Towards Bridging the Gap Between Visual Cybersecurity Analytics and Non-Experts by Means of User Experience Design

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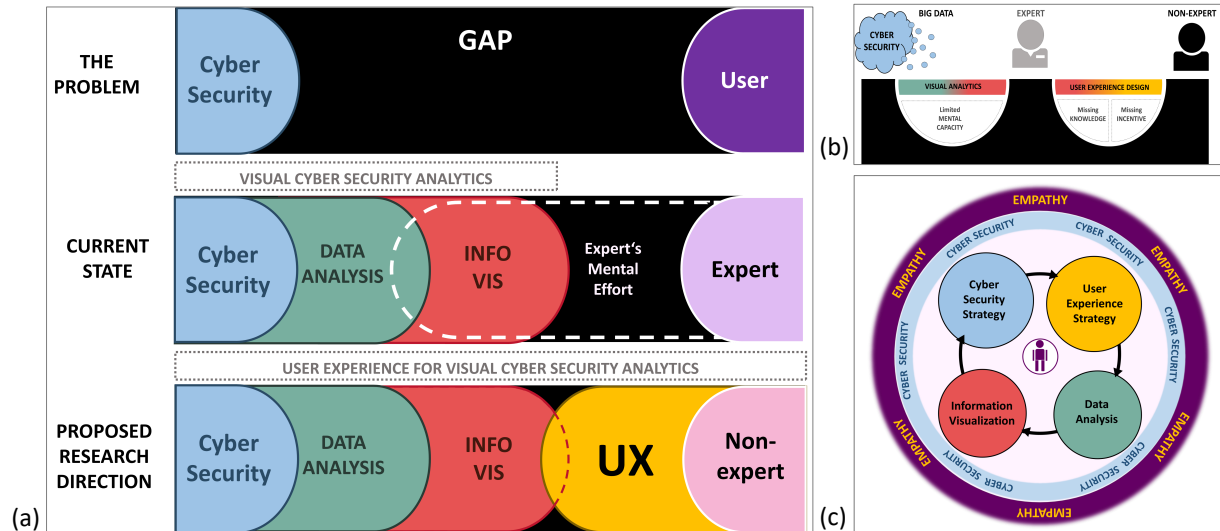Fraunhofer IGD & Technische Universität Darmstadt

Figure 1: The gap: (a) The mental gap between users and the CS world. The expert can bridge it by VA and mental effort. Non-expert needs support by UX. (b) The gap to the expert can be caused by limited mental capacity and the additional gap to non-experts by the lack of incentive and knowledge (c) A vision how the four research areas could work together, enveloped by empathy and domain knowledge.

1 INTRODUCTION

This poster targets the insufficient awareness of the casual internet user concerning their vulnerability to cybercrime. We believe that this problem is mainly caused by the knowledge deficit of non-experts about cybersecurity (CS). Moreover, a lack of motivation hinders people to have a critical look at this vital topic. At the same time, human factors, including cyber interest and awareness, have been identified as the main element in cybersecurity to protect an organization from future cyber threats [13]. Boyce et al. have also emphasized human factors, especially of general users, as a critical factor in cybersecurity [2]. We further postulate that there is a gap that can be bridged by attracting non-experts and aim for these users' satisfaction by means of User Experience Design (UxD) applied to Visual Cyber Security Analytics (VCSA). The purpose of this poster is to illuminate this gap by providing a detailed problem description and the resulting research directions. Looking at the current state of the relationship between internet users and the cyberworld, there are mainly two groups to differentiate:

- **Experts:** Have a broad understanding of CS-related topics, motivated by an intrinsic or professional interest.

- **Non-experts**: Have no or little understanding of CS-related topics and have a low or missing desire to spend the mental effort to learn how to use CS tools.

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Both groups are connected to the Internet in their everyday life. Thus both should be aware of the risks and consequences of their behavior. Unfortunately, the high rate of vulnerabilities shows, that this is not the case yet [9]. Therefore, we constitute, that there is a mental gap between the human and the world of CS (see Fig. 1 (a)), which needs to be overcome to increase the protection against cybercrime. Inspecting the gap further, we can differentiate two kinds of subgaps (see Fig. 1 (b)).

- The **gap to the expert:** The first gap is caused by a large amount of information within the domain of CS and the limited mental capacity of humans. While experts have a broad understanding of CS as such, they need support to process the massive amount of information gained within their analyses.

- The **gap to non-expert:** Non-experts have problems to gain a general understanding of CS. Therefore they are separated from CS by an additional gap, which is caused by the lack of knowledge and a potential lack of incentive.

Eliciting and analyzing data from the cyberworld is the first useful step to support the understanding towards CS. Visual analytics (VA) represents the next big step towards the human by providing automated data analysis combined with interactive visualizations of the data. Using VA for the analysis of CS has become common practice for experts [12]. In many cases, at this step the expert is able to close the gap by mental effort (prior knowledge and a motivation caused by his or her profession), while for the non-expert this gap is left open. Indeed, the target group of research in VCSA seems to be experts in most cases [10]. Thus, the research question arises how the remaining gap can be closed. We argue, that there are two main

factors, which hinder non-experts to approach the world of CS and to understand the requirements for the own CS:

- **Lack of knowledge and understanding,** which makes the non-expert avoid certain services or sometimes even develop feelings of cyber anxiety.

- **Lack of incentive,** which hinders the non-expert to overcome felt restraints and thereby the lack of understanding.

Applying VA to CS can also be a great support for non-experts in gaining insights into their own system and reflecting their own behavior in the cyber-world. We argue, that this understanding will strengthen the responsibility for CS. However, this requires ways to communicate the information in a manner that is appropriate to non-experts. Another major goal is to evoke an intrinsic motivation for VCSA in non-experts and keep them interested. In particular, this means to find a way to bridge the gap between the way VA is currently applied to CS and the way the non-expert would be able to appreciate and understand it. In contrast to the experts, from non-experts, no prior knowledge or motivation can be expected [9]. Therefore, design has to close the gap. This can be supported by addressing humans' psychological needs through design. This way of designing is the subject of UxD [5]. In conclusion we argue for collaborative research at the intersection of VA, CS and UxD.

2 User Experience Design in Visual Cyber Security Analytics

User experience (UX) is defined as *"a person's perceptions and responses that result from the use and/or anticipated use of a product, system or service."* [1] This broad definition makes it difficult to exhaustively describe all facets of UX. In any case, it is important, that UX goes beyond good usability. Hassenzahl et al. [6] states that usability is focusing on the avoidance of negative emotions, while UxD intends to create positive emotions and feelings. We observe, that at the current point in time the term *user experience* is not a frequently used term in the domain of VCSA. A search within the publications of VizSec shows no results for the term *user experience*. We have also tried some other terms, related to mood and experience, as for example *pleasure*, *satisfaction*, *fun* or *frustration* - with similar results. One could argue, that user-centered design (UCD) and the endeavor to design usable, intuitive interfaces is a common practice in VCSA. And indeed, the terms *usability* and *user-centered* are represented more frequently within the publications of VizSec. But there is a crucial difference between these three terms. UCD is a central method during the design process. However, applying UCD does not automatically create good UX. Further, it is important to understand the difference between usability and UX [1]. While usability by definition is only concerned with the efficiency and effectiveness and satisfaction *during* use, UX addresses the experience *before*, *during* and *after usage*.

While current research seems to assume a strong interest for the data, which is presented by means of VA, this can only be assumed for experts. Considering ordinary people, however, designing a motivation should be part of the solution. According to the definition of UX, attracting people to the topic of CS (before use) and motivating them to deal with it further (after use) is therefore obviously a task of user experience design. There also have been attempts to enhance cyber-situation awareness of non-experts by applying VA, as for example in [8], [11]. However, in both cases a strong interest to the area of CS is presupposed. Therefore, the question how to inspire the user for an initial interest and how to uphold this interest, is out of scope of most of the related work. Recently, approaches to apply VA for personal purposes have been investigated [7]. Interestingly, the survey of 66 papers did not include any work on CS. Nevertheless the authors of this survey stated the demand for more aesthetic and fun factors as well as considering the unique perspective of

individuals. Though out of scope for CS, there are attempts in VA to design for positive UX. In many cases this is initiated by thriving for visual aesthetics. Cawthon et al. describe aesthetics as *"something that enlivens or invigorates both body and mind, awakening the senses."* [3] We argue that integrating aspects like fun, enjoy, inspiration, motivation, pleasure as central requirements would help to bridge the gap between CS and non-expert users. To achieve this it is important to derive an intuitive understanding of the targeted user. This can be done by developing a strong sense of empathy within the design process [4]. Methods of UxD have the potential to strengthen these kind of senses. How these methods could be integrated into the design process of VCSA efficiently is one of the open research questions that we want to emphasize. Fig. 1 (c) illustrates how the four research areas should be combined within an atmosphere of empathy and understanding of the related topics of CS.

3 Conclusion

With this poster we aim to illuminate the remaining gap between casual users and the current state of VCSA. Thereby, we identified the non-experts' lack of understanding and incentive as the weakest link. For further research we propose two main directions. On the one hand we claim that more VCSA solutions should be designed with an explicit focus on the non-experts' needs. On the other hand, we emphasize the need to include motivation and attraction of the user as central requirements in the development process. Further strategies to integrate empathy into the design process should be derived. We therefore propose integrating methods of UxD in the development process of CS solutions.

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