Policy

Eye-tracking devices have become a powerful tool for researchers in various fields to investigate human visual patterns when interacting with visual information [Kröger et al. 2020]. In the fields of psychology and human factors, eye-tracking methodology is often used to measure individuals' pupil dilation, eye movements, and fixation time. These measurements have previously shown strong evidence to serve as an index measure of visual perception, attention, and cognitive processes [Eckstein et al. 2017; Magliacano et al. 2020]. In the privacy field, eye-tracking has been utilized to investigate internet users' visual perception and reading patterns when requested to read privacy policies (e.g., online cookie disclaimer and terms of use service; [Ghaiumy Anaraky 2022; Steinfeld 2016]. Other studies have also attempted to assess the effectiveness of different types of privacy notifications in capturing users' attention [Ozimek et al. 2019; Sheng et al. 2020]. Non-intrusive notifications have been found to be more susceptible to the banner blindness phenomenon, meaning that most users tended to ignore them. Such an effect was found to be influenced by the location of the notifications, whether positioned at the top or the bottom of the website. Notably, notifications placed at the top had a significantly higher likelihood of being noticed and retained more visual attention compared to those located at the bottom [Ozimek et al. 2019].

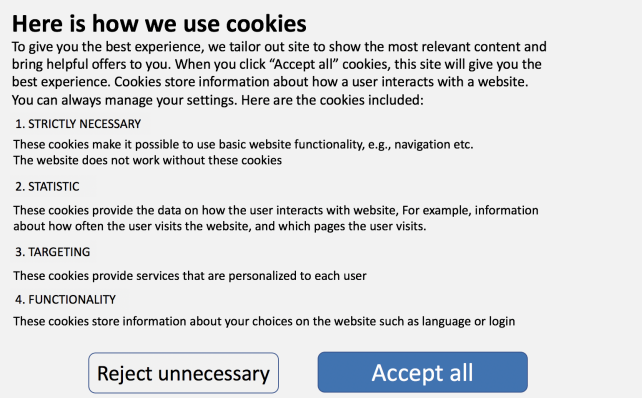

Figure 1: Cookie disclaimer with highlighted "Accept all" button.

3 METHODOLOGY

3.1 Experimental Design

A one-way within-subject experimental design will be adopted in this study. The independent variable will be the presentation nudge of online cookie consents (Highlight "Accept all button" vs No-highlight). The dependent variables will be the amount of time spent on reading the cookie and their privacy decision of whether to accept or reject online cookies. The order of two different versions of online cookies consent will appear randomly to each participant to counter order effect. Each participant will be requested to find a specific piece of information within a "Webpage" presented by a static image. During the process, an online cookie consent will pop up, participants are required to respond to the consent in order to continue with the searching task.

3.2 Stimulus

The stimuli used in this experiment will be two different static web pages and two different cookie disclaimers. The first web page is a "flight" web page see Figure 3. The second web page is a "laptop" web page see Figure 4. For the cookie disclaimers, one disclaimer has a highlighted "accept all" button see Figure 1. The other disclaimer's "accept all" button is not highlighted see Figure 2.

3.3 Participants

An a priori power analysis was conducted using G*Power 3.1 to compare the difference between the amount of time people spent reading online cookie consent (H1) and whether they accept the online cookies (H2) when the visual presentation of online cookie consent differs. The results of the power analysis indicated that to have 80% power to detect an effect at the p = .05 level with a medium effect size of Cohen's d = 0.50, a minimum of 27 participants would be needed.

3.4 Covariates

Digital privacy literacy. The Online Privacy Literacy Scale will be adopted to assess individuals' conceptual knowledge related to digital privacy [Ghaiumy Anaraky 2022]. This scale contains a

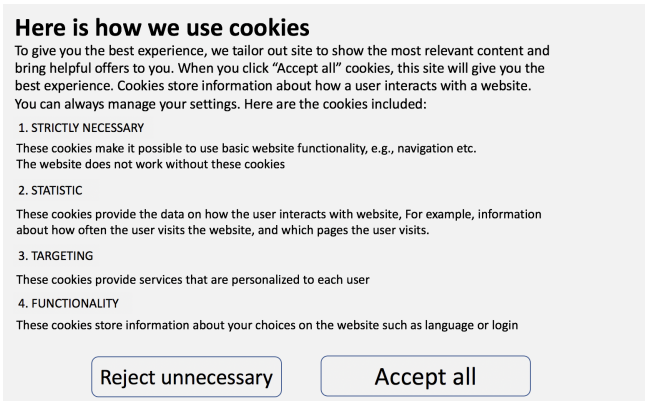

Figure 2: Cookie disclaimer without highlighted "Accept all" button.

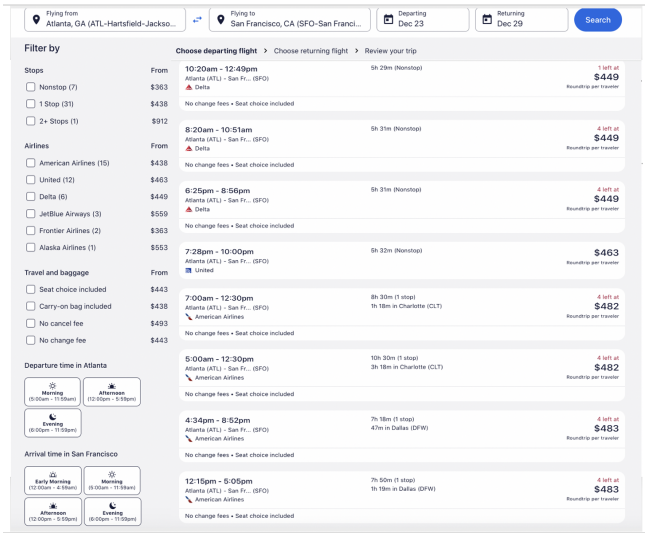

Figure 3: Cookie disclaimer without highlighted "Accept all" button.

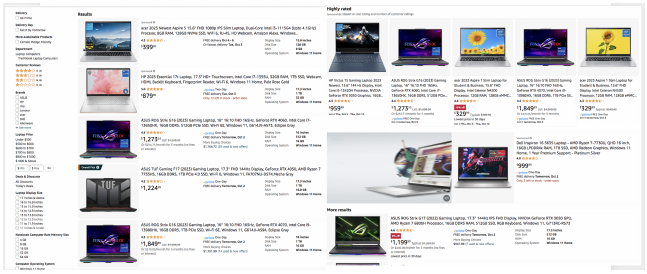

Figure 4: Cookie disclaimer without highlighted "Accept all" button.

total of seven multiple choice questions (i.e., "What is a 'Functional cookie'?") and participants' total score will be scored based on the correct response to each question. Higher total scores reflect stronger privacy knowledge [Ghaiumy Anaraky 2022].

Privacy concern. To measure internet user's level of privacy concern, the Global Information Privacy Concern questionnaire will be utilized [Malhotra et al. 2004]. This scale includes a total of 6 items (i.e., *"I am concerned about threats to my personal privacy today"*). Participants will respond on a 7-point scale anchored from 1 *(Strongly Disagree)* to 7 *(Strongly Agree)* for each item. Higher total scores will indicate stronger privacy concerns.

Privacy fatigue, an 8-item scale developed by Choi et al. [2018] will be implemented to measure privacy fatigue. This measurement scale was originally adapted from the Maslach Burnout Inventory – General Survey [Schaufeli 1996] that contains two vital dimensions—emotion exhaustion and cynicism. Example questions include *"It is tiresome for me to care about online privacy"* (emotional exhaustion) and *"I doubt the significance of online privacy issues more often"* (cynicism). Participants will respond to each item on a 7-point Likert scale from 1 *(Strongly Disagree)* to 7 *(Strongly Agree)*. Higher total scores will be associated with higher levels of privacy fatigue.

3.5 Procedure

The study will take place in a classroom equipped with a Gazepoint eye-tracker. Upon participants' arrival, they will first be asked to provide written informed consent, indicating their voluntary agreement to participate in the study. The study will commence with the calibration of the Gazepoint eye-tracker. Once successful calibration is achieved, participants will be instructed to locate specific information from a real webpage presented as a static image. Upon clicking "continue," the webpage will be displayed. After three seconds, an online cookie consent prompt will appear, and participants will be required to make a selection regarding online cookies before proceeding with their information search. Participants will perform the information search task twice, with each session involving different webpages. Additionally, two versions of online cookie consent with distinct presentation nudges will randomly appear on each webpage. Upon completing the information search task, participants will be directed to complete a survey for measuring covariates. The entire study session is expected to last approximately 10 to 15 minutes.

3.6 Apparatus

To measure individuals' fixation time and saccade eye movement, a Gazepoint eye-tracker (GP3 HD) will be used. It has a sampling rate of 60 Hz and accuracy of 0.5-1 degree. This device will be connected to a desktop with a 21-inch monitor with a resolution of 1920×1080 pixels. Participants will be seated approximately 30 inches away from the monitor.

Figure 5: Gazepoint eyetracker connected to desktop.

Figure 6: Averaged heat map for Cookie consent with highlighted "Accept all" button

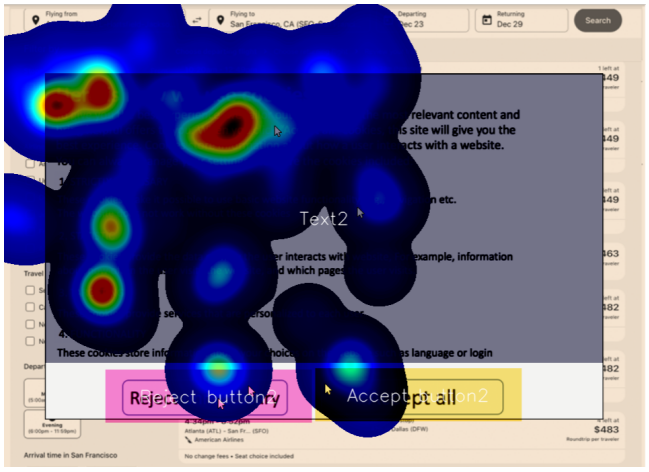

Figure 7: Averaged heat map for Cookie consent with non-highlighted "Accept all" button

4 RESULTS

4.1 The amount of time spent on reading privacy policy

A within-subject paired sample t-test was conducted to compare the average amount of time participants spent on reading online cookie consent when the "Accept all" button is highlighted vs. not highlighted. The results showed that there is no significant difference in reading time (in seconds) for privacy policy, t(14) = -1.6313, p = 0.125. This suggests that participants did not spend more time reading online cookie consent before making a decision when the "Accept all" button is highlighted (M = 8.06) compared to non-highlight (M = 9.14).

Additionally, Two heatmaps were generated from the Gazepoint Analysis Software, as indicated in Figures 6 and 7. The average heat map on the text part of online cookie consent/privacy policy is higher when the "Accept button" is highlighted.

To test hypothesis 2, a Chi-square test was conducted to examine whether there is a significant difference in percentage of "Accept all cookies" between highlight vs. no highlight in the cookie consent. The results indicated that when the "Accept all" button is highlighted, 73% of people proceed with that choice; While "Accept All" button is not highlighted in the given consent, only 53% participants accept all cookies. However, the difference in percentage did not reach statistical significance, $Chisq = 1.292$, $df = 1$, $p = 0.256$; Thus, highlighting the "Accept all" button did not significantly lead more people to accept all cookies compared to no highlight in an online cookie consent.

4.2 Additional post-hoc analysis for covariates

Two logistic regressions (*one for cookie consent with no highlight, one for cookie consent with highlight*) were conducted to test whether individuals' level of privacy fatigue, digital/online cookie literacy, and privacy concern will predict their decisions on whether to accept online cookies. The results revealed that when the "Accept all" button is highlighted, there is no significant impact of privacy fatigue, privacy concern, and cookie literacy on the likelihood of accepting cookies, $ps > 0.05$. Likewise, no effect was found when cookie consent has no highlighted button, $ps > 0.05$. Thus, individuals' choice of whether accepting online cookies were not affected by their level of privacy fatigue, privacy concern, and digital literacy.

5 DISCUSSION

The primary goal of this study was to examine how highlighting the "Accept all" button would influence users' reading time for online cookie consent and their subsequent privacy decision-making. It was expected that participants would spend less time reading the privacy policy when the "Accept all" button is highlighted in the given cookie consent (H1). Although the results did not statistically support this hypothesis, the heatmaps partially supported this prediction by demonstrating that participants had a higher percentage of fixation on the text description of the privacy policy when there was no button highlighted. Consistent with the findings discovered by Steinfeld [2016], our results suggest that participants may spend

more time reading the text description of the online cookie policy when their attention is not distracted by the button.

We also hypothesized that participants would be more likely to accept all cookies when the "Accept all" button is highlighted compared to online cookie consent without any highlight. While our findings supported the direction of this hypothesis, with 20% more people accepting all cookies when the button was highlighted, this did not reach statistical significance. Such results did not support the findings from previous research suggesting that when certain options, such as "Accept all cookies," are made visually prominent, users may be inclined to click that button because it attracts the most attention [Acquisti et al. 2017; Nouwens et al. 2020]. One possible explanation is that this study is underpowered due to the small sample size and time constraint. Consequently, there is a possible increase in the Type 2 error rate that did not allow our data to reach a significant level. Therefore, a greater sample size would be needed to further enhance the current results of this study.

5.1 Implications

There are several important implications for Dark Pattern Design and Presentation Nudges in Privacy Settings of this experiment. First, we underscored the prevalence of dark pattern designs for privacy and their potential impact on user behavior. This awareness is essential for digital platforms and regulatory bodies to address ethical concerns associated with manipulating users into privacy choices that may not align with their best interests. Second, disregarding the non-significant data due to limited statistical power, the current findings highlighted the significance of visual saliency in presentation nudges and its potential to influence user decisions. Developers and designers should critically assess the ethical implications of emphasizing certain options, such as "Accept all cookies," to ensure transparency and respect for user autonomy. Furthermore, our investigation into the amount of time spent reading online cookies when a presentation nudge is employed sheds light on the dynamics of user attention and information processing. This has important implications for user experience design, as it suggests that certain design elements may affect the time users dedicate to understanding privacy-related information.

6 LIMITATIONS & FUTURE WORK

In this section, we outline our study's limitations and propose directions for future research. Owing to time constraints and limited resources, the collected sample size of 15 fell short of the expected 27 participants. The reduced sample size resulted in decreased statistical power, potentially increasing the margin of error. It is important to note that the study was underpowered, emphasizing that the outcomes of the current investigation are preliminary, and future replications are necessary in this research domain.

We utilized a convenience sampling method by recruiting classmates and friends in college. This sample of participants consists exclusively of college students. Consequently, results and findings may not be generalizable to a broader population. Future research should consider employing random sampling methods and recruiting participants with more diverse personal characteristics, such as education level, age, and race.

Additionally, this study utilized Gazepoint analysis software. While it is a reliable tool for conducting eye-tracking studies and producing valid results, researchers should be mindful of its limited functionality. In future studies, an alternative approach could involve programming the study using Psycho-Py, a versatile and widely-used software tool for experimental psychology. This could provide additional flexibility and features for a more comprehensive analysis of eye-tracking data.

Lastly, our study employed online cookie consent and background images of real websites to ensure external and ecological validity. However, it is critical to note that this study used static images (screenshots) of the websites due to technical difficulty. Future experiments should consider utilizing real, dynamic web pages to simulate real-world usage scenarios for measuring privacy-related decision-making.

7 CONCLUSION

In conclusion, our study aimed to investigate the impact of highlighting the "Accept all" button on users' reading time for online cookie consent and subsequent privacy decision-making. While the statistical results did not fully support our hypotheses, the heatmaps indicated a shift in user attention towards the text description of the privacy policy when the button was not highlighted, aligning with previous research. Although our findings suggested a directional support for the hypothesis that users would be more likely to accept all cookies when the "Accept all" button is highlighted, the lack of statistical significance indicates a need for caution in interpreting these results. Despite limitations related to a small sample size and time constraints, the study has important implications for understanding the ethical considerations of presentation nudges in privacy settings, emphasizing the need for transparency and respect for user autonomy. Moving forward, addressing these limitations and conducting future research with larger and more diverse samples, alternative software tools, and dynamic web pages can enhance the robustness of our findings and contribute to the broader understanding of user interactions with privacy interfaces. Understanding the implications of these findings is crucial for both researchers and practitioners in the field of digital privacy.

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