Digital Fitness for Citizens: Design and Acceptance of a Smartphone Based Behaviour Change Support System for Personal Cyber Security

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Abstract

Cyber security is an increasingly important topic for private citizens. While organisations could provide a supportive environment for secure behaviour, private citizens lack this support. One promising and scaleable method to change behaviour is persuasive technology.

This poster presents a Master's thesis investigating whether smartphone-based behaviour change can be applied to personal cyber security. Therefore, a persuasive app interface was designed after analysing the context of usage. This interface was presented to (n=73) participants via an online survey to assess persuasiveness factors and usage intention.

Participants perceived the app as persuasive and effective in supporting them with security related behaviour, which in turn increased intention to use. Moreover, social comparison led to social pressure and a decrease of intention to use. Persuasive technology seems to be a promising direction for behaviour change in cyber security.

1 Introduction

Digitalisation leads to an increasing usage of digital services and devices. Close to ninety percent of German citizens use smartphones and seventy percent (mobile) computers [3]. Unfortunately, to securely use these devices and services, users need to adapt their behaviour, e.g. by using 2 factor authentication, strong passwords, a password manager and doing regular updates and backups.

While companies could, in theory, provide structured support, private citizens lack this support for successful behaviour change. In domains such as medicine or environmental protection, the Persuasive Systems Design (PSD) Framework has already been successfully applied to support behaviour change through mobile apps.

B.J. Fogg [1], coined the term *Captology*, describing the research field of using "Computers to change what we think and do". Based on this work, Oinas-Kukkonen et al. invented the Persuasive Systems Design (PSD) Framework [2], which provides a systematic way of analysing the context and designing tools to assist in behavioural change through design elements in four categories: *Primary Task Support*, *Dialogue Support*, *System Credibility Support* and *Social Support*.

Therefore, this study investigates how PSD could be applied to personal cyber security and what factors influence the usage intention of prospective users. Consequently, we asked: *Can a Smartphone-Based Behaviour Change Support System be applied to IT-Security for Citizens?* Thus we investigate the research questions:

> **RQ1**: How could a persuasive app for personal cyber security be designed?
>
> **RQ2**: How do participants perceive the persuasive app?
>
> **RQ3**: What leads to possible adoption of that system?

To this end we designed a non-functional app interface, which was shown to participants in an online study. Further, we assessed the perception of the app, factors influencing usage, and intention to use.

Our main contributions are an interface based on PSD which aims to change private citizens' security-related behaviour and the identification of factors influencing the perception of and intention to use the app.

2 Methodology

We followed the Process of the Persuasive Systems Design (PSD) Framework, i.e. we analysed context factors and designed a persuasive system. After we built a mock up, we

presented images depicting the interfaces to participants in an online survey. Participants were recruited through an email list where people with interest in the project could register, as well as personal contacts and snowballing. We recruited german speaking participants, since the project is concerned with the german population. We collected 73 valid answers, of which 39 were women. The mean age was 48.6 while the youngest participant was 23 and the oldest 80 years old. The sample had a slightly higher educational level compared to the german population.

Study Design   In the survey, we assessed their perception of *Primary Task Support, Dialogue Support, Social Support, Effectiveness, Persuasiveness, Social Pressure* and finally, *Intention to Adopt*, as well as demographics. All answers were captured using 5-point Likert scales (1:"Fully disagree" - 5:"Fully agree"). The study design was based on Shevchuck et al. [4]. Their survey was adapted to our use case and translated into German. We added the perception of *Social Pressure* after piloting. The research model was also inspired by Shevchuck et al., which was, in turn, based on the Unified Theory of Acceptance and Use of Technology (UTAUT) [5]. The complete measurement instrument can be found in the Appendix in Table A.2.

Persuasive Application   The mobile application interface consisted of five tabs. The interface can be found in the Appendix in Figure 1 and Figure 2. First, users were greeted by introducing the goal of the app (i.e. "This app will help you secure your accounts and devices") and giving them the opportunity to add information about devices and accounts, they frequently use, thus *tailoring* it to their context and *reducing complexity* by securing their assets step by step. Next, the app provides *progress monitoring*, displaying the fraction of accounts with 2FA enabled, devices with up-to-date software, passwords in a password manager, as well as the time since last backups. Moreover, this tab *suggest* next steps to further increase the user's security posture, i.e. setting up 2FA for the mail account. Two additional tabs were concerned with the securing of accounts and devices, respectively. On top of each tab, a short description should motivate the user to engage with the following steps. To help users further secure their accounts, the app *suggests* to increase the strength of the social media password, or to secure the mail account with a second factor. Moreover, the app *praises* the user for a secure mail password and 2FA on the social media account. The app provides *social comparison*, by highlighting that five friends already increased the strength of their social media password. The tab about the devices *suggests* to update the iPhone and to back up new data, while *praising* the user for an up-to-date operating system on the laptop and automatic backups of the iPhone. The last tab contains an overview of friends' recent activity, e.g. someone just set up 2FA. Moreover, it provides *social comparison* by contrasting the progress of the user to

their friends' and *suggesting* to keep up with their friends by securing an additional account. Further, the app shows *praise* by highlighting the user's progress compared to their friends.

To summarise, a mobile app was developed using persuasive features, such as *suggesting, praising*, and *progress monitoring*, as well as providing *social comparison*. The interface of this app was then shown to participants in an online survey, assessing their perception regarding different persuasive categories and intention.

3   Key Results

Perception   Participants agreed ($M = 3.94, SD = .650$) that the app would support them in their *primary task*, i.e. securing their assets, as well as engaging them through *dialogue support* ($M = 3.62, SD = .776$). *Social support*, i.e. possibility for comparison was agreed to ($M = 3.73, SD = .500$). Moreover, participants reported *social pressure* ($M = 3.57, SD = .805$). Participants also perceived the app as *persuasive* ($M = 3.33, SD = .763$) and *effective* ($M = 3.66, SD = .691$). On average participants had a positive *intention to use* ($M = 3.40, SD = .939$), while some (fully) disagreed.

Influential Factors   After assessing the perception of different factors via questionnaire, our research model based on UTAUT was used to analyse the relationship betwen these factors: *Primary task support* had a significant positive effect on *perceived persuasiveness*, as had *dialogue support*. *Social support* was not associated with *perceived persuasiveness*. *Perceived effectiveness* and *perceived persuasiveness* had a strong significant positive effect on the *intention to adopt* such a system in the future. *Social pressure* had a significant negative effect on the *intention to adopt*, while itself being influenced by gender (i.e. men reported significantly lower perceived social pressure compared to women). Age further had a significant negative effect on the *intention to adopt*. Exploratory analysis further indicated a correlation between *social pressure* and *perceived effectiveness*.

4   Discussion

Overall, the application of *Persuasive Systems Design* to personal cyber security seems to be a promising approach. Participants mostly perceived the application as supportive, persuasive, and effective. However, the social elements raise concerns. Participants with a higher perceived social pressure through the social elements had a lower intention to use the app. While the research model did not propose a corresponding hypothesis, there could also be a connection to perceived effectiveness. Moreover, the social pressure was higher in women as compared to men. In the area of personal cyber security, social visibility of (lack of) security measures may even be harmful, since others could identify weaknesses.

Acknowledgments

References

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A   Appendix

A.1   Interface Mock-Up

The five different screens in the app interface are shown in Figure 1 and Figure 2.

A.2   Measurement Instrument

See table on page after next page.

(a) Welcome Screen

(b) Overview Screen

(c) Accounts Screen

Figure 1: Interface Mock-Up

(a) Devices Screen

(b) Social Screen

Figure 2: Interface Mock-Up (cont.)

Construct	Question	Reversed
PRIM	The app helps me track and monitor my behavior.	
PRIM	The app makes it harder for me to behave securely.	*reversed*
DIAL	The app rewards me for secure behavior.	
DIAL	The app encourages me to behave securely.	
SOCI	The app allows me to observe other people's actions.	
SOCI	The app prevents me from comparing myself with others.	*reversed*
SOCI	The app shows me how much other people engage in secure behavior.	
SOCI	The app shows me what secure behaviors are.	
SOPR	If I had the choice, I would share my progress with my friends.	*reversed*
SOPR	I find the information about my friends helpful.	*reversed*
SOPR	The information about my friends encourages me to use the features of the app.	*reversed*
SOPR	If my friends can see my progress, I feel pressured.	
PEPE	The app has an impact on me.	
PEPE	The app is relevant to me personally.	
PEPE	The app makes me rethink my habits.	
PEPE	The app convinces me to behave securely.	
EFFE	My chances of behaving securely would improve by using the app.	
EFFE	In my opinion, using the app would have an impact on my security behavior.	
EFFE	My chances of behaving securely would decrease by using the app.	*reversed*
EFFE	In my opinion, the app would have no impact on my securely behavior.	*reversed*
ADOP	I would use the app permanently in the future.	
ADOP	I would be willing to try the app in the future.	
ADOP	I would consider using the app in the future.	
ADOP	I would not use the app in the future.	*reversed*

Table 1: Questions in the survey for different constructs, translated from german. *PRIM* = (Primary) Task support, *DIAL* = Computer Human Dialogue Support, *SOCI* = Social Support, *SOPR* = Social Pressure, *PEPE* = Perceived Persuasiveness, *EFFE* = Perceived Effectiveness and *ADOP* = Intention to Use