Prevention or Panic: Design and Evaluation of a Crime Prevention IS

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Completed Research Paper

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Abstract

Crime prevention is one of the major challenges of modern society that can be addressed by IS. Yet, research in the direction of design principles, perception and implications of crime prevention IS is limited. In this paper we design and evaluate a system to support individuals in increasing their safety. We build upon concepts shown to be effective for crime prevention from several literature streams, deriving six main design principles: (1) information provision, (2) community involvement, (3) preventive tips provision, (4) targeted notifications, (5) gamification and (6) social media integration. We evaluate the proposed system from three perspectives: (1) effect of dissemination of crime information over fear of crime, (2) technology acceptance and its relation to fear of crime, and (3) usage motivations. Our results indicate that the proposed system does not increase the fear of crime. Instead, it holds a potential to motivate its users to undertake preventive measures.

Keywords: Crime prevention IS, crime mapping, fear of crime, perceived risk of crime, UTAUT2, design science

Introduction

Preceded only by basic physiological needs, the second most important need of individuals is the need for safety: either their own safety, the safety of their family members, or of their possessions (Maslow, 1943). Yet, statistical reports published across the world indicate a very high level of criminal activities making crime reduction one of the most critical challenges of modern society (Bendler et al., 2014). For example, in 2014 there were 526'066 criminal incidents in Switzerland (Bundesamt für Statistik, 2014), 70% of those representing property crimes. Moreover, 14% of property crimes are cases of household burglary, resulting in burglary being the most reported crime category.

The large number of burglary incidents has financial consequences for the victims. For example, in 2013 burglary victims in US experienced an estimated $4.5 billion in property losses with an average loss per incident of over $2000 (Federal Bureau of Investigation, 2013). These numbers do not even represent the full amount since it is estimated that at least half of the incidents are not officially reported (Shower, 1991). The growing crime rate is also financially affecting the industry, such as the insurance sector. For example, due to the 16% increase of burglary incidents in 2012 in Switzerland, there was an increase of number of property claims of 30% (Riklin, 2013).

Apart from the financial effect, one of the most critical outcomes of high level of crime is the anxiety it imposes upon individuals leading towards numerous negative consequences for individuals and society. This emotional reaction to crime, commonly referred to as *fear of crime* (FOC), was found to result in significant decrease in the quality of life (e.g. Bannister and Fyfe, 2001; Box et al., 1988; Doran and Burgess, 2012; Grabosky, 1995; Gray et al., 2010; Jackson, 2002; Nasar et al., 1993; Wilson-Doenges, 2000). Moreover, due to the strong focus on criminal activities in mass media, the subjective evaluation of individuals regarding the likelihood of victimization, i.e. *perceived risk of victimization* (PRV), was shown to be significantly higher than the actual risk (e.g. Duffy et al., 2008; Grabosky, 1995; Kemshall, 1997). Even when the crime rates have been reduced, the level of FOC did not drop accordingly (Chainey and Tompson, 2012) or has even risen (Gray et al., 2011). Because FOC leads to distrust and anti-social behavior (Doran et al., 2012; Garofalo, 1981; Spelman, 2004), it could provoke neighborhood breakdowns (Box et al., 1988; Nasar et al., 1993), thus increasing the likelihood for future criminal activities (Erete, 2013; Smith, 1987). Therefore, FOC and PRV emerged as commonly used measures in victimization studies, employed to assess the effectiveness of police initiatives (Jackson, 2006; Kreis, 2012).

To address the above listed challenges, police forces across the world are undertaking actions to involve citizens in crime prevention and safety co-creation through *community policing* initiatives (Kreis, 2012; Ratcliffe, 2002). One approach towards empowerment of the community members is sharing crime-related information with the public, leading towards greater transparency and facilitating the development of problem-solving strategies (Buslik and Maltz, 1998). This approach, commonly referred to as *crime mapping*, has led to the emergence of multiple crime-tracking information systems (IS), hosted mostly - but not exclusively - by police departments. Among the pioneers was the UK Home Office with the publication of their monthly crime maps in December 2008 (Chainey and Tompson, 2012). The interest in the Police.co.uk website was so immense that the service crashed on its first day due to the large number of visitors (Garbett et al., 2015).

Apart from the platforms created by the officials, numerous commercial solutions for crime prevention emerged in the last few years (Ratcliffe, 2002). These solutions can be divided into two broad categories: (1) crime mapping and (2) crime sharing IS. Crime mapping IS offer visualization of crime incidents on a map, with examples being CrimeReports (CrimeReports, 2015), Crimemapping (Crimemapping, 2015), or SpotCrime (SpotCrime, 2015). Crime sharing IS facilitate reporting of personal crime-related experiences with other platform users or officials, with examples including WikiCrimes (WikiCrimes, 2015), CrimePush (CrimePush, 2015), etc. These IS support the principles of raising the awareness among individuals and as such have been shown to be an effective tool for crime reduction (Bendler et al., 2014; Kreis, 2012).

Crime and its consequences have already been a long lasting topic for the social sciences, such as criminology, victimology, sociology, psychology, etc. Yet, the proliferation of geographical information systems (GIS) and their application in crime prevention IS (CPIS) have lead to a broader range of crime related topics requiring an interdisciplinary approach. As an outcome, scholars started looking into algorithms for crime analysis and prediction (e.g. Chainey et al., 2008; Nakava and Yano, 2010; Wang and Brown, 2012), into alternative crime information sources (e.g. Bendler et al., 2014; Gerber, 2014), as well as into visualization techniques (Chainey and Tompson, 2012). They have also started to lay down design principles for such systems (e.g. Blom et al., 2010; Garbet et al., 2015; Lewis and Lewis, 2012).

Despite the recognized importance of research in the domain of security and safety related applications (Chen et al., 2012), there is still a lack of understanding regarding the effects these IS have on the citizens' risk perception, as well as the underlying mechanisms which would motivate sustainable user engagement potentially leading to crime prevention (Kounadi, 2015; Ruiz, 2011). To address this issue, in this work we design and evaluate a CPIS. In order to determine the design principles shown to be effective for crime prevention technology, we build upon the research from psychology, sociology, criminology, human-computer interaction (HCI) and IS. During the design phase, we identify six main concepts for integration in the proposed CPIS: (1) information provision, (2) community involvement, (3) provision of preventive tips, (4) targeted notifications, (5) gamification, and (6) social media integration. Consequently, we evaluate the potential of the proposed artifact from three different perspectives: (1) the effect of dissemination of crime information over FOC and PRV, (2) the technology acceptance of the system and its relationship to FOC, and (3) the motivations for passive and active usage of the proposed platform.

The remainder of this paper is structured as follows. First, we provide an overview of the previous work in related research areas. Based on the literature review, we identify the research gap addressed by this work. Next, we provide an overview into the applied methodology. Consequently, we present the results of the design process and survey-based evaluation and discuss our findings with regard to the previously identified research gap. This paper concludes with a summary and an outlook on future research.

Related Work

This work evaluates the perception of CPIS with a goal to generate knowledge about the relation between the psychological consequences of crime and a set of technology acceptance constructs. As such, our approach is multi-disciplinary. It includes topics from the research areas of psychology, sociology, and victimology, with a focus on FOC, and criminology, with a focus on crime mapping. Finally, we look into the fields of IS and HCI, with a focus on design principles for crime prevention technology. This section reviews the relevant research from the adjacent fields and points out to the identified research gap.

Research on Fear of Crime

FOC is commonly referred to as "… a negative emotional reaction to crime or the symbols associated with crime" (Ferraro and Grange, 1987). As such, FOC was found to be manifested through numerous physiological and psychological changes of the affected individuals, resulting in feelings of anger, frustration, violation, helplessness, anxiety, alienation and general dissatisfaction with life (Ferraro and LaGrange, 2000; Miceli et al., 2004; Morrall et al., 2010; Warr, 2000). Moreover, FOC also affects the society by reducing the sense of community and neighborhood cohesion (Box et al., 1988; Nasar et al., 1993), creating distrust (Garofalo, 1981) and destroying the social relations (Doran et al., 2012; Spelman, 2004). Still, the effect of FOC is not always negative, since it was found to motivate the individuals to change their behavior by undertaking protective measures (Box et al., 1988; Keane, 1998; Reid et al., 1998; Warr, 1985).

Apart from studying the consequences, scholars and government representatives are also focused on explaining the factors that facilitate FOC. Supported by the "broken window" theory (Wilson and Kelling, 1982), FOC was found to be higher in poorest and most deprived neighborhoods (Smith, 1987). On individual level, gender, age, income and education were shown to influence the FOC (e.g. Ferraro, 1995; Garofalo, 1979; Thomas and Bromley, 2000; Warr, 1984). In addition, PRV, as a cognitive mechanism that underlies the creation of FOC (Farrall et al., 2009; Hale, 1996) was found to be an important explanatory variable (Hale, 1996; Warr, 1984).

Despite the large body of research, there are still many open questions regarding the FOC. Previous research on relation between previous victimization and FOC is inconclusive with some authors confirming the correlation between these two factors (Gray, 2011; Mawby and Gill, 1897), and others rejecting it (Box et al., 1998) or suggesting other factors, such as education, as mediators (Carcach et al., 1995). Similarly, studies investigating the influence of presenting crime information to individuals yield contradictory results. Garofalo (1981) distinguishes among three sources of information, which have an influence over the image of crime, risk assessment and FOC, i.e. direct experience, interpersonal communication and media. In particular, FOC is mostly attributed to the incorrect and exaggerated information presented in mass media (e.g., Conklin, 1975; Clemente and Kleiman, 1977; Heath, 1984; Stafford and Galle, 1984). Similarly, police communication programs were shown to increase the FOC, especially for females, elderly and burglary victims with an external risk-orientation (e.g. Baumer, 1978; Winkel, 1991). On the contrary, the results of the British Crime Survey from 1984 showed that accurate crime information is likely to reduce FOC (Maxfield, 1987). Finally, Kuttschreuter and Wiegman (1998) showed that multimedia campaigns for provision of crime related information (through regional newspapers, radio and personal contact with an information officer), organized in The Netherlands, lead to a more positive attitude towards the criminal justice system and had no effect, among others, on risk assessment, FOC, preventive behavior, and the attitude towards crime reporting.

In addition to the previously identified open questions, research over FOC in the context of specific crime types is unevenly distributed. Despite the fact that burglary is among the most common crime types (Erete, 2013), which has considerable psychological impact over extended period of time (Beaton et al., 2000) and causes the highest level of fear (Hough, 1995; Skogan and Maxfield, 1981), previous research

on fear of burglary (FOB) is very limited. FOB was found to be correlated with age, gender, previous victimization and social isolation, as well as the level of incivility and the objective risk of crime in the residence area (Hale et al., 1994; McCoy et al., 1996; Nikolic-Ristanovic, 1995). In addition, fear of offences that might co-occur during burglary, such as assault, rape, or weapon threat, was shown to enhance the FOB (Warr, 1987).

In order to address the high level of FOC, police forces across the world have shifted the focus from actual risk reduction to reassurance (Chainey and Tompson, 2012). One of the undertaken initiatives in the direction of reassurance is crime mapping which has attracted the attention of practitioners and scholars.

Research on Crime Mapping

Crime mapping refers to the practice of placing markers on the map to denote locations where crime incidents occurred. As such, this practice is not new and has been part of the standard police practice for revealing location-related cues and identifying patterns regarding crimes (Ratcliffe, 2004). Development of geographical information systems (GIS) has enabled digitalization of the crime maps. Instead of pins, online crime maps use symbols to represent individual locations of different types of crimes (Weisburd and McEwen, 1998), or apply aggregation methods which result in density maps revealing crime hotspots (Eck et al., 2005). In addition, predictive algorithms enable forecasting of potential crime leading towards the recent trend of *predictive policing* (Perry, 2013). Moreover, development of mapping services such as Google Maps (Google Maps, 2015) has simplified the process of crime mapping by avoiding the need for integration of GIS (Longley et al., 2011).

The main rationale behind crime mapping initiatives was to address perceptions of crime, and promote community engagement and empowerment, leading towards better public service transparency and accountability (Chainey and Tompson, 2012; Wallace, 2009). As such, crime maps provide the possibility to the citizens to undertake active role in crime prevention, thus contributing to public good (Ratcliffe, 2002; Wallace, 2009). Based on these premises, providing crime related information to the public was assumed to be positive and socially beneficial (Wallace, 2009). However, this assumption lacks theoretical confirmation, since the mechanisms behind this rationale were never clearly specified and have rarely been addressed in academic studies (Chainey and Tompson, 2012).

One of the main challenges of crime mapping is privacy of crime victims. Once the incident information is published online, it enables identification of the victim, which in case of burglary might imply that the affected property is vulnerable to burglary, leading potentially to repeat victimization (Ratcliffe, 2002). To address this issue, various aggregation techniques have been developed which lead to another challenge, i.e. the accuracy of the provided information and the negative socio-economic effect it might cause (Chainey and Tompson, 2012; Eck et al., 2005; Ratcliffe, 2002). Revealing crime information might label certain area as "high crime area" which could lead to its marginalization by affecting the insurance premiums, property prices, or quality of services due to the unwillingness of skilled employees to work in such area (Ratcliffe, 2002; Wallace, 2009). If this situation happens due to the erroneous data generated through wrong aggregation, inaccurate geo-coding or inappropriate visualization, it could actually serve as a first "broken window". Thus, despite the recognized potential, further work is needed to resolve technical challenges (Chainey and Tompson, 2012; Ratcliffe, 2002).

Despite the popularity of these platforms, research in the direction of public perception of crime mapping and their potential implications is still very limited with only three studies conducted in this direction (Kounadi et al., 2015). Groff et al. (2005) measured the effect of the form of crime data presentation over FOC and showed that maps produce less fear than tabular statistics. Quinton (2011) revealed that people generally have a positive perception of crime maps, they find them informative and credible and, that the information dissemination does not increase the FOC. Finally, Kounadi et al. (2015) showed that the street-level aggregation on a density map is the preferred form of data visualization. In order to fully understand the magnitude of the effect these platforms have over crime perception and prevention further academic research is needed since, according to Christopher Bruce, former president of the International Association of Crime Analysts, "…implications are complicated even if the use of data is simple" (Ruiz, 2011).

Finally, questions have been raised regarding the underlying principles that can be used as design principles for crime mapping applications in order to achieve the intended goal. According to Chainey and

Tompson (2012), a CPIS should provide (1) accurate and (2) relevant crime information, by covering a wide range of criminal incidents. Moreover, the provided information should be presented in a form of (3) a crime map (Groff et al., 2005; Quinton, 2011), where (4) in case of providing individual incidents, these are to be visualized by using symbolic markers to make risk assessment more entertaining for at-home users and reduce FOC (Wallace, 2009). Still, (5) privacy should also be taken in consideration, which can be achieved through data aggregation (Chainey and Ratcliffe, 2005; Eck et al., 2005). In addition, CPIS should also provide (6) targeted information in times of increased risk, (7) mechanisms to draw users back and keep them engaged on the platform (e.g. via prevention tips), and (8) integration of social media platforms to improve the community engagement through dialog (Chainey and Tompson, 2012). Finally, (9) provision of crime prediction feature would facilitate the protective role of the CPIS (Perry, 2013).

To gain deeper knowledge about the mechanisms that would lead to greater citizens' engagement, novel solutions for crime prevention were proposed that build upon the idea of improving the communication between the community and the police.

Research on ICT for Safety and Crime Prevention

With the recognized value of the crime mapping approach and the proliferation of various computer-mediated crime prevention initiatives, researchers have turned their attention to extending the existing and proposing alternative solutions, which might yield the same outcome. Current research in this direction is mostly conducted within the HCI research community and can be divided into: solutions based on sensor technologies, those requiring certain risk-reducing actions from their users, and systems designed for individuals to be informed and exchange about potential risks. In particular, the focus is placed on understanding the design principles for crime prevention solutions based on information and communication technology (ICT), as well as the individuals' perception of these solutions.

Sensor based solutions aim at obtaining data regarding unusual and potentially risky behavior from sensors, such as surveillance cameras – for household protection (Brush et al., 2013), or wearable computers – for decreasing the fear among older adults (Blythe et al., 2004). This information is further shared with the police representatives or community members who can act upon it by undertaking risk-reducing actions. Similarly, Satchell and Foth (2011) propose a hand-held device that automatically records and shares the location of an individual on a short time interval, while also providing the "help" button functionality that could be triggered manually when needed. While these approaches were found to have potential for reducing crime and FOC, they revealed one common issue, i.e. high level of (1) security and privacy concerns, which should be taken in consideration when designing safety IS. In addition, (2) the possibility for fast and easy interaction was shown to be a key feature, which would enable mass adoption of these systems in different scenarios and by different user groups.

Of systems requiring an action, Blom et al. (2010) propose a mobile application that allows individuals to tag and share areas of the city on a virtual map where they feel unsafe. Based on their findings they suggest the following design principles: (3) enabling social and communal involvement, (4) capturing and conveying location based safety attributes, and (5) supporting comforting, preventive or reactive use of the service. In addition, Garbet et al. (2015) propose Fearsquare, which serves personally contextualized risk information, cross-referenced with geo-located user check-ins on Foursquare. They recommend applying "critical design" which assumes "exposing and exploring alternative assumptions about key relationships in our field – the user, the design, interaction, the business or home context, and quality of life now and in the future" (Bardzell, 2009). The results of both studies indicated that CPIS that require active user engagement are perceived as effective for reduction of FOC.

The previous two approaches build upon the victimization theory, which states that providing information to users would increase feelings of safety and decrease risk of victimization (Lewis and Salem, 1981). Opposed to the victimization theory, the social control theory focuses on understanding the communities and suggests that social interactions have the potential to reduce criminal activities through informal enforcement of social norms (Lewis and Lewis, 2011). Recent studies that investigate the communication within existing online and offline communities reveal that this approach also enables building and strengthening of social ties, undertaking collective actions and sharing of information and advices among community members (e.g. Erete, 2013; Lewis and Lewis, 2012). Thus, crime prevention technologies should be designed to (6) support communication and (7) sharing of personal experience, (8) promote the perception of in-person neighborhood cohesion, (9) redefine neighborhood spaces as places where

community collaboration occurs, and (10) facilitate collective efficacy (Erete, 2013; Lewis and Lewis, 2012). Moreover, in order to increase the attractiveness of these systems, Erete (2013) proposes introduction of (11) gaming principles, such as rewarding the users with virtual points when they interact with their neighbors. Finally, Erete (2013) points out that it is important to design preventive and not responsive solutions since once there has been an intrusion the victim is already psychologically affected.

The significance of public security and safety was also recognized in the IS community as one of the main applications of business intelligence and analytics (BI&A), addressing the development of new technologies, systems and algorithms for security related applications (Chen et al., 2012). Among the potential applications, crime analysis and computational criminology focus on public safety and crime prevention (Chen et al., 2012). Still, while research into safety and security from the perspective of analysis and prediction was addressed in several research disciplines such as computer security, computational criminology, and terrorism informatics (Brantingham 2011; Chen et al. 2008), property crime prevention has received little attention in the IS community. In a recent publication, Bendler et al. (2015) analyze the potential of social media as a source for analysis and prediction of criminal activities and show that their approach has potential for explaining burglary, theft, vehicle theft and robbery. Yet, an interdisciplinary approach to the topic of CPIS, especially from the design and implications perspective is still outstanding (Kounadi et al., 2015). Moreover, some of the above mentioned studies recognized the ease of use of the proposed system as one of the key design features (Blythe et al., 2004; Satchell and Foth, 2011), or addressed usefulness in terms of the potential of CPIS for FOC reduction (Blom et al., 2010; Garbet et al., 2015). Still, none of these studies examines individuals' perception or attitude towards crime prevention technology, indicating a lack of knowledge regarding the technology acceptance of CPIS.

Research Gap and Research Questions

As pointed out in the previous subsections, research in the direction of design principles, perception and the potential implications of crime prevention ICT-based initiatives is very limited. In particular, there is still a lack of understanding of the effect caused by dissemination of crime information over the FOC and PRV. Second, there are a limited number of studies focusing on property crimes and burglary as the most common and most harmful category of crime against property. Third, there is a lack of theoretical confirmation that presenting crime information (via crime mapping) promotes preventive behavior. Fourth, there is a lack of understanding which mechanisms would lead to greater citizens' engagement.

In order to address the above listed issues, and answer the call to understand the critical (intended and unintended) implications of IT artifacts for individuals and society, as well as their perception-based potential, raised by Orlikowski and Iacono (2001), in this work we design and evaluate a crime prevention IS with the goal of addressing the following research questions:

RQ1. Which design principles should be integrated into CPIS in order to support its goal of crime prevention (and ultimately crime reduction)?

RQ2. What is the effect of showing high level of crime within a CPIS over its users' FOC, PRV, and their intention of using prevention measures?

RQ3. What are the main technology acceptance and psychological constructs that influence users' intention to use the IS?

RQ4. What are main motivations for passive (content consumption) and active (content generation) participation on CPIS?

The following section details the methodology applied in order to obtain the answers.

Methodology

The work described in this paper is conducted in collaboration with one of the largest Swiss insurance companies, in continuation denoted as *Insurer*. Concerned with a growing crime rate and the implications such situation might have over the insurance business, the Insurer was interested in providing a novel ICT solution that would support its users in undertaking crime prevention activities. Being positioned as a cooperative, the Insurer intended to deploy this solution in a way that it would not only bring value to

their customers, but to the Swiss population as a whole. Building upon these premises, the main moto of the project was "creating safer Switzerland".

To achieve the presented goal, a structured design-science methodology for IS development was adopted (Hevner et al., 2004). During the design phase of the CPIS, a close collaboration was established between the researchers, experts on criminal and clinical psychology and theft experts from the insurance industry. The methodological approach of this work follows a five-step process shown in Figure 1.

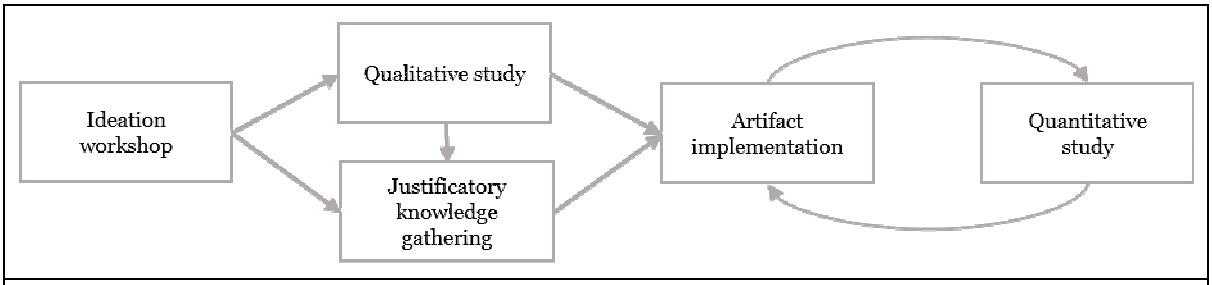

Figure 1. Design and evaluation process

As a first step, a three-day *ideation workshop* (Jonson, 2005) was organized in December 2013. The goal was to gain deeper understanding of the business needs and to generate ideas on the topic of "creating safer Switzerland". The workshop had twelve attendees that represented a balanced mix between four researchers and eight representatives of the Insurer from different business units (innovation manager, product manager, business development manager, IT architect, jurist, and claims inspector). The main outcome of this step was an initial set of design principles. In addition, few concerns were raised regarding the potential psychological implications of the proposed solution.

In order to address the concerns regarding the potential psychological implications of a CPIS raised in the first step, a *qualitative study* was performed in a form of two semi-structured interviews. The first interviewee was an expert in clinical psychology, specialized in the psychological consequences of burglary, while the second interviewee was a specialist in criminal psychology from the police of the canton of Zurich. Both interviews addressed the perception of safety from a psychological point of view, the potential negative effects of revealing the crime information to the public, and the idea of sharing personal experiences on CPIS. The interviews were carried out in person, recorded and transcribed. The main goal of this study and the chosen approach was to understand the respondent's point of view rather than to make generalizations. Thus, the result of this step was a clearer understanding of the psychological implications of crime prevention initiatives as well as an extended set of design principles.

In parallel to the qualitative study, a literature review was conducted to *gather justificatory knowledge* about CPIS. Research fields to be included in the review process were chosen based on the design principles identified in the previous steps. In particular, focus was placed on the crime prevention initiatives and the psychological consequences of crime. A relevant body of domain knowledge as outlined in the Related Work section was obtained. As an outcome, the final set of design principles was compiled as an answer to the RQ1.

Based on the obtained design principles, an ICT *artifact was implemented*. In order to gain preliminary insights regarding the feasibility of the envisioned solution, only the first three main design principles were implemented in the first phase (see *Results* section for reference). Once the results of the evaluation were obtained, a fully functional prototype was developed. The artifact was developed as an application for tablets in order to (1) provide contextual information at any time, and (2) present greater level of details on the screen, thus making it easier for the users to navigate through different functionalities.

Finally, a *quantitative study* was performed in June 2014 to evaluate the feasibility of the proposed solution. The participants were presented with a description of the ICT prototype and then asked to fill out a survey. The main goal of the study was to assess whether seeing an unsafe situation of Switzerland affects people's perceptions of safety and their willingness to use the proposed ICT artifact and/or other preventive measures. The participants were randomly assigned in two equally sized study groups that were treated differently. The first group (503 participants) was shown an image of "safe Switzerland" where the crime map visualized lower level of crime represented through lower map density and

dominance of green color. The second group (506 participants) was presented with an image of "unsafe Switzerland", i.e. a map with greater density and dominant red color. A legend was also shown indicating that green level indicates low level of incidents while red color represents very high level of crime incidents. Figure 2 illustrates the different map versions.

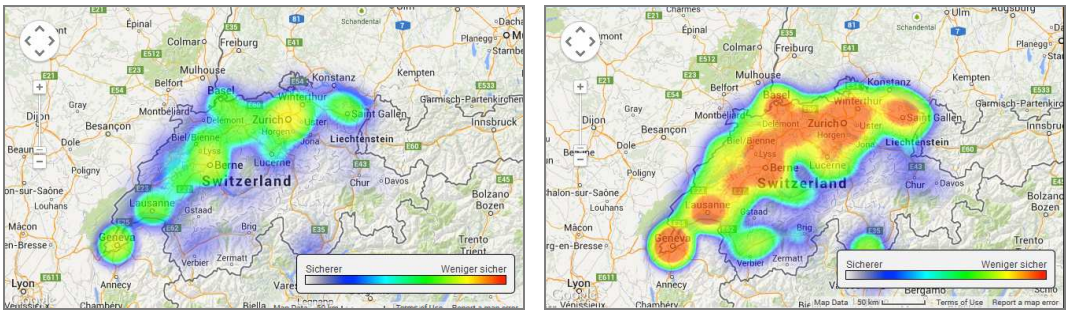

Figure 2. "Green" vs "red" map visualization

The survey was divided in four parts. First part addressed the demographics information about the participants including age, gender, education level, and living area. The second part contained questions regarding the psychological implications of crime measured through FOC and PRV. Operationalization of FOC was based on two questions related to the safety when walking alone after dark as suggested by Ferraro and LaGrange (1987) on a four-point Likert scale (from 1-"safe" to 4-"unsafe"). The PRV was operationalized using a question related to the likeliness of being a victim of burglary within the next 12 months, with a binary answer scale ("yes" or "no") (Killias et al., 2011; LaGrange et al., 1992). Finally, to understand the users' willingness to use preventive measures, a list of seven preventive measures, compiled based on the prevention tips provided by law enforcement representatives (Polizei Basel-Landschaft, 2015), was presented to the participants, with three possible answers, "yes", "no" and "I do it already". The operationalization of these indicators is listed in Table 1.

Construct	**Operationalization**
FOC	*How safe do you feel …* **FOC1**: … for yourself when walking alone in your neighborhood after dark? **FOC2**: … for a family member when she is walking alone in her neighborhood after dark?
PRV	**PRV**: Do you think that it is likely that someone will break into your home within the next 12 months?
Preventive measures	**PMn**: Do you think that you will use the following preventive measures against burglary in the next 12 months?

Table 1. Risk perception and preventive behavior indicators and questions

The third section of the questionnaire aimed at understanding the acceptance and potential use of the proposed artifact. For this purpose, the extended unified theory of acceptance and use of technology (UTAUT2) proposed by Venkatesh et al. (2012) was adopted. The three constructs from UTAUT2 considered relevant for our study are *performance expectancy* (PE), *effort expectancy* (EE) and *social influence* (SI). These constructs further determine the *behavioral intention* (BI) to use a technology. For each construct, several statements were formulated and measured on a five-point Likert scale from 1 – "very unlikely" to 5 – "very likely". The operationalization of these constructs is listed in Table 2.

Construct	**Operationalization**
Performance expectancy	**PE1**: Using the safety map would enable me to make a better-informed decision regarding an area or neighborhood where I would like to rent or buy a place to live. **PE2**: Using the safety map would enable me to have a more realistic view on the safety in my neighborhood and city. **PE3**: Using the safety map would make it easy for me to get tips regarding

Construct	Operationalization
	protection from burglary or other criminal activities. **PE4**: I would find the safety map useful in my daily life.
Effort expectancy	**EE1**: I would find the safety map easy to use. **EE2**: Learning to use the safety map would be easy for me.
Social influence	*I would consult and contribute to the safety map if …* **SI1**: … people whose opinions I trust would do the same. **SI2**: … people who are important to me would do the same. **SI3**: … people who I trust would do the same.
Behavioral intention	**BI1**: I would consult the safety map on my smartphone. **BI2**: I would contribute to the safety map by sharing my personal experience.

Table 2. Operationalization of the UTAUT2 constructs

Finally, motivational aspects were considered building upon the motivation theory (Ryan and Deci, 2000). We hypothesize that the usage of the proposed system is driven by the intrinsic motivation. First, the motivation to consult the safety map can be seen as intrinsic motivation to know (Vallerand et al., 1992). The measurement was based on self-reporting as suggested by Vansteenkiste and Deci (2003) over eight statements built upon possible use cases of the application. Similarly, the motivation to contribute to the safety map was operationalized into four statements, based on hypotheses inspired from intrinsic motivations for volunteering (Yang and Lai, 2010). In particular, ideology (Nov, 2007), altruism (Prasarnphanich and Wagner, 2009; Smith, 1981) and social norms (Fisher and Ackerman, 1998) have been identified as key drivers of content generation. The statements were rated on a five-point Likert scale, from 1 - "not at all accurate" to 5 - "extremely accurate". A full listing is shown in Table 3.

Usage type	Motivation
Passive usage - Intrinsic motivation to know	*I would consult the safety map to …* **MP1**: … check the safety of a neighborhood before renting or buying a new place to live. **MP2**: … check the safety of the neighborhood or area where my family members live (e.g. children, parents, siblings). **MP3**: … check the safety of a neighborhood or area when going out (ex. to a concert, social event, sport event, etc.). **MP4**: … check for safe areas when I go jogging. **MP5**: … check for safe areas to park my car. **MP6**: … check for safe areas to leave my bicycle. **MP7**: … check for safe areas when I visit a foreign city. **MP8**: … receive safety and prevention tips.
Active usage – volunteering, altruism and social norms	*I would contribute because …* **MA1**: … I am genuinely concerned about the safety of my neighborhood. **MA2**: … I would feel responsible for sharing my own experiences to help others. **MA3**: … the map has helped me. **MA4**: … my family or close friends would also contribute.

Table 3. Motivations for passive and active participation

Based on the obtained answers, the potential of the proposed artifact was evaluated from three different perspectives (RQ2-RQ4) as already elaborated in the *Research Gap and Research questions* section. In particular, to address the RQ2, we applied independent-samples t-test to compare the mean values of obtained results regarding the FOC measures between the two groups. In addition, we applied two-proportion z-test to measure the differences in PRV and users' willingness to use preventive measures

between the two study groups. Further, to address the RQ3, we first applied one-sample t-test to compare the mean values of the obtained results regarding the individual technology acceptance measures to the neutral value. In addition, to estimate the effect of the considered UTAUT2 constructs (PE, EE and SI), as well as the overall FOC (for oneself and for family members) over the behavioral intention to use the proposed system, we applied structural equation modeling (SEM), as a method that provides a possibility for analysis of relationships between (latent) constructs (Gefen et al., 2000). Finally, to address the RQ4, we applied one-sample t-test to compare the mean values of the obtained results regarding the usage motivations to the neutral value.

Results

In the following subsections, the results of the design process and evaluation are presented.

Ideation Workshop

The first day of the ideation workshop was dedicated to exploring the problem space by brainstorming for *project visions*. The outcome was a list of 12 ideas, which can be divided in two broad categories: software-based solutions and intervention based solutions. The first group contained ideas such as creating a mobile platform that either uses gamification principles to motivate its users to provide safety relevant information, or shows crime incidents on a map and gathers information from users about unsafe areas. The second group offered greater variety, from deterring criminals by increasing the neighborhood security or creating "friendly neighborhoods", to avoiding crime-related news in media.

The second day of the workshop was dedicated to exploring the solution space. Undertaken activities included identification of the stakeholders, based on which three teams were created. Each team generated extreme personas which served as a basis for discovery of the solution boundaries and generation of further ideas. Those ideas were then transformed into prototypes and evaluated by members from other teams by applying the think aloud method (Van Someren et al., 1994). Figure 3 illustrates the activities undertaken on the second day.

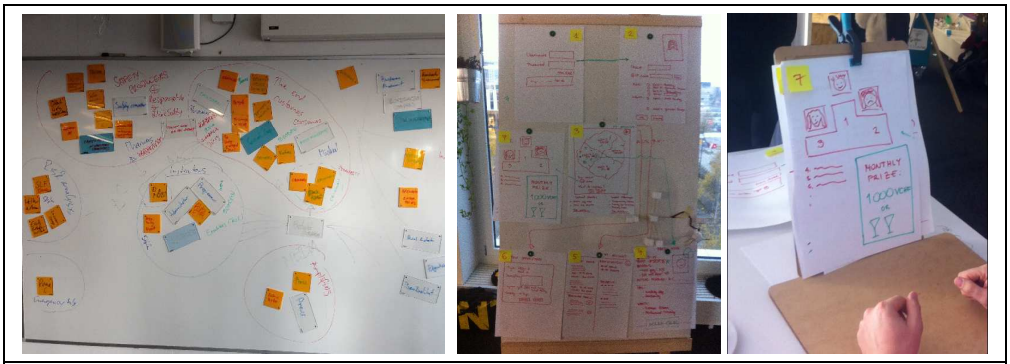

Figure 3. Stakeholders, critical function prototype and user testing

Results of the prototype evaluation in form of critical functions were used as input for the third day when each prototype was finalized and then presented in a session of elevator pitches.

In summary, the ideation workshop was a useful step in understanding the business needs and the needs of potential users, defining the solution boundaries and raising new questions worth looking into. The main outcomes were the following:

- *Prototype design principles*: (1) technology-based solution, (2) map based visualization of crime incidents, (3) tips based prevention, (4) community involvement, and (5) gamification.
- *Challenges*: negative psychological effects of crime information on the general public, and motivating long-term and active participation.

Qualitative Study

Since this study is not in the focus of this work, we summarize below only the key results that were used to better inform the identification of design principles for the envisioned artifact and to serve as guidelines for the quantitative study. In terms of general understanding of the FOC, one relevant insight was that basic trust is developed during one's childhood resulting in relation between FOC and general fear. Second, it was emphasized that having a possibility to make a choice is very important. Related to this, was the statement that when communicating information about crime, the potential negative psychological impact has to be counterbalanced. According to the first interviewee, "if you show a person that he or she is living in a high risk area, you should really offer something additional to offset their worries". In addition, the second interviewee suggested that the crime map concept should be more focused and should include "small crimes such as bicycle theft". Finally, a common takeaway from both interviews was that people generally feel safe in Switzerland and that they are not aware of the recent increasing trends in criminality. This confirmed the necessity to measure the risk perception, and it indicated that the crime map concept might be used to raise awareness. To summarize, the following results were obtained:

- *Prototype design principles*: (1) broader set of crimes, and (2) prevention tips.
- *Study design principles*: measuring the general FOC instead of FOB, and measuring the PRV.
- *Learnings*: Swiss citizens feel safe, crime mapping has a potential to raise the awareness, and crime information does not always have negative psychological consequences.

Justificatory Knowledge Gathering

According to the first step of the design process, five initial design principles were proposed: (1) ITC-based solution, (2) map-based visualization of crime incidents, (3) community involvement, (4) tips based prevention, and (5) gamification. In addition, the qualitative study contributed with one more design principle: (6) focusing on a broader set of property-related crimes. Against this background, justificatory knowledge from the fields of psychology, sociology, criminology, HCI and IS was applied and mapped onto the objectives of a CPIS. As an answer to the RQ1, the following design principles were identified:

DP1. *Information provision* through crime mapping technology to empower the individuals, raise the awareness and promote preventive behavior (ideation workshop; Box et al., 1988; Chainey and Tompson, 2012; Keane, 1998; Reid et al., 1998; Wallace, 2009; Warr, 1985).

i) Extending the solution boundaries to a set of property related crimes including burglary, theft, vehicle theft, and robbery, to increase the information relevance (qualitative study; Chainey and Tompson, 2012).

ii) Using aggregation methods for visual representation of crime incidents from the initial dataset (see *Artifact Implementation* section for details) to address the privacy issues (Eck et al, 2005; Chainey and Ratcliffe, 2005).

iii) Using symbolic markers for user reported incidents to reduce FOC, assuming that privacy is not a concern in this case since individuals act voluntarily (Groff et al., 2005; Wallace, 2009).

iv) Implementing crime prediction mechanisms based on the historic data to facilitate protective role of the IS (Blom et al., 2010; Perry, 2013).

DP2. *Community involvement* for building and strengthening of social ties and sharing of information and advices among community members (ideation workshop; Blom et al. 2010; Erete, 2013; Lewis and Lewis, 2012).

i) Enabling users to share personal crime-related experiences (ideation workshop; Erete, 2013; Lewis and Lewis, 2012).

ii) Fast and easy interaction to support mass adoption and usage in critical situations (Satchell and Foth, 2011).

iii) Enabling users to share prevention and protection tips to promote the preventive role of CPIS (e.g. Erete, 2013; Lewis and Lewis, 2012).

iv) Provision of possibility for communication and discussion among the platform users (e.g. Erete, 2013; Lewis and Lewis, 2012).

DP3. *Prevention tips* for counterbalancing the dissemination of crime related information and enabling supportive function of the system (ideation workshop; qualitative study; Blom et al., 2010; Chainey and Tompson, 2012).

DP4. *Targeted information*, i.e. warnings in times of increased risk to promote the preventive role of CPIS, and establish mechanisms to draw users back and keep them engaged (Chainey and Tompson, 2012).

DP5. *Gamification*, i.e. provision of rewarding system to motivate higher level of interaction, e.g. based on contribution to the platform with personal experiences (ideation workshop; Erete, 2013).

DP6. *Social media integration* to improve the community engagement (Chainey and Tompson, 2012; Lewis and Lewis, 2012).

Of the above listed design principles, DP1-DP4 can be considered as crucial for building an effective CPIS since they create the basis for the preventive and supportive role of the proposed system. In turn, DP5 and DP6 have a role to increase the engagement, and thus also the perceived value of the proposed CPIS.

Artifact Implementation

Based on the above listed design principles an ICT based artifact was developed. The artifact was implemented as a crowdsourcing application that would allow its users to report criminal incidents. Based on the reported incidents, a crime map is created which shows 12 months in the past and the future. In order to avoid the problem of unsustainable content generation and consumption cycle typical for new crowdsourcing applications, where lack of content leads to lack of users and back (e.g. Kumar, 2009), an initial dataset was provided by the Insurer in a form of property claims data. In addition, two types of preventive tips were provided: (1) static tips, and (2) dynamic tips derived from the reported incidents. Moreover, each user is presented with personalized risk estimation, based on the details provided for the user profile, such as age, gender, etc. Finally, depending on the user preferences, notifications are triggered regarding reported incidents in user's proximity or within any area of interest. Figure 4 illustrates the two versions of the artifact.

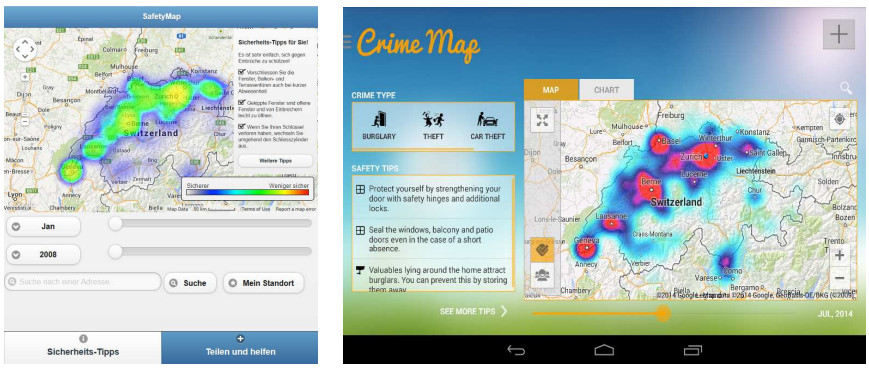

Figure 4. Crime mapping view from two artifact versions – basic version (left) and full version (right)

Quantitative Study

A total of 1009 participants have filled out the survey as a part of our study. Of those, 49% (494 participants) are male and 51% (515) female. Their ages range from 25 to 70 with the smallest group being the one with participants bellow 26 years (2.8%; 28). Further, 33.4% (337) fall within the range between

26 and 40 years, 38.5% (388) between 41 and 55 years, and the remaining 25.4% (256) have above 56 years. In terms of the education, 16.2% (163) have low education, 52.5% (530) medium and 31.3% (316) have high education. Regarding the nationality, 76.1% (768) are Swiss, while the remaining 23.9% (241) are foreigners, which corresponds to the general population distribution in Switzerland. Finally, 24.9% (251) live in the West part of Switzerland, 24.1% (243) in the Alps region, 22.3% (225) in the Central West part and 28.7% (290) in the Central East part of the Switzerland.

In order to provide an answer to our second research question (RQ2), we compared the mean values of the reported FOC. The mean value of FOC1 for the "Green Map" group was found to be very low (M = 1.50, SD = 0.634) indicating that the majority of participants stated that they feel safe or somewhat safe. Similarly, FOC2 was also found to be low (M = 1.60, SD = 0.636). The results of the "Red Map" group show similar situation where both FOC1 (M = 1.48, SD = 0.630) and FOC2 (M = 1.61, SD = 0.658) have low values. The results of the independent-samples t-test showed that there is no significant difference in the FOC between the two subject groups, both for oneself and for a family member. In terms of the PRV, within the "Green Map" group 20% of the participants (103) answered that they believe they will become a victim within the next year, while in the "Red Map" group this number equals 23% (118). Two-proportion z-test revealed that there is no significant difference between the proportions of participants who believe they will become victims between both subject groups. Figure 5 illustrates the results for FOC and PRV.

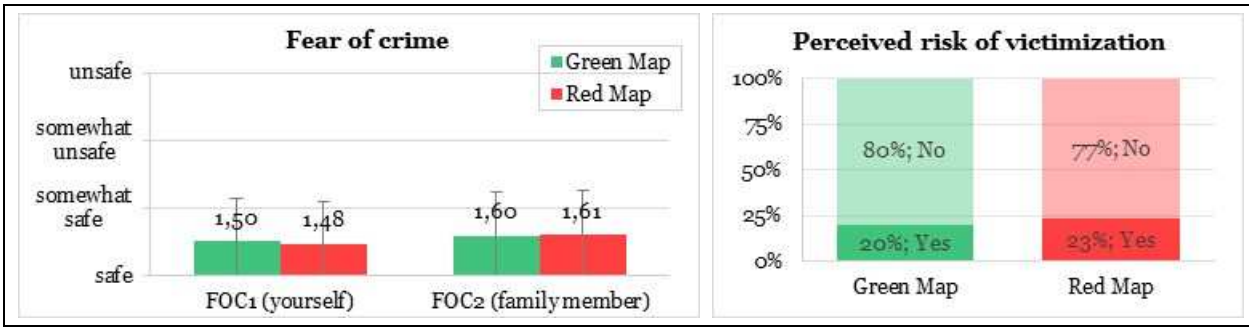

Figure 5. Influence of crime level on fear of crime (FOC) and perceived risk of victimization (PRV)

When applying two-proportion z-test over the results regarding the willingness to use preventive measures, no significant difference was found to exist between the two subject groups for all three proportions of users: (1) those who already apply the measure, (2) plan to do it, or (3) do not intend to do it. Therefore, instead of focusing on two separate groups an overall impression was obtained by looking into proportions over the total number of participants. The results revealed that P7, P4, P3 and P5 are the most popular measures, which are preventive measures already in use or planned, while P1 and P2 are the least preferred options. Figure 6 illustrates the exact numbers across the three proportions.

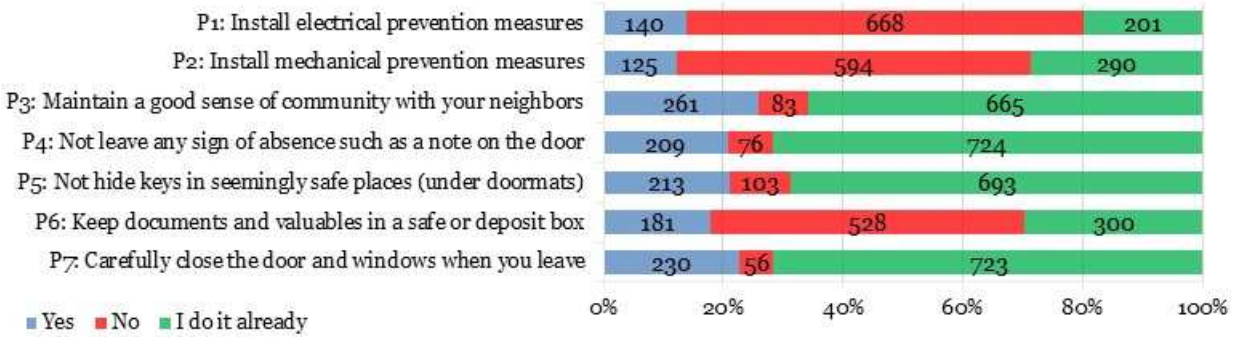

Figure 6. Willingness to use preventive measures

To address the RQ3, we first looked into the mean values of the measures representing UTAUT2 constructs in order to obtain a general understanding regarding the acceptance of the proposed solution.

In regard to the performance expectancy, only the PE4 referring to the daily usage of the proposed CPIS was significantly smaller than the neutral value 3 (M = 2.91, SD = 1.603), while the remaining three PE1 (M = 3.43, SD = 1.556), PE2 (M = 3.37, SD = 1.524) and PE3 (M = 3.62, SD = 1.431) were found to be significantly larger ($p < 0.05$). Further, the CPIS was perceived as easy to use with both constructs, EE1 (M = 4.16, SD = 1.329) and EE2 (M = 4.25, SD = 1.265), being significantly higher than the neutral value ($p < 0.05$). Same results were obtained for the social influence measures SI1 (M = 3.12, SD = 1.635), SI2 (M = 3.14, SD = 1.598) and SI3 (M = 3.19, SD = 1.621) with all of them being significantly larger than the neutral value ($p < 0.05$). Finally, the intention to use the proposed system on a smartphone (BI1) was found to be significantly smaller than the neutral value (M = 2.99, SD = 1.753), while the intention to share personal experiences (BI2, M = 3.23, SD = 1.623) was found to be significantly larger ($p < 0.05$).

In addition, to ascertain the effects of the three considered UTAUT2 constructs, as well as of the FOC on users' behavioral intention to use the proposed CPIS, we build a SEM. We fitted the hypothesized structure model to the data by means of a Maximum Likelihood algorithm in IBM SPSS Amos 22.0.0. The model was statistically significant ($\chi 2(55) = 208.32$, $p < 0.0005$), with all parameters indicating a good model fitness: GFI = 0.96; NFI = 0.97; RMSEA = 0.05. Figure 7 presents the standardized direct effects of the four considered constructs on the endogenous variable. We found that PE and SI represent predictors of system usage intention with high factor loadings of 0.34 and 0.63, respectively (*** $p < 0.001$). Effort expectancy and FOC were found to have very small and statistically insignificant effects.

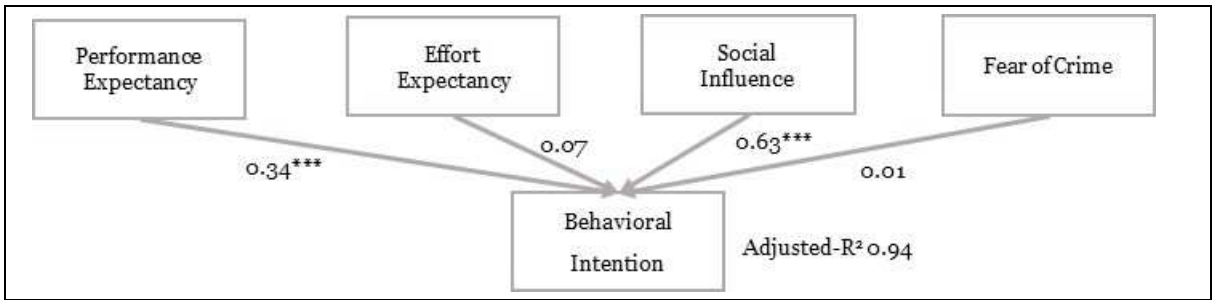

Figure 7. Structural equation model of selected UTAUT2 constructs and fear of crime

To test the reliability of the measured model, we computed the Cronbach's Alpha index (α) of the deployed constructs, i.e. 0.86 for PE, 0.85 for EE, 0.92 for SI, 0.86 for FOC, and 0.69 for BI. With the exception of BI, all indices exceeded by far the recommended threshold of 0.70 (Gefen et al., 2000). Moreover, given the fact that all loadings were significant (*** $p < 0.001$), and the average variance extracted (AVE) exceeded the recommended threshold of 0.50 for every construct (Fornell and Larcker, 1981), we concluded convergent validity to be supported by the data. As for the discriminant validity of the model, most of the square roots of AVEs exceeded the correlations between the relevant construct and all the other constructs in the model. Insufficient discriminant validity occurred only for BI <-> SI, BI <-> PE and SI <-> PE correlations. Table 4 and Table 5 provide the details of the obtained results.

	PE	EE	SI	FOC	BI	Err. Variance	CR	AVE
PE1	0,74					0,452	0,854	0,594
PE2	0,8					0,36		
PE3	0,74					0,452		
PE4	0,8					0,36		
EE1		0,89				0,208	0,845	0,732
EE2		0,82				0,328		
SI1			0,90			0,190	0,925	0,804
SI2			0,90			0,190		
SI3			0,89			0,208		
FOC1				0,89		0,208	0,862	0,757

	PE	EE	SI	FOC	BI	Err. Variance	CR	AVE
FOC2				0,85		0,278		
BI1					*0,65*	0,577	*0,698*	0,539
BI2					0,81	0,344		

Table 4. Statistics of Confirmatory Factor Analysis (CR = Composite Reliability)

Construct	PE	EE	SI	FOC	BI
PE	0,77				
EE	0,53***	0,86			
SI	*0,84***	0,40***	0,90		
FOC	0,18***	-0,04	0,17***	0,87	
BI	*0,91***	0,51***	*0,95***	0,18***	0,73

Table 5. Bivariate Correlations and square roots of AVEs of Latent Constructs (diagonal).

Finally, in order to address the RQ4 we looked into the mean values obtained for each motivation for both passive and active usage. The results of the one-sample t-test revealed that the overall motivation to use the proposed system was small, with each value being significantly smaller that the neutral value 3 ($p < 0.05$). Receiving prevention tips (MP8, $M = 2.81$, $SD = 1.335$) and acquiring knowledge before relocating (MP1, $M = 2.64$, $SD = 1.420$) obtained highest ranks among the motivations for passive usage. These were followed by MP2 ($M = 2.42$, $SD = 1.343$), MP7 ($M = 2.40$, $SD = 1.348$), MP5 ($M = 2.23$, $SD = 1.338$) and MP6 ($M = 2.12$, $SD = 1.314$). Finally, obtaining information before going out (MP3, $M = 2.10$, $SD = 1.236$) and before jogging (MP4, $M = 1.90$, $SD = 1.174$) were found to be the least relevant. In terms of active usage, contributing due to being concerned about the neighborhood safety (MA1, $M = 2.81$, $SD = 1.360$) was found to be the main motivation. It was followed by MA3 ($M = 2.53$, $SD = 1.338$) and MA4 ($M = 2.45$, $SD = 1.304$). Finally, MA2 ($M = 2.36$, $SD = 1.278$), i.e. feeling responsibility to share experience with others, received the lowest rank. Figure 8 illustrates the obtained results.

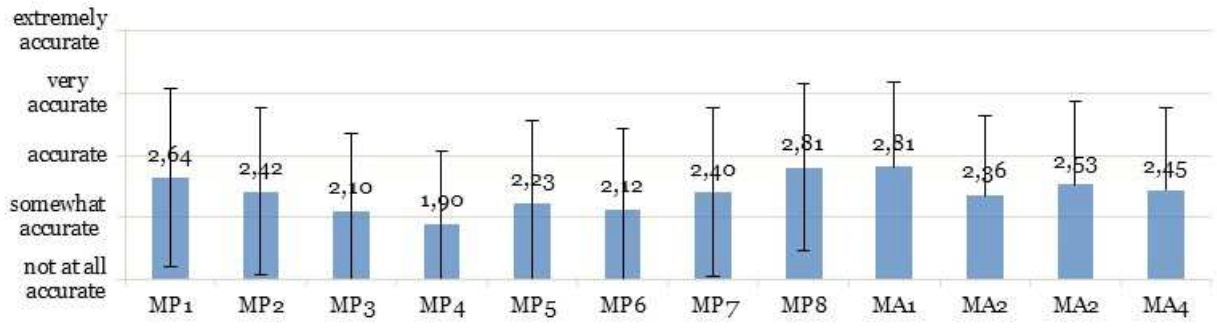

Figure 8. Motivation for passive (MPn) and active (MAn) usage of the proposed CPIS

Discussion and Conclusions

In order to address the first research question, we have applied a bottom-up approach by understanding the problem first and then gathering justificatory knowledge regarding the underlying concepts. This knowledge was further used to determine the mechanisms needed to solve the identified problem of addressing high crime rates. The derived list of design principles clearly indicates that crime prevention technology should be addressed as a multi-disciplinary problem at the intersection of research on psychology, sociology, victimology, criminology, computer science, HCI and IS.

As already expected, based on the learnings from the qualitative study, the results of the empirical study confirmed that majority of Swiss people feel safe or somewhat safe both for themselves and for their

family members. Contradictory to this is the finding that more than 20% of the participants believe that there is a high probability that they will become a victim of burglary within the next year, which is significantly higher compared to the actual risk of 0.65% (Bundesamt für Statistik, 2014). This result complies with the previous studies (Duffy et al., 2008; Grabosky, 1995; Kemshall, 1997; Ratcliffe, 2002), pointing out to the importance of addressing the high levels of crime as the antecedent of PRV in order to prevent further psychological and societal implications.

In terms of the potential effect of dissemination of crime information over the FOC and PRV, the results of our experiment show that seeing a map with higher levels of crime does not significantly affect one's FOC and PRV. This implies that the envisioned CPIS would not spread panic among its users, as pointed out during the ideation workshop. Instead, our results comply with the victimization theory proposed by Lewis and Salem (1981), leading towards the conclusion that designing a CPIS which communicates the objective risk exposure, holds a potential to decrease the risk of victimization, ultimately leading to increased feelings of safety.

In addition, no effect of showing crime information was found to exist over the willingness to employ preventive measures. Instead, the awareness in regard to prevention possibilities was shown to be high (as indicated with the percentage of those participants already employing certain preventive measure). This however only applies to simple preventive measures. When it comes to the willingness to employ preventive measures that require a financial effort, majority of the participants stated that they are not willing to undertake them. This opens the door for behavioral interventions that could influence the users in implementing prevention actions as suggested by the system.

In regard to technology acceptance, our results indicate that the system was perceived as useful and easy to use. However, it is not perceived as a service that would be used on a daily basis. This finding complies with the previous research conducted by Chainey and Tompson (2012). Moreover, performance expectancy and social influence were found to be the main drivers for the technology acceptance. As users are already familiar with general mobile application usage, effort expectancy rendered as insignificant for the IS adoption. Finally, FOC was shown to have no significant impact on one's intention to use the proposed CPIS. Thus, focusing on functionalities which would support the users in performing certain activities, as well as integration of social media as a possibility to tackle the social influence construct by providing insights into the activities of the social peers, should be of high priority when designing CPIS. It should be noted that construct reliability was not satisfied for the behavioral intention to use the proposed system. We believe the relative low factor loading of the BI1 measurement and the resulting lower index of the BI construct, is due to the fact that users might be willing to use the system on other platforms as well, and not only on smartphones. Thus, the measurement formulation introduced a bias towards smartphone owners. In addition, since the discriminant validity was not fully satisfied, further analysis is needed to validate the obtained results.

Finally, non-habitual usage scenarios, such as choosing a safe area to relocate or receiving prevention tips, as well as the general safety in the neighborhood, were shown to be the major motivators of the system usage. These results indicate that when designing crime prevention technology attention should be given to mechanisms which will keep users engaged with the system, and thus providing a platform for citizens engagement and empowerment.

Summary and Future Work

In this paper we designed and evaluated a crime prevention IS which has a goal to support individuals in increasing their safety by raising the risk awareness and providing tips for undertaking preventive measures. Our solution builds upon concepts shown to be effective for crime prevention, derived from relevant literature in psychology, sociology, criminology, HCI and IS. The main components of the proposed CPIS are: (1) information provision, (2) community involvement, (3) preventive tips, and (4) targeted notifications. In addition, (5) gamification and (6) integration of social media were identified as principles which could increase the engagement on the platform. We evaluated the potential of the proposed artifact from three different perspectives: (1) the effect of dissemination of crime information over FOC and PRV, (2) technology acceptance of the system and its relation to FOC, and (3) the motivations for passive and active usage. Our results show that presenting crime information does not affect the safety perception and it does not influence the willingness to undertake preventive measures.

Moreover, the system was perceived as useful and easy to use, where the usage intention was driven by the performance expectancy and social influence, while effort expectancy and FOC had no effect over the behavioral intention. Finally, receiving prevention tips and contributing to the platform due to concerns regarding the neighborhood safety were found to be the main usage motivators. These results indicate that the proposed CPIS would not lead to increased fear of crime, but instead holds the potential to motivate its users to undertake preventive measures.

The study presented in this paper is limited to Switzerland, thus the obtained results might differ in different geographical regions. In order to address this issue we plan to repeat our study with participants from different countries in order to be able to make a generalization of the obtained results. In addition, we intend to look deeper into the potential use cases and specific features, which would motivate users' engagement on the platform on a more regular basis. Finally, we plan to deploy the system and conduct a field study in order to gain insights into the actual usage.

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