EyeTC: Attentive Terms and Conditions of Internet-Based Services with Webcam-Based Eye Tracking

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Abstract. Now and then, users are asked to accept terms and conditions (T&C) before using Internet-based services. Previous studies show that users ignore reading T&C most of the time and accept them tacitly without reading, while they may include critical information. This study targets solving this problem by designing an innovative NeuroIS application called EyeTC. EyeTC uses webcam-based eye tracking technology to track users' eye movement data in real-time and provide attention feedback when users do not read T&C of Internet-based services. We tested the effectiveness of using EyeTC to change users' behavior for reading T&C. The results show that when users receive EyeTC-based attention feedback, they allocate more attention to the T&C, leading to a higher text comprehension. However, participants articulated privacy concerns about providing eye movement data in a real-world setup.

Keywords: Eye tracking · Attentive user interface · Attention feedback · NeuroIS

1 Introduction

Internet users are confronted with legally binding documents such as terms and conditions (T&C) on a daily basis. However, almost no one reads them before agreeing on the content, which is also named as "the biggest lie on the internet" [1]. Nevertheless, such documents may include critical information that allow third parties to benefit from users' information while they do not truly agree on that. Users often give the provider permission to keep, analyze and sell their data when accepting T&Cs of Internet-based services. Previous studies show that when users signed up for a fictitious social network service, 98% of them missed clauses to allow data sharing with the NSA and employers [1]. Besides, not reading important legal texts has also been analyzed for computer usage policies [2], security warnings for downloads [3], or when connecting to public Wi-Fi [4]. One of the reasons users accept such information without reading it is that they consider it an interruption of their primary task like finishing an online purchase transaction

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or signing up for a new Internet-based service [5]. Attitude, social trust, and apathy are also found to explain partially why users elect not to read such legal documents [2]. Also, habituation might explain such behavior, while the design of T&C can create this habituation and lead to fewer people reading and cognitively processing what they agree to [3, 5].

Apart from the reason why people do not read T&C, there is a need to increase user's awareness about their failure and to guide them in reading missed parts of T&C, especially when it includes critical information. Existing approaches focus on forcing users to stay on the T&C page for a specific time or force them to scroll until the end of the T&C before accepting them to inspire users to read them. However, these approaches do not guarantee that users properly read the document, and there is a need to design more intelligent approaches. One solution is to "convert" T&C to attentive documents in order to track of how documents are really read [6]. Attentive user interfaces (AUI) are known as user interfaces that are aware of the user's attention and support them to allocate their limited attention [7–10]. Eye tracking technology is the primary device for designing such AUIs as it allows to retrieve information about visual attention [11, 12]. NeuroIS researchers also suggested using this technology to design innovative applications [13–16] and AUIs [17–21]. However, there is a lack of research on using eye tracking devices for designing attention feedback [22]. Therefore, in this study, we suggest designing an AUI that focuses on T&C. We name this application EyeTC. EyeTC refers to an attentive T&C that tracks users' eye movement in real-time and provides attention feedback when users ignore reading the content of T&C. We especially focus on using webcam-based eye trackers since they are cheap and available for users, and they do not need to buy extra tools to use EyeTC. Therefore, in this study, we focus on answering the following research question (RQ):

RQ: How to design attentive T&Cs with webcam-based eye tracking to enhance user's attention to T&Cs and their comprehension?

To answer this question, we investigated webcam-based eye trackers' usage for designing attentive T&C within a design science research (DSR) project. Scholars have emphasized the need for the integration of the DSR and NeuroIS fields in order to designing innovative applications [14, 15]. In this project, we propose the EyeTC application that can track users eye movement via webcams in real-time and use this information to provide attention feedback while processing T&C. In this study, we focus on the development and evaluation phase of the first design cycle. After instantiating the suggested design, we evaluated it in a laboratory experiment. Our results show that using attentive T&C improves users attention allocation on T&C as well as their text comprehension. However, they articulated privacy concerns for sharing their eye movement data in a real-world scenario. We contribute to the field of NeuroIS by providing evidence of how eye tracking technology can be used for designing AUIs that support users to read T&C.

2 The EyeTC Prototype

To conceptualize and implement EyeTC, we followed the eighth and ninth-contribution types of the NeuroIS field suggested by [12]. Specifically, we defined two main components of EyeTC: an attentive T&C, which is considered as a neuro-adaptive IS, and attention feedback, in the form of live biofeedback. Figure 1 depicts an overview of the instantiation of these two dimensions in EyeTC.

For developing the attentive T&C component, we used webcam-based eye tracking technology. Using low-cost eye trackers is suggested for information system research [20, 23], and one of the options is using webcam-based eye trackers [24]. We converted webcams to eye trackers by integrating WebGazer JavaScript[1] [25]. Next, the eye tracking system retrieves gaze data using the webcam recording and stores the information about the predicted gaze position (sensing attention). After the user agrees to the T&C, the reading detector system of the attentive T&C analyses the user's reading intensity (reasoning about attention), and if visual attention does not pass a certain threshold, users will receive feedback on the lack of attention. Later, if the user agreed to the T&C without reading the text, the attention feedback system is activated (regulating interactions). First, in the attention feedback component, users are informed by a pop-up warning message stating the importance of reading legal documents and upcoming attention feedback design. Next, the attention feedback system uses the information about the reading activity of the user to highlight the specific AOIs that were not read yet by users sufficiently while accepting the T&C.

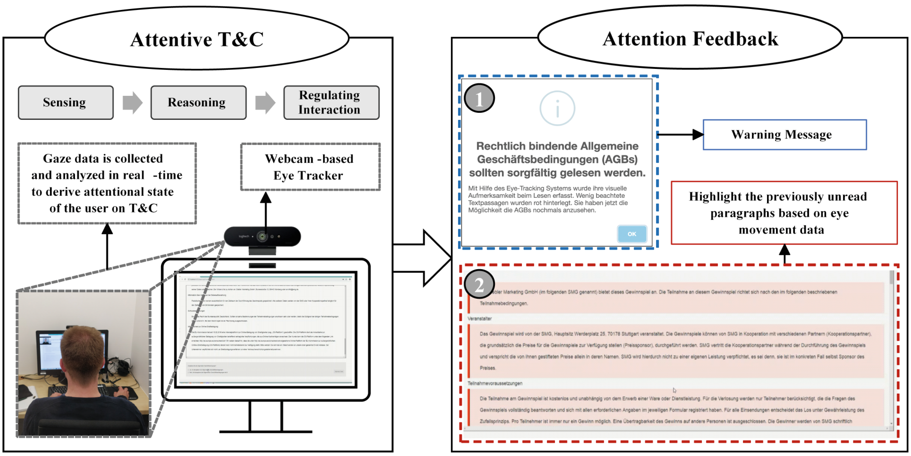

Fig. 1. Components of EyeTC to enhance users' attention to T&C and comprehension

[1] https://webgazer.cs.brown.edu/.

3 Experimental Design

To evaluate EyeTC, we executed a controlled laboratory experiment with two groups in which attention feedback types were manipulated between subjects. As apparatus, we used Logitech Brio 4K Ultra HD webcam on all laboratory computers and the WebGazer. In the following we discuss the two presented attention feedback types as well as the experimental procedure.

3.1 Attention Feedback Types

In this study, we designed two different types of attention feedback for T&C readers distributed in the control and treatment groups. Both groups received feedback types after being forced to read T&C by scrolling until the end of the T&C and choose to the agreement on the provided content (similar to existing approaches on the internet when facing T&C). After users click on the continue, the treatment group received EyeTC and the corresponding attention feedback with both warning message and highlighting option discussed in the previous section. The control group received general attention feedback in the form of only a warning message. This warning message aimed to create bottom-up attention and reminded participants about reading the legal text carefully. Both groups received the same warning message with the same primary text. The only difference is that the treatment group users were informed about receiving the highlighted passage in the next step. Therefore, with this design, we argue that both groups experienced the same situation except the personalized highlighted passage provided by EyeTC to the participants in the treatment group.

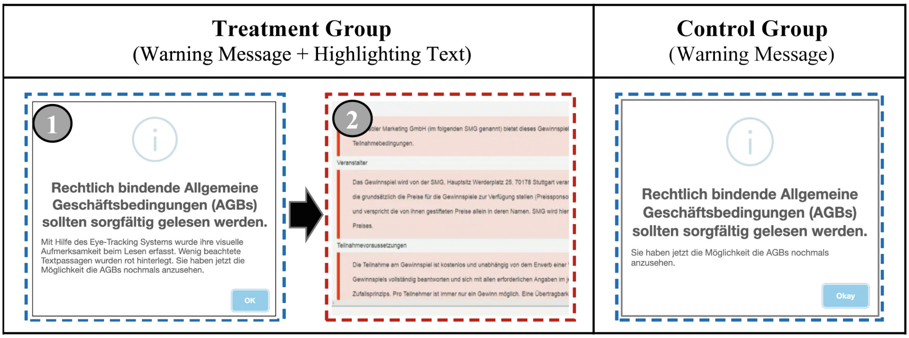

Fig. 2. Two types of attention feedback used in this study to investigate the EyeTC

3.2 Experimental Procedure

Figure 3 shows the experimental steps to evaluate EyeTC. After reading the experimental instruction and performing the calibration, we started a bogus experiment. In this experiment, we asked users to choose their favorite pictures among two options while we track their eyes to find the relationship between their choice and the visual behavior. After performing the bogus experiment, we offered the users to participate in a lottery to win an extra 20 euros besides the compensation for the experiment participation. For that, they had to read and accept our designed T&C. Both groups were forced to scroll down the T&C before the accept button got activated. In this phase, the attentive T&C started to record and analyze the user's eye movements while reading the T&C. After users accepted the T&C, the treatment group received a warning message and attention feedback, and the control group received only a warning message. Next, the participants from both groups were forced to check the T&C again, which was considered as their revisit phase. During all these steps, the user's interaction data is recorded, and users' exploration time on each step is considered as the duration of their allocated attention. After they were done with the experiment, we measured the T&C text comprehension of the participants with a declarative knowledge test in the form of 15 multiple-choice questions. Last, participants joined a survey for demographic questions, perceived usefulness of the attention feedback types, and the ability to articulate privacy concerns using webcam-based eye trackers.

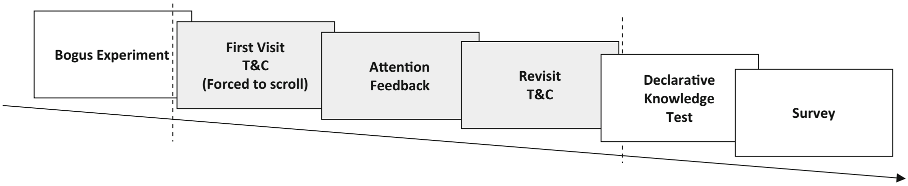

Fig. 3. Experiment steps used for evaluating EyeTC

4 Results

In total 62 university students (32 female, 30 male) with an average age of 22.82 (SD = 2.61) participated in this laboratory experiment. Users were assigned randomly to one of the two groups. Furthermore, all the participants in both groups visited the T&C for two times and system did not detect anyone that read the T&C precisely in the first visit.

First, we checked the users' first visit duration. Executing Wilcoxon rank-sum test shows that the first visit duration for the treatment group (M = 122 s, SD = 87 s) did not differ significantly from participants in the control group (M = 125 s, SD = 81 s) , $W = 463$, $p = .81$, $r = -.03$. It shows that both groups had similar behavior regarding reading T&C. However, in the revisit phase, participants in the treatment group (M = 144 s, SD = 97 s) had a significantly higher reading duration than the control group (M = 38 s, SD = 42 s), $W = 814$, $p < .001$, $r = -.595$. It shows that users that received attention feedback changed their behavior and spend more time on T&C. The provided T&C includes 914 words and with an assumed reading speed of 250 words/minute [26] the reader might need around of 195.85 s to read the text. By comparing the total reading time (first visit and revisit) of both groups we argue that a reader might read the T&C in the treatment condition (total time spent M = 266 s, SD = 130 s), but not in the control condition (with a total time spent M = M = 163 s, SD = 84 s). Also, comparing the total duration time on T&C shows that the treatment group spent significantly more seconds on T&C than participants in the control group, $t = 3.69$, $p < .001$.

Furthermore, the performance in a declarative knowledge test as measured by the number of correct answers was higher for users in the treatment group (M = 10, SD = 2.8) than for users in the control group (M = 8.8, SD = 2.1), W = 650, $p < .05$, $r = -.305$. Despite, the results of the survey show that both groups have high privacy concerns about using eye tracking technology and there is no difference between the treatment group (M = 5.74, SD = 1.1) and the control group (M = 5.55, SD = 1.12), W = 527.5, $p = 0.511$, $r = -.083$ (Fig. 4).

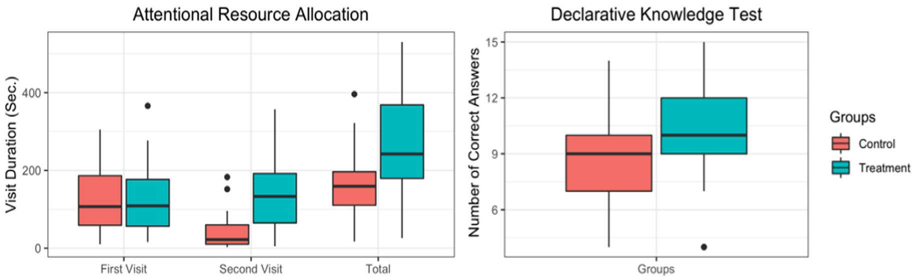

Fig. 4. The influence of EyeTC on attention allocation and text comprehension

5 Discussion

Our experimental results show a positive effect of EyeTC on the users to read T&C. The personalized highlighting of passages that have not been read was significantly more effective than a simple reminder in the form of a prompt. In conclusion, EyeTC caused a higher reading duration on the T&C and better text comprehension. Tracking tools are often known to decrease privacy, but we show that eye tracking can be used to increase privacy by supporting people in reading T&C and understanding them. Based on the DSR contribution types provided by Gregor and Hevner [27] this project is considered as "improvement" type since we could provide as the solution (EyeTC) for a known problem (ignore reading T&C). Furthermore, by implementing EyeTC as a trustable eye tracking software [28], users can decide to use eye tracking in a way to help them not to miss out important content.

However, this research also has some limitations that should be covered in the future. Using webcam-based eye tracking was beneficial for designing EyeTC as they are integrated into most personal computers and are more available than using eye trackers. However, they are less accurate and precise compared to the infrared eye trackers. Also, they are very sensitive to movements, and we controlled for the steady posture of the participants during the experiment. However, there is a chance that the EyeTC did not provide accurate highlighting visualization for some participants during the experiment. However, as people typically ignore reading T&C, it was not reported by any participants. Furthermore, we did not consider the user's eye movement data in the evaluation section to control data noise regarding the webcam-based eye trackers. For the evaluation, we focused on the users' mouse clicks as interaction data as well as the survey results. As future work, we suggest general highlighting of typical passages that people do not read and investigate the users' reaction and the need for personalized adaption of the system. Also, to validate the results, we suggest designing and evaluating EyeTC with accurate eye trackers in the future. A more accurate eye tracker can also help to better understand how users process T&C. Also can support EyeTC to distinguish between skimming, reading, and non-reading behavior, etc. [6, 29, 30]. Furthermore, the results are based on a controlled lab environment, and there is a need to check the effectiveness of EyeTC in the field and as long-term studies. Also, the future agenda is to establish standards for integrating EyeTC either by T&C providers or in a way that users can install it to receive support. Also, the findings from this study may be further developed to create applications beyond attentive T&C. For example, this system could be used in e-learning courses to motivate learners to read factual texts; companies might find it helpful to implement a reading enhancing system for certain documents, reading other legal documents like a contract, etc.

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