From crime hotspot to secure hotspot
Unravelling the human factors of campus security

Thesis submitted for the degree of doctor in Safety Sciences at the University of Antwerp by

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Dankwoord

Eind 2017, ondertussen bijna vier jaar geleden, kreeg ik de kans om te starten met dit doctoraatsonderzoek naar de beveiliging van campussen. Omdat ik dit traject niet alleen doorlopen heb, bedank ik graag enkele mensen die heel belangrijk zijn geweest tijdens dit hele proces.


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**Nederlandstalige samenvatting**

Terwijl hogeschool- en universiteitscampussen vaak worden beschouwd als omgevingen die immuun zijn voor criminaliteit, wijst eerder onderzoek uit dat delicten zoals verbaal en fysiek geweld, diefstal, vandalisme en seksueel ongewenst gedrag regelmatig voorkomen op de campus. Daarnaast geeft ongeveer een vierde van de studenten aan dat ze zich soms onveilig voelen op en in de buurt van de campus en speelt beveiligingsperceptie een belangrijke rol in de werktevredenheid van personeelsleden. In voorgaande studies is men het er over eens dat een sterke beveiligingscultuur een organisatie weerbaar maakt tegen criminaliteit. Deze beveiligingscultuur bestaat uit drie domeinen die nauw verbonden zijn met elkaar: het technologische (bv. alarmsystemen, bewakingscamera’s), het organisatorische (bv. procedures) en het menselijke domein (bv. het gedrag van mensen).

Terwijl hoger onderwijsinstellingen vaak investeren in technologische en organisatorische maatregelen, wordt het menselijke domein vaak over het hoofd gezien. De bijzondere eigenschappen van campussen, zoals het publiek toegankelijk karakter en de grote aanwezigheid van studenten, zorgen ervoor dat gesofisticeerde technologische maatregelen niet altijd haalbaar of wenselijk zijn. Veel potentieel kan daarom toegeschreven worden aan de menselijke factor in het kader van de beveiliging van de campus. Deze cruciale rol wordt in het bijzonder onderstreept binnen het concept van *security awareness* of beveiligingsbewustzijn. Het verhogen van de bewustwording van de mogelijke beveiligingsrisico’s en handelingen om deze risico’s te beperken kan een belangrijke troef zijn in het beveiligingsbeleid. Anderzijds is het belangrijk dat personeelsleden en studenten zich veilig voelen en vrij kunnen deelnemen aan alle activiteiten op de campus. Het beperken van *fear of crime*, of de angst voor criminaliteit, maakt integraal deel uit van het menselijke beveiligingsdomein. Naast de campus zelf, wordt ook de buurt waarin deze gelegen is vaak gekenmerkt door enkele specifieke factoren die de kans op criminaliteit en angst kunnen vergroten. Terwijl eerder onderzoek voornamelijk focust op de relatie tussen socio-demografische factoren, werd tot nu toe weinig aandacht besteed aan de invloed van deze campusomgeving op angst voor criminaliteit onder studenten en personeelsleden.
Deze dissertatie heeft als doel om de menselijke factoren in de beveiliging van de campus te ontleden. Enerzijds wordt onderzocht welke factoren bijdragen aan het beveiligingsbewustzijn van studenten en personeelsleden en op welke manier zij nog bewuster kunnen gemaakt worden. Anderzijds wordt gefocust op angst voor criminaliteit onder studenten en personeelsleden en de invloed van omgevingsfactoren, zoals de inrichting van de omgeving en de aanwezigheid van overlast. Omdat het onderzoek naar beveiliging in het algemeen en beveiliging op de campus meer specifiek nog zeer beperkt is, werd eerst een conceptueel model voor beveiligingscultuur ontwikkeld en een overzicht geboden van de verschillende methoden om deze beveiligingscultuur te meten. Bovenstaande werd op een multi-methodische manier onderzocht, daarbij gebruik makend van (i) een literatuuronderzoek naar fysieke beveiliging, (ii) een systematische review van de bestaande meetinstrumenten voor beveiligingscultuur, (iii) een survey onder studenten en een survey onder personeelsleden, (iv) quasi-experimenten met awareness trainingen en nudges en (v) systematische observaties in de directe omgeving van de campus.

De resultaten tonen aan dat het inzetten op kennis, attitudes en gedrag in het kader van beveiliging noodzakelijk is bij het vergroten van beveiligingsbewustzijn onder studenten en personeelsleden. Terwijl awareness trainingen voornamelijk effectief zijn in het bijbrengen van noodzakelijke kennis en verbeteren van attitudes, toont het experiment met nudges verandering in het gedrag op het vlak van beveiliging teweeg te kunnen brengen. Daarnaast wordt een duidelijk verband aangetoond tussen angst voor criminaliteit onder personeelsleden en studenten en de omgevingsfactoren van de campus. Gebaseerd op onze bevindingen raden we aan hoger onderwijsinstellingen meer in te zetten op de menselijke factor in beveiliging. Op een kostenefficiënte manier kunnen er initiatieven ontwikkeld worden die het beveiligingsbewustzijn onder personeelsleden en studenten vergroten. Het aanpakken van overlast en inzetten op architecturale aanpassingen in de omgeving via de principes van Crime Prevention Through Environmental Design (CPTED), zorgt daarnaast voor minder angst voor criminaliteit en een campusomgeving waar iedereen vrij kan deelnemen aan activiteiten.
CHAPTER 1

Introduction

1.1. Campus security

Although there is general consensus in empirical literature that university and college campuses are more secure than the communities in which they are located (Barton et al., 2010; Gregory & Janosik, 2002), previous studies show that crimes such as theft, verbal and physical violence, vandalism and sexually undesirable behaviour are quite prevalent at higher educational institutions (HEI’s) (Doss et al., 2017; Jacobsen, 2017; Jennings et al., 2007; Schokkenbroek et al., 2020). The high student population, the prevailing freedom, lack of guardians and homogenous nature of the campus setting create an environment with opportunities for crime to occur (Petherick, 2000). McPheters (1978) and Fox and Hellman (1985) were among the first researchers to empirically examine campus crime and explore factors associated with its occurrence. While their publications can be considered as the starting point of a long research tradition in the United States, it is only recently that attention has been given to these issues in Europe (Maran & Begotti, 2019; Maran & Zedda, 2014; Sani et al., 2020). Due to the large differences in educational system and campus design of HEI’s in the two continents, it is risky to extrapolate findings from the United States to Europe. This implies that to date, little is known about crime victimization at non-American campuses.

Over the years, several theories have been developed to explain which factors contribute to the occurrence of criminal incidents. Concerning crime on campus, the lifestyle routine activity theory (LRAT) (Cohen et al., 1981) is often put forward as a valuable explanation for victimization. According to this theory, crime is associated with the daily routines of people. A combination of a greater proximity to crime, the presence of motivated offenders and suitable targets, and a lack of capable guardians increases the likelihood of criminal events. In a campus environment, the gathering of many students in auditoria or the presence of a high number of staff members during events may increase exposure to crime. Moreover, engaging in activities that are inherently part of student life, such as going to bars at night, may be accompanied by an increased presence of motivated offenders (Hayes et al., 2020). Besides
students and staff members, also personal property, such as laptops, smartphones or bikes, or business equipment such as projectors, printers or lab equipment, can be considered as suitable targets. The presence of capable guardians lowers the probability of crimes to occur and serve as ‘the ears and eyes’ of the campus. In addition to police patrol or security guards, also students, staff members, visitors or neighbouring residents may fulfil this role of capable guardian (Tewksbury & Mustaine, 2003). Moreover, physical measures, such as closed-circuit television (CCTV), detection systems and various other forms of technology used to monitor the campus, could serve as capable guardians (Barnes, 2009).

In order to prevent or reduce campus crime, HEI’s have to identify and protect suitable targets, strengthen guardianship and minimize offences across the campus environment. In comparison with other organizations, HEI’s often consist of specific characteristics which creates many challenges to secure them (Jennings et al., 2007). Most campuses in Europe are characterized by a very open infrastructure with many (semi-) publicly accessible buildings. This implies that not only students and staff members can enter the campus, but that also external people can freely walk through the campus buildings (Rasmussen & Johnson, 2008). Additionally, next to the normal teaching and working activities, numerous events take place on campus. Occasions such as study days, workshops, student parties or staff activities are accompanied by a highly increased presence of people. Contrary to this open campus character, extra protection is required for some areas, such as server rooms or labs.

Moreover, not only the campus itself, but also the direct neighbourhood of the campus is characterized by some specific features which may be linked to an increased presence of crime. The limited research that has been done on this topic has found some associations between a neighbourhood’s proximity to a college or university campus and its level of crime. Previous studies show that a large majority of crimes occur approximately within 150 meters beyond the campus boundaries, in the student-dense neighbourhoods (Nobles et al., 2013; Weiss, 2013). A combination of the individual characteristics of those spending time in these areas along with the structural characteristics of the campus environment should theoretically create conditions conducive to opportunities for crime. On one hand, these neighbourhoods can be considered as crime attractors, as they may attract offenders seeking to capitalize on the opportunities present in these areas, such as intoxicated students or insecure housing largely vacant during the day. On the other hand, the campus neighbourhood can be seen as
a crime generator due to the presence of numerous venues designed for student leisure, such as bars, restaurants and shopping venues that attract people to an area and may become potential targets. This finding is supported by numerous studies on crime hot spots which have consistently found associations between the presence of these types of businesses and higher rates of crime (Weisburd et al., 2012).

Since the beginning of this century, it has become clear to scientists and practitioners that the development of a strong security culture is indispensable to make organizations prepared for and resilient against criminal incidents (Breidenbach, 2000; Solms, 2000). Although there is some unanimity about the need of a security culture, there does not exist a concise definition of what is meant by ‘a security culture’, nor are there clear views on how to create this organizational culture to support security (Chia et al., 2002). This could be explained by the fact that security culture research is still a relatively young discipline, in which theories and models are still emerging (Malcolmson, 2009). In order to conceptualize security culture, previous studies draw inspiration from the more developed and related field of safety sciences (Máté, 2017; Reniers et al., 2011). Also in this dissertation, we rely on the definition of Vierendeels et al. (2018), who refer to safety culture as an entanglement of technological, organizational and human domains. Therefore, in order to create a strong security culture, an integral focus on technological (e.g., CCTV, fences, locks), organizational (e.g., procedures, responsibilities) and human (e.g., behaviour, attitudes) domains is needed.1

While HEI’s (and other organizations) often focus on the technological and organizational domains to prevent and mitigate criminal offenses, less attention is paid to the human factors, such as the behaviour or attitudes of organizational members (Ghafir et al., 2018; Metalidou et al., 2014). As HEI’s are by their very nature open-access environments where people move between and among buildings and outdoor spaces, sophisticated technological techniques (e.g., badge checks, fences) are often not desirable or feasible (Rasmussen & Johnson, 2008). Therefore, a crucial role is reserved for students and staff members to act as capable guardians in order to reduce the opportunities for crime on campus. In previous studies, authors refer to ‘security awareness’ or people’s understanding of the importance of security and their own

1 In this dissertation we will refer to a ‘physical’ security culture, in order to make a distinction between security in the physical world and security in a digital world, which is often called information security or cyber security.
responsibility in it (Rezgui & Marks, 2008; Siponen, 2000). It is assumed that by making students and staff members more aware of the potential risks and the (preventive) actions they can take, security culture can be strengthened. On the other hand, it is also important that they are not deterred from knowing the risks, but that they feel secure to engage in activities on campus. Previous research has shown that fear of crime among students and staff members may negatively affect their participation in educational or work-related activities (May et al., 2010). Moreover, feelings of fear of crime may well have more of an impact on people than the reality of crime (Gover et al., 2011).

Considering the above, besides investing in the technological and organizational security domains, it should be the aim of HEI’s to strengthen students’ and staff members’ security awareness and reduce their fear of crime in order to strengthen the security culture. Understanding which factors contribute to this human domain of campus security is undoubtedly indispensable to improve it. An introduction to the two main human concepts of this dissertation, security awareness and fear of crime, is presented below.

1.1.1. Security awareness

Previous studies indicate that security awareness can be distinguished in three dimensions: what people know (security knowledge), what people think (security attitude) and what people do (security behaviour) (Kaur & Mustafa, 2013; McCormac et al., 2017). The three components originate from the Knowledge, Attitude and Behaviour (KAB) model of Baranowski et al. (2003), which assumes that the accumulation of knowledge may result into changes in attitudes, which can in turn lead to changes in behaviour. For instance, when individuals have knowledge about the potential security threats and understand the importance of security procedures, their attitude might change which may result in more security compliant behaviour. Vice versa, a lack of knowledge of the potential security breaches and its implications may lead to a lack of security motivation and the incomprehensibility of the seriousness of potential risks and the associated needs for security procedures. This can in turn lead to an impediment of logical decision-making associated with security.

Over time, various methods have been developed in order to affect people’s behaviour by increasing their knowledge. Initiatives such as promotional methods (e.g., posters, stickers),
enforcing methods (e.g., awareness tests, confidentiality agreements), educational methods (e.g., trainings, workshops) or informational methods (e.g., leaflets, e-mail warnings) all have the aim to share information which ideally leads to more compliant behaviour (Johnson, 2006). While some studies confirmed the relationship between individuals’ knowledge, attitude and behaviour in the field of security (e.g., Parsons et al., 2014), research carried out in other fields, such as healthcare (Baranowski et al., 2003) and environmental awareness (Newbould & Furnell, 2009), has shown that increased knowledge is not the ultimate factor of change in behaviour. In these domains, researchers have started to search for alternative approaches to achieve changes in people’s behaviour.

An approach that has been frequently used in other domains is the use of nudging, or ‘the ways of influencing choice without limiting the choice set or making alternatives appreciably more costly in terms of time, trouble, social sanctions, and so forth’ (Hausman & Welch, 2010, p. 126). Nudges have gained widespread recognition through the work of Thaler and Sunstein (2009), who assume that individuals can be directed towards certain behaviour by gentle pushes or nudges. Examples are the displaying of caloric information on a menu with the goal of less calorie intake (Thunström, 2019) or the placement of footsteps leading towards a bin to facilitate dropping garbage in the bin (Hansen & Jespersen, 2013). To date, the use of nudges in the field of security is still limited to a few examples such as posters with watching eyes in bicycle parking facilities to deter offenders of stealing bikes (Nettle et al., 2012) or the introduction of a travel pass with biometric data for passengers that want to cross the border without the interrogation of security guards at the airport (Schuilenburg & Peeters, 2015).

The findings above show that further research is needed about the relationship between people’s security knowledge and their behaviour in order to examine how students’ and staff members’ security awareness can be improved. Additionally, further exploration of the effectiveness of nudges in the field of security is necessary to examine whether this approach may be useful for directing students and staff members towards more secure behaviour.
1.1.2. Fear of crime

Fear of crime is considered as one of the main effects of crime and victimization and can be distinguished in three dimensions: a cognitive dimension, or the perceived risk of victimization; an affective or emotional dimension, or feelings of anxiety; and an expressive dimension, or the behavioural attitudes or measures taken in response to feelings of fear, such as avoidance behaviour (Hardyns & Pauwels, 2010). Fear of crime can have detrimental effects, not only on people’s health (Jackson & Stafford, 2009), but also on social networks, neighbourhoods and society as a whole (Hale, 1996). On campus, higher levels of fear of crime have been related to psychological strain and avoidance behaviour, which may negatively affect students’ participation in educational activities (Schuck, 2017). Additionally, fear of crime has been found to play an important role in the level of job satisfaction among employees (Ayim Gyekye, 2005; Nielsen et al., 2011). Over time, the impact of demographic factors on levels of fear of crime on campus has been largely emphasized (Fisher, 1995; Jennings et al., 2007; Warr, 2000). For instance, findings reveal that fear of crime increases with age and that women express more feelings of anxiety in comparison to their male counterparts (Schreck & Miller, 2003).

In addition to individual determinants, environmental cues may also matter. Previous research has demonstrated the relationship of physical features of the built environment and people’s fear of crime (Cozens & Sun, 2018; Marzbali et al., 2012). In this light, the concept of Crime Prevention Through Environmental Design (CPTED), has become one of the most popular prevention strategies to reduce crime and fear of crime. Introduced by Jeffery (1971), the CPTED approach involves the implementation of physical environmental designs that may reduce the opportunities for criminal behaviour and thus reduce fear of crime through architectural means. Various studies have found that CPTED consists of five key principles: surveillance (e.g., security guards, police patrol), access control (e.g., detection mechanisms), territoriality (e.g., fences, property signs), maintenance (e.g., cleanliness, condition of the buildings) and activity support (e.g., parks, shops) (Armitage & Monchuk, 2019; Cozens, 2016).

Additionally, underlying the principle of maintenance, the broken windows theory proposes that the presence of social (e.g., drunk people, people fighting) and physical disorder (e.g., litter, graffiti) has an important impact on people’s fear of crime (Wilson & Kelling, 1982). Public disorder may reflect the neglect of the community and a breakdown in behavioural
norms and formal and informal social controls (Perkins & Taylor, 2002; Skogan, 1990). The presence of physical or social disorder could inform the belief that victimization is likely to happen (Robinson et al., 2003).

A subset of studies that investigated the relationship of CPTED and disorder and fear of crime in a campus setting, focused on three correlates of fear of crime: prospect, refuge and escape (Fisher & May, 2009; Petherick, 2000). Their findings show that higher levels of fear of crime on campus are related to a poor visibility of the location, a lower chance for victims to escape and a higher presence of areas that contain hiding places for offenders. Each of these correlates are design features which are minimized or eliminated in high CPTED facilities. For instance, Tseng et al. (2004) evaluated security perceptions at two different parking garages of Ohio State University in the United States following a 2-year implementation of a CPTED program. Their findings confirmed the positive relationship between CPTED modifications and people’s perception of security, with lighting being the most significant factor affecting perceptions. Fernandez (2005) surveyed students’ perceptions of secure and unsecure exterior sites on Louisiana State University campus finding that visibility, clean and well-kept areas, and proper landscaping increased students’ perception of security. More recently, Cozens and Sun (2018) examined students’ fear of crime in relation to the level of CPTED finding that lower levels of CPTED were associated with more frequent feelings of insecurity.

As most European campuses are open-access environments where traditional security measures are often not desirable, a more feasible approach could be the implementation of CPTED principles and the reduction of social and physical disorder (Maier & DePrince, 2020; Robinson, 1999). Further examination of the impact of physical cues in the environment on students’ and staff members’ fear of crime is needed to obtain more insight in potential strategies that may reduce these feelings of insecurity.

While it is the main focus of this dissertation to explore and improve the human factors of security, reference is made to the technological and organizational security domains. For instance, attention will be paid to CPTED, which can be categorized under the technological domain, and nudging, which can be categorized under the technological and organizational domains. The integral focus on human, organizational and technological aspects of security culture shows that all these domains are strongly intertwined.
1.2. Relevance of the dissertation

1.2.1. Scientific relevance

This dissertation contributes to the literature on physical security in general and campus security in particular. It is only since the terrorist attacks of September 11, 2001 that physical security gained widespread attention which moved the topic to a higher place on the business agendas of many companies (Sas et al., 2019). Although from then on organizations mostly focused on small crimes such as vandalism and theft, a more recent expansion in other security incidents such as espionage, organized crime and cyberattacks, led to increased attention for all intentional and malicious security threats. Also in scientific research, an acceleration in the development of security concepts and models can be observed in the past two decennia (Reniers et al., 2020; Sas et al., 2020). Nevertheless, security culture can be considered as a research domain that is still in its infancy. This finding is supported by the fact that there does not exists a widely accepted definition of security culture and that there is also no standard agreement on how an organization’s security culture can be measured or evaluated. While some researchers have made some attempts in specific security domains, such as nuclear security (e.g., World Institute for Nuclear Security, 2011) and cyber security (e.g., Schlienger & Teufel, 2003), studies in other domains are missing (Malcolmson, 2009). It is the aim of this dissertation to fill this knowledge gap in literature by focusing on security culture in general and campus security in particular. More specifically, the conceptual part (Chapter 2) and methodological parts (Chapters 3 and 4) will provide more insight in the conceptualization and measurement of an organization’s security culture.

Subsequently, a second knowledge gap in scientific literature can be identified in the field of campus security. While hundreds of studies have been conducted in an attempt to explain victimization on campus, the large majority is carried out at American colleges and universities (e.g., Jennings et al., 2007; Kaminski et al., 2010; Steinmetz & Austin, 2014). Although there exists a large body of scientific research on topics such as the prevalence of sexual assault (e.g., Klein & Martin, 2019), the impact of school shootings (e.g., Kaminski et al., 2010) and the effect of security legislation (e.g., Janosik & Gehring, 2003) on American campuses, it is difficult to apply the conclusions about these studies to European HEI’s (Sani et al., 2020). Contrary to European HEI’s, campuses in American countries are characterized by large
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populations of students living on campus (in dormitories) and spending their free time on campus (e.g., in fraternities and sororities, campus gyms, campus restaurants) (Huesman et al., 2009). Moreover, the widespread phenomenon of school shootings in the past decades led to the development of specific campus security legislation and an implementation of more severe security measures, such as campus police officers and metal detectors. The campus design and security policies are contrary to those of European HEI’s where focus lies on preserving open campuses where students, staff and visitors can enter buildings freely. The lack of scientific interest in campus security studies at European HEI’s could be rooted in the assumption that campuses are secure and safe places (Fisher, 1995; Fox et al., 2009; Jacobsen, 2017) or in the absence of tragic incidents (e.g., shootings) compared to American universities. It is the aim of this dissertation to fill this knowledge gap and focus on campus security in a non-American context. More specifically, the empirical part (Chapters 5-8) will focus on students’ and staff members’ perceptions of security at the University of Antwerp, in Belgium.

Finally, the large majority of studies on campus security focus on the security perceptions of students, while little is known about the feelings and perceptions of other campus’ residents, such as staff members (Gover et al., 2011). Previous research on security awareness in other environments than the campus showed that older people are often more security aware and behave in a more secure way in comparison with younger individuals (Pattinson et al., 2015). Additionally, previous studies on fear of crime found that feelings of anxiety are associated with age, indicating that older people have higher levels of fear of crime compared to younger individuals (Gibson et al., 2002). These findings suggest that students and staff members should not be presumed to share the same perceptions as they are generally at different life phases and may have different relationships with HEI’s (i.e., for staff members the campus is a workplace, but for students it could be a home, especially for those residing in student housing) (Kyle et al., 2017). It is therefore the aim of this dissertation to fill this research gap by including staff members in the research samples of the empirical studies that were carried out. More specifically, in Chapters 5, 6 and 8 the factors that contribute to staff members’ security awareness and fear of crime on campus will be explored.
1.2.2. Practical relevance

In addition to the scientific relevance, this dissertation also contains an important practical relevance. All HEI’s have a common goal: attracting and retaining prospective students to sustain sufficient enrolments and recruiting qualified staff members to achieve and maintain a high quality of education (De Jager & Bezuidenhout, 2014). Previous research has shown that the perception of a secure and crime-free campus environment plays an important role in the school choice process of prospective students and their parents (Ammigan & Jones, 2018; The British Council, 2012). Additionally, studies carried out in other types of organizations found that employees’ security perceptions are related with their job satisfaction, indicating that the perception of a secure environment is associated with a higher level of satisfaction (Ayim Gyekye, 2005; Nielsen et al., 2011). A major step towards understanding what security programs and policies HEI’s can implement to address crime, is to study what affects the perception of a secure campus. When it comes to Belgium, very little - if any - research has been carried out on campus security in general and security perceptions of students and staff members in particular. As such, this dissertation has the aim to provide an important practical relevance by offering policy recommendations for HEI’s based on the different studies that were carried out in Chapters 5 to 8.

Secondly, the findings of this dissertation mainly contribute to the practical security approach of the University of Antwerp. The university served as the research area of all empirical studies that were carried out during this research project. Moreover, at the start of this research, the steering group ‘Security’ was composed which fulfilled an advisory role during the different research phases. Its contribution was reflected in regularly meetings in which interim results and future research ideas were discussed. The close cooperation with the University of Antwerp implies that the conclusions and recommendations of this dissertation are most applicable to support further developments in this university’s security policy. However, this certainly does not mean that this dissertation is only of practical relevance for the University of Antwerp. In the first couple of months of the research project, 10 qualitative in-depth interviews were carried out with security managers from other HEI’s in Belgium and The Netherlands. During those meetings, topics such as the best practices, main concerns and future priorities regarding campus security were discussed. Due to the confidential nature of these conversations, the results are not be published in this dissertation. However, the
security managers’ shared insights were born in mind during the whole research project. This implies that this dissertation consists of a practical relevance for (European) HEI’s in general and the University of Antwerp in particular.

Finally, the practical relevance of this dissertation extends beyond HEI’s. Previous research has shown that also in other organizations the human domain of security is often ignored or overlooked compared to the large investments that are made in technological and organizational measures (Ghafir et al., 2018; Luo et al., 2011). Moreover, most organizations focus on tackling criminal incidents that already took place and approach their security policy mainly in a reactive way, while focus is very rarely on a proactive way of thinking (Ruighaver et al., 2007). In other words, an integrated and proactive approach to security challenges is often lacking (Chia et al., 2002). This dissertation has the aim to focus on the human factors of security and explore how this human domain can be strengthened by taking into account the interconnected technological and organizational domains. As such, the findings and insights of this dissertation may also be useful for other organizations than HEI’s who have the aim to further develop their security approach in a more proactive way with a key focus on the human security domain.

1.3. Aims of the dissertation

It is the key aim of this dissertation to unravel the human factors of campus security. As illustrated in the introduction of this dissertation, the human domain forms an integral part of an organization’s security culture but is often not prioritized or even ignored. To examine which factors affect this human domain and how it can be strengthened, this dissertation comprises three main parts: (1) a conceptual part, (2) a methodological part and (3) an empirical part.

To unravel the human factors of campus security, it is indispensable to start this dissertation with an understanding of what is security. We will refer to (physical) security culture to take into account all relevant security aspects of the organization. As the current literature lacks a uniform definition of security culture, **it is the aim of the conceptual part of this dissertation to develop a comprehensive conceptual model of security culture that integrates all relevant security domains of the organization.**
The methodological part of this dissertation builds on this conceptualization and examines how security culture can be measured and evaluated. Due to the lack of a standardized measuring tool, an overview of existing instruments is provided. Subsequently, systematic social observations (SSO) are applied in practice in order to investigate the potential value of this methodological approach for analysing the environmental cues in the campus environment. As such, the methodological part aims to investigate how security culture can be measured, thereby taking into account the conceptualization and integrality of the different domains of security culture.

The insights obtained in the conceptual and methodological parts are put in practice in the empirical part. As HEI’s are by their nature open-access environments, sophisticated technological measures are often not feasible. A crucial role is therefore reserved for the human factors of security. On one hand, students and staff members that are security aware may prevent and reduce criminal events and strengthen HEI’s security culture. Therefore, it is the first aim of the empirical part of the dissertation to explore which factors constitute security awareness on campus, how these factors are related to each other and how they can be strengthened. On the other hand, it is important that students and staff members feel secure on campus and that they can engage in their activities without fear of crime. Therefore, it is the second aim of the empirical part to explore the extent to what environmental cues of the campus are related to students’ and staff members’ fear of crime and how these feelings of fear can be reduced.

1.4. Research design

1.4.1. Research setting

All empirical studies included in this dissertation were carried out at the University of Antwerp. The University of Antwerp is one of eleven Belgian universities and is located in the largest city of Belgium (based on its population). The university consists of nine faculties spread among four main campuses (see Figure 1.1). While one campus is located in the centre of the city of Antwerp, the other three campuses are situated in a more rural environment on the outskirts of the city. All campuses are open to the public and are directly accessible by public roads. This implies that campuses are not only visited by students and staff members, but also by visitors such as inhabitants of the city or tourists. At the start of this research project (2017)
the university enrolled 20,492 students, while at the end of the project (2021) 21,133 students were studying at the university. In 2017, 5,618 staff members were employed at the university which increased to 6,205 employees at the end of the research project.

**Figure 1.1.** Overview of the locations of the four campuses of the University of Antwerp.

### 1.4.2. Research methods

This dissertation adopted a multimethod approach. The emergence of multimethod research, or also called a mixed methodology, multi-strategy research, hybrid or combined research, is often associated to the famous article of Campbell and Fiske (1959) on measurement validation. The multimethod approach became a widely used strategy for improvement and led to a systematic practice to employ different types of methods interacting with each other (Hunter & Brewer, 2015). With regard to crime and security, this multimethod approach became widely recognized and institutionalized in the public policy arena in 1973 with the establishment of the U.S. Department of Justice’s Victimization Surveys to supplement the
FBI’s Uniform Crime Reports (Brewer & Hunter, 2006). In this dissertation, a combination of six research methods was used: (1) qualitative in-depth interviews, (2) a literature review, (3) a systematic review, (4) systematic social observations (SSO), (5) quantitative surveys and (6) quasi-experiments. Table 1.1 provides an overview of the datasets.

**Table 1.1. Overview of the different datasets used in this dissertation.**

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Method</th>
<th>Year</th>
<th>Sample size (N)</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Qualitative in-depth interviews</td>
<td>2017</td>
<td>18</td>
<td>n/a</td>
</tr>
<tr>
<td>2</td>
<td>Literature review</td>
<td>2018</td>
<td>n/a</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Systematic review</td>
<td>2018</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Systematic social observations</td>
<td>2020</td>
<td>406</td>
<td>4, 8</td>
</tr>
<tr>
<td>5</td>
<td>Quasi-experiment</td>
<td>2018</td>
<td>74</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Survey</td>
<td>2018</td>
<td>1,443</td>
<td>5, 8</td>
</tr>
<tr>
<td>7</td>
<td>Survey</td>
<td>2019</td>
<td>1,463</td>
<td>7, 8</td>
</tr>
<tr>
<td>8</td>
<td>Quasi-experiment/survey</td>
<td>2019</td>
<td>3,963/197</td>
<td>6</td>
</tr>
</tbody>
</table>

At the beginning of the research project, 10 qualitative in-depth interviews were carried out with security managers from different HEI’s located in Belgium (n=8) and The Netherlands (n=2). Additionally, eight interviews were conducted among staff members of the University of Antwerp, who all have a certain responsibility in campus security (e.g., Head of Infrastructure Department, Head of Communications Department). Because of the confidential character of the content of these interviews, the results are not written down in this dissertation. The obtained insights did provide inspiration for the general approach of the research project and led to input for the development of the research designs of the empirical studies.

To respond to **the aim of the conceptual part of this dissertation**, or the development of a conceptual model for security culture, an extensive literature review was carried out. Because of the limited availability of research on physical security, inspiration was drawn from studies in the related field of safety sciences. Based on the literature study, a conceptual model for safety culture was examined and translated to the security domain.

In order to fulfil **the aim of the methodological part of this dissertation**, namely the investigation of how security culture can be measured, a systematic review was carried out. Based on the predefining of eligibility criteria, six already existing measuring tools were
selected, examined and compared to each other. Both academic studies and grey literature were consulted in order to include all relevant scientific and practical-oriented measuring tools. The results of this systematic review led to recommendations for the development of a standardized measurement instrument.

Subsequently, in a second methodological study, SSO (N=406) were carried out in four campus neighbourhoods of the University of Antwerp. SSO are considered a key measurement strategy for a wide variety of social science phenomena (Raudenbush & Sampson, 1999). The most important advantage of this observation technique is that it relies on the independent observation of a location by the researcher and not on conversations with respondents. Therefore, it does not have to deal with socially desirable answers or non-response (Hoeben et al., 2018). In this dissertation, three different observation methods were applied: in-situ observations, observations via original photographs and observations by means of Google Street View images. A combination of methods was carried out in order to examine to what extent the measurement of the physical properties of the environment could be improved.

To fulfil the **first aim of the empirical part of this dissertation**, or the exploration of which factors constitute security awareness and how they are related to each other, a large-scale survey among all staff members (N=5,924) of the University of Antwerp was carried out. Self-selection processes were used as staff members could voluntarily choose to fill in the questionnaire. This led to a response rate of 24%, or 1,443 staff members that participated in the study. In order to explore how staff members’ security awareness could be strengthened, a quasi-experiment was carried out, making use of a one group pre-test post-test design. As we were not able to include a control or comparison group in the study, this experimental design was considered most appropriate. By measuring the same dependent variable in one group of participants before (pre-test survey) and after (post-test survey) the organization of a security training, a comparison was made between the pre-test and post-test scores in order to obtain insight in the impact of the security trainings on staff members’ security awareness.

Subsequently, to explore further how security awareness could be strengthened, a second empirical study was carried out. In this study, nudges were used in order to examine whether this approach would be effective in directing students and staff members to more secure behaviour. A non-equivalent control group pre-test post-test design was applied to examine
the effectiveness of nudges in a natural setting. Although randomization and true experimentation are ideal goals to test the effectiveness of an intervention (Kenny, 1975), this was not possible. The non-equivalent control group pre-test post-test design has the advantage that it is possible to compare scores before and after a treatment in a group that receives the intervention and in a non-equivalent control group that does not receive the intervention (Ledford & Gast, 2014). This way, the impact of the implementation of nudges on the behaviour of students and staff members could be observed. Additionally, an oral survey was carried out among 197 respondents at the end of the experiment to obtain more insight in other factors that could have contributed to a potential change in behaviour.

To fulfil the second aim of the empirical part of this dissertation, or the exploration of the relationship of environmental cues and students’ and staff members’ fear of crime, two empirical studies were carried out. In a first study, the impact of the presence of disorder on students’ fear of crime was examined, by carrying out a large-scale survey among all students \( (N=21,095) \) of the University of Antwerp. Students could voluntarily choose to fill in the questionnaire, which led to a response rate of 7%, or 1,463 students who participated in the study.

Finally, a second empirical study was carried out in order to further explore the relationship of environmental cues and fear of crime. More specifically, the influence of the presence of CPTED measures in the neighbourhood of the campus on students’ and staff members’ fear of crime was examined. The results originating from the SSO provided more insight in the presence of CPTED in the neighbourhood of the campuses. These findings were merged with the data from the two large-scale surveys, distributed among students and staff members of the university of Antwerp, in order to explore the impact of the environmental cues on their fear of crime.
1.5. Structure of the dissertation

Importantly, this PhD research is a dissertation on articles which means that part of this dissertation has already been published (or accepted for publication) in the form of journal articles\(^2\). The dissertation will start with a conceptual part (Chapter 2), followed by a methodological part (Chapters 3 and 4). The findings from the first two parts are applied in practice in the third empirical part of this dissertation (Chapters 5-8). An overview of the structure of the dissertation is provided in Table 1.2.

**Table 1.2.** Overview of the structure of the dissertation.

<table>
<thead>
<tr>
<th>Conceptual part</th>
<th>Chapter 2</th>
<th>An integrative conceptual framework for physical security culture in organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methodological part</td>
<td>Chapter 3</td>
<td>Measuring the security culture in organizations: A systematic overview of existing tools</td>
</tr>
<tr>
<td></td>
<td>Chapter 4</td>
<td>Measuring CPTED and disorder through different systematic social observation methods: In-situ observations, original photographs and Google Street View images</td>
</tr>
<tr>
<td>Empirical part</td>
<td>Chapter 5</td>
<td>The impact of training sessions on physical security awareness: Measuring employee’s knowledge, attitude and self-reported behaviour</td>
</tr>
<tr>
<td></td>
<td>Chapter 6</td>
<td>Nudging as a crime prevention strategy: The use of nudges to improve cyclists’ locking behaviour and reduce the opportunities for bicycle theft</td>
</tr>
<tr>
<td></td>
<td>Chapter 7</td>
<td>Unravelling college students’ fear of crime: The role of perceived social disorder and physical disorder on campus</td>
</tr>
<tr>
<td></td>
<td>Chapter 8</td>
<td>The relationship between crime prevention through environmental design (CPTED) and fear of crime: A multi-method approach in four university campus neighbourhoods</td>
</tr>
</tbody>
</table>

\(^2\) All articles in this dissertation are co-authored. In all studies the doctoral candidate took the lead, while the promoters of this research, Prof. dr. Hardyns, Prof. dr. Ponnet and Prof. dr. Reniers, revised the articles. Prof. dr. Hardyns and Prof. dr. Ponnet also assisted the doctoral candidate with the analysis of the collected data. For a detailed overview of the doctoral candidate’s contribution to each chapter, we refer to the ‘Author contributions’ at the end of this dissertation.
The first part of this dissertation offers a theoretical framework for physical security culture in organizations. Although the dissertation will mainly focus on the human aspects of security, it was indispensable to first obtain a clear insight in all aspects that contribute to an organization’s security culture. Due to the relatively young status of research on physical security culture, theoretical frameworks and models are still developing (Aven, 2007). In comparison to security culture, the related field of safety sciences is characterized by a longer academic history and because of the main similarities between safety and security, much can be learned from adopting knowledge from the former discipline to the latter (Kriaa et al., 2015). Taking this into account, the first study (Chapter 2) presents an integrative framework for physical security culture based on The Egg Aggregated Model (TEAM) model for safety culture, as proposed by Vierendeels et al. (2018). The TEAM-model for security culture provides an integral and comprehensive overview of all related security aspects within an organization, by making a distinction between the technological, organizational and human security domains. This conceptual framework forms the starting point of this dissertation on which the following chapters are build.

In order to investigate how an organization’s security culture can be measured, the second article (Chapter 3) provides an overview of already existing measurement instruments. In order for organizations to improve their security culture, it is indispensable to obtain insight in the current strength of the different security domains (Chia et al., 2002). To date, very little research has been carried out into how organizational security culture should be evaluated and only a few measuring tools have been created worldwide (Schlienger & Teufel, 2005). The limited number of existing tools mainly focus on the measurement of security culture in specific domains, such as nuclear or information security. This implies that a common view or widely accepted approach to measure security culture is lacking (Alnatheer et al., 2012) . Based on a systematic review of literature, six tools that met the eligibility criteria of the search process are explored and compared to each other. An identification of the strengths and weaknesses of each measurement approach provides further insight in the characteristics that a standardized tool should consist of. Based on the findings, recommendations for the development of such a tool are presented. In the empirical part of this dissertation (Chapters 5-8), these methods are used in practice in order to unravel the human factors of campus security.
Since it is one of the aims of this dissertation to examine the impact of contextual determinants on fear of crime, the third article of this dissertation (Chapter 4) will explore how these physical cues in the environment can be assessed most accurately. Over time, systematic social observations (SSO) have become a popular method for measuring environmental characteristics (Hinkle & Yang, 2014). Although this methodological approach consists of many advantages compared to more traditional methods, some concerns arise when conducting observations within a specific neighbourhood (e.g., security of observers, travel costs) (Gracia & Herrero, 2007). In order to find effective and alternative ways to examine the physical environment, this study applies a multi-method approach combining three types of SSO (i.e., observations in situ, observations based on original photographs and observations by means of Google Street View images). The observations were carried out in four campus neighbourhoods in order to examine the presence of CPTED and disorder. Given the potential strengths and weaknesses associated with physical and virtual SSO, different measurement approaches were carried out to evaluate their reliability and validity. By doing so, the quality of the three observation approaches is assessed in order to improve ecometric measures of the physical properties of the environment. While this article mainly focuses on the methodological approach of the examination of the environmental design, the relationship between the results of these observations and fear of crime are presented in Chapter 8 of this dissertation.

The third part of this dissertation has an empirical aim and will focus on the application of the findings of the previous chapters in order to unravel the human factors of campus security. The fourth article (Chapter 5) aims to examine the factors that contribute to security awareness and explore how this level of awareness can be improved. As previous research indicated that security awareness consists of people’s knowledge, attitudes and behaviour (Baranowski et al., 2003), the relationship between these three dimensions is be measured based on a large-scale survey among all staff members of the university. Additionally, the impact of security trainings on staff members’ security awareness is examined, by carrying out a quasi-experiment on campus. Based on the results of a pre-test and post-test among the participants of the security trainings, the impact of the training on their security knowledge, attitude and self-reported behaviour is measured. The findings of this study provide further
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insight in the relationship between people’s knowledge, attitude and behaviour and offers potential strategies to increase people’s level of security awareness.

The fifth article of the dissertation (Chapter 6) examines further how people’s security awareness can be improved. By carrying out a quasi-experiment with nudges, it is the aim to increase cyclists’ awareness and reduce the opportunities for bicycle theft in the direct neighbourhood of the campus. While this technique showed promising results in domains such as healthcare (Shaffer, 2017) and sustainable energy consumption (Kasperbauer, 2017), little is known about its effectiveness in the field of security. Although the campus is subject to various types of crime, statistics show that bicycle theft has been one of the most common forms of crime for a long time, especially in neighbourhoods of HEI’s (Van Dijk et al., 2007). A potential prevention strategy to reduce the opportunities for bicycle theft for offenders is the stimulation of cyclists to lock their bike in a decent way. Taking this into account, two types of nudges were implemented at different bicycle parking sites in the neighbourhood of one university campus. On site observations and a survey among cyclists were carried out in order to examine the effectiveness of the nudges for reducing bicycle theft. The findings offer more insight in the potential of the nudging approach to direct people towards more secure behaviour to prevent crime.

Besides strengthening the human factor in order to reduce crime, it is also the aim of HEI’s to create an environment in which campus’ residents feel secure to engage in their daily activities. A minimalization of students’ and staff members’ fear of crime on and in the direct neighbourhood of the campus is therefore indispensable (Fisher, 1995; Maier & DePrince, 2020). The sixth article of this dissertation (Chapter 7) aims to examine the determinants of people’s fear of crime in order to decrease these feelings. Focus lies on the influence of contextual determinants on students’ fear of crime. More specifically, the relationship between the presence of social and physical disorder and the three dimensions of fear of crime (i.e., feelings of anxiety, perceived risk of victimization and avoidance behaviour) is examined based on a large-scale survey among all university students. The findings of this study provide more insight in the potential strategies to reduce students’ fear of crime on and in the neighbourhood of the campus by making adjustments in the physical environment.
The seventh article of this dissertation (Chapter 8) builds on the findings from the previous chapter and examines further the influence of physical cues in the environment of fear of crime. In addition to the presence of social and physical disorder, previous research has shown that also characteristics of the built environment may be related with campus’ residents fear of crime (Cozens & Sun, 2018; Fisher & May, 2009). In order to examine this relationship, SSO were carried out to provide insight in the presence of CPTED measures in the neighbourhood of the four university campuses. Additionally, data collected via the two-large scale surveys among students (see also Chapter 7) and staff members (see also Chapter 5) were consulted in order to get a view on their feelings of anxiety, their risk perception and their avoidance behaviour on campus and in its neighbourhood. By applying this multi-method approach, a unique insight is provided in the relationship between the environmental design of the four campuses and students’ and staff members’ fear of crime. Based on these findings, recommendations to reduce feelings of insecurity among campus’ residents are formulated.

In Chapter 9, the dissertation’s main concluding remarks are highlighted, followed by an overview of recommendations for HEI’s. Based on our findings derived from the conceptual, methodological and empirical parts, some guidelines are provided for HEI’s who have the aim to maintain an open campus culture while ensuring that staff members and students feel secure. Finally, the limitations of this dissertation are presented, linked to opportunities for future research.
1.6. References


Introduction


Introduction


Nettle, D., Nott, K., & Bateson, M. (2012). ‘Cycle thieves, we are watching you’: Impact of a simple signage intervention against bicycle theft. *PloS one, 7*(12), e51738.


Introduction


CHAPTER 2

An integrative conceptual framework for physical security culture in organizations

A conceptual framework for physical security culture in organizations is proposed, based on the integrative model of safety culture, as developed by Vierendeels et al. (2018). The proposed conceptual framework for physical security culture has the advantage that it brings security threats, technique, organization and human aspects together in a coherent, integrative and related way. The framework includes five main domains of security culture, being (1) an observable technological domain, (2) an observable organizational domain, (3) an observable human domain, (4) a non-observable organizational domain or perceptual domain, and (5) a non-observable human domain or psychological domain. These five main domains can be further divided into several more specific sub-domains of security culture. At their turn, these sub-domains can be translated into measurable security results, being (1) observable security outcomes, (2) the security climate of an organization or the shared perceptions on security, and (3) the individual intention to behave secure or insecure. The aim of the framework is to take all security-related aspects into account – based on the specific security threats to which an organization is exposed – leading to a pro-active approach of the physical security of organizations. The framework provides specific points of departure to make the security culture measurable, and by extension controllable.

This chapter is based on:

2.1. Introduction

The field of academic research in the domain of security culture is relatively new. Only since the beginning of this century, attention for security has been translated into scientific research, with a huge boost in studies since 9/11. From then on, more and more security initiatives have been emerged in both science and practice. Due to the relatively young status of security culture research, conceptual frameworks, theories, and models are still fully developing. An advantage in this ongoing development process, is the resemblance of security with safety, causing that inspiration for security research can be found in the field of safety research, of which the latter has a longer academic history.

In this paper, a conceptual framework for physical security culture in organisations is proposed, based on the integrative model of safety culture, as developed by Vierendeels et al. (2018). The safety culture model of Vierendeels et al. (2018) is called The Egg Aggregated Model (TEAM) of safety culture and is developed based on an extensive review of literature regarding existing studies and models with respect to safety.

2.2. Main resemblances and differences between safety and security

For a long time, security and safety were seen as independent from each other. Though, more recent research illustrates that there arises synergy when safety and security measures are considered jointly. Much can be learned from adopting the knowledge of the one discipline to the other and vice versa (Kria et al., 2015).

The main resemblance between safety and security is the focus on preventing undesirable events such as injury to people, material damage and environmental damage. The main difference is the origin of these undesirable events, being unintentional in the field of safety, and intentional in the field of security. This difference in origin leads to an important distinction in the desired degree of transparency. In the field of safety, a high level of transparency – both within and outside organisations – is required in order to optimally prevent undesirable safety events and in order to optimally come to insights and learn from each other. However, in the field of security, this transparency is also needed, but only within trusted communities, for instance within a single plant or between multiple plants of the same organisation. Outside these trusted communities, the level of transparency should be
curtailed in order to optimally prevent undesirable security events and to protect (sensitive) information. This can be clarified by, for example, storage tanks of chemical products. Safety-wise, the characteristics of the stored chemicals should be easily retrievable in case of for instance a leak or a fire. However, security-wise, the retrievability of the chemical characteristics makes it easier to choose a target in case of for instance theft or a terrorist attack. Therefore, this information should only be shared within the trusted community, for instance with the nearest fire department.

Another distinction relates to the difference between risks in the domain of safety, and threats in the field of security. Safety risks are predominantly rooted inside the organisation, whereas security threats are mostly rooted outside of the organisation. Safety risks are often well-known by the organisation, as the accident scenarios are inherently linked to the specific characteristics of the organisation. However, looking at security, it is more difficult to fully cover the specific threats to which an organisation is exposed, as this could cover a wide spectrum of possible scenarios that are influenced by aspects out of the control or knowledge of an organisation (Jore, 2017).

A noteworthy resemblance is that both safety and security can be viewed as a part of the overall organisational culture (Hopkins, 2006; Connolly, 2000). This implies that both safety and security should be integrated in other corporate processes. Doing so, in order to be as efficient and effective as possible, both safety and security should be assessed in an integrative, holistic way. In other words, continuous attention is needed for both the safety culture and the security culture of an organisation.

### 2.3. The need for a proactive and integrative approach of security culture

Organisations – and even governances – are approaching their security in a predominantly reactive manner which is incident-driven, instead of using a more proactive approach (Ruighaver et al., 2007). Also, based on the literature, it can be concluded that security research often lacks an integrative approach. After all, it are mainly the technological security aspects that receive attention. It is only in the last decade that the concept of security culture gains interest from researchers and business leaders, with a dominant position of information/cyber security. There is nearly no reference to other types of security issues.
However, in analogy with safety culture, a proactive and holistic approach is needed when addressing the security culture of an organisation.

As elaborated in the safety culture model of Vierendeels et al. (2018), safety culture consists of three main domains, being a technological, an organisational and a human domain. This approach can be extended to the field of security culture, where security culture consists of three main domains:

1. A technological domain, which comprises aspects regarding the present security technology, material and equipment present in the company.

2. An organisational domain, which comprises aspects such as the security management, the company security policy, and the resources available for security.

3. A human domain, which comprises aspects such as knowledge, attitudes, assumptions, decisions, and actions of individuals regarding security.

Both the organisational and the human domain are manifested at two levels:

1. Firstly, there are the tangible, observable aspects regarding security. These are the aspects that are observable when walking around in the company. This concerns, for instance, the security behaviour of employees, or the security rules, procedures, instructions, etc. that can be consulted in documents of the company.

2. Secondly, there are the less tangible, non-observable aspects. These are the aspects that cannot be observed by walking around in a company. This concerns, for instance, what employees think of the level of security in the company, or the attitude they have towards security.

The technological domain consists only of observable aspects. This structure leads to five domains, as can be seen in Figure 2.1, which together form the physical security culture of an organisation. The five domains can be further divided into several sub-domains, which are represented as the white boxes in Figure 2.1. Important are the arrows in the model, which symbolise that all the different domains of the physical security culture are related in a cyclic way.
The grey boxes in the conceptual model represent the security results. In case of the three observable domains, the several sub-domains result in observable security outcomes. In case of the non-observable organisational domain or the perceptual domain, the several sub-domains result in the security climate of an organisation, being the shared perceptions on security. In case of the non-observable human domain or the psychological domain, the several sub-domains result in the individual intention to behave secure or insecure.

The security culture of a specific organisation is influenced by external factors such as the level of technological development of a country or a region, the socio-economic status of a country or a region, the policies, regulations and legislations of a country or a region, the national culture, etcetera. In addition, the security culture of an organisation is inextricably linked to the security threats to which a specific organisation is exposed to. In other words, the entire security culture of an organisation – security results included – is influenced by the specific security threats of the organisation. For instance, in the financial sector, the security threats of espionage, fraud and theft are more prominent than for instance in the chemical sector where the security threats of terrorism and activism are more prominent. The presence of these possible security threats influence the entire development and rollout of the security culture of the organisation.
Figure 2.1. An integrative conceptual framework for physical security culture in organisations.
2.4. Addressing the security culture of an organisation

To address the physical security culture of an organisation, several steps should be taken as illustrated in Figure 2.2. Firstly, the security culture should be diagnosed. In order to obtain a clear image of the current physical security culture in the organisation, all sub-domains constituting physical security culture should be measured.

Subsequently, based on this measurement, recommendations should be formulated and implemented in order to improve the current physical security culture (van Nunen et al., 2016). It is important that continuous attention is being paid to the security of a company. Follow-up is needed in order to meet with possible changes within the company as well as external developments and trends in the field of security. It is an everlasting process, a cycle of evaluation and maintenance or change.

During this continuous process of addressing security culture, some aspects should be taken into account, in analogy with addressing safety culture (van Nunen et al., 2016). It is for instance important to use a multi-method approach in order to adequately explore and understand the security culture of an organisation. Also, the involvement of the entire organisation is important. Employees, supervisors, managers, contractors, clients, suppliers, etcetera; all should be taken into account when diagnosing the security culture. This comprehensive involvement is not only crucial during the diagnose of the security culture, but also during the phase of formulating improvement strategies and setting priorities. Not only leads this comprehensive involvement to a more accurate diagnose of the security culture, it also leads to the creation of a foundation to successfully implement and maintain the improvement strategies.

![Figure 2.2. Addressing physical security culture (adapted from van Nunen et al., 2016).](image-url)
2.5. Conclusion

The proposed conceptual framework for physical security culture in organisations has the advantage that it brings technique, organisation and human together in a coherent, integrative and related way. The aim of the framework is to take all security-related aspects into account, leading to a pro-active approach of the physical security, instead of working on an incident-driven base. The framework provides specific points of departure to make the security culture measurable, and by extension controllable. The importance of continuous attention for security is being stressed, as well as the importance of the involvement of the entire organisation in order to obtain sustainable improvements in the field of security.
A conceptual framework for physical security culture

2.6. References


CHAPTER 3

Measuring the security culture in organizations: A systematic overview of existing tools

There has been an increase in research into the security culture in organizations in recent years. This growing interest has been accompanied by the development of tools to measure the level of security culture in order to identify potential threats and formulate solutions. This article provides a systematic overview of the existing tools. A total of 16 are identified, of which six are studied in detail. This exploration reveals that there is no validated and widely accepted tool that can be used in different sectors and organizations. The majority of the tools reviewed use only a quantitative method; however, security culture includes very different domains and therefore a mixed-method approach should be used. In contrast to security culture, instruments for measuring safety culture are widely available, and with many similarities between these two domains it is possible that well-established tools for measuring safety culture could be adapted to a security environment.

This chapter is based on:

3.1. Introduction

Prior to 2001 organizations generally paid little or no attention to security threats. However, the terrorist attacks on 9/11 instigated a shift, and the issue of security was suddenly much more important (Baybut & Ready, 2003). Many business leaders focused on implementing new security technology, and paid less attention to the broader ‘security culture’ of their organization (Chia et al., 2003). However, the increased interest in security within organizations encouraged researchers to study this topic more in depth. They realized that an organization’s security culture might play an important role in maintaining an adequate level of security in an organization (Andress & Fonseca, 2000; Beynon, 2001; Breidenbach, 2000; Schwarzwalder, 1999; von Solms, 2000). For instance, Connolly (2000) argues that a strong security culture is needed to convince employees that security is an important issue, as it impacts the likelihood of a malicious attack. Vierendeels et al. (2018) believe that the success of security measures is related to the security culture of organizations. According to Da Veiga and Martins (2015), a strong security culture enables members of an organization to behave in a more secure way in order to reduce security incidents.

Despite substantial interest in the subject, researchers struggle to agree on what factors or constructs constitute security culture, and how it can be established (Alnatheer et al., 2012; Schlienger & Teufel, 2003). A number of authors suggest that security culture must be regularly modified to ensure that it constantly corresponds with the goals of an organization (Kruger and Kearney, 2006; Martins & Eloff, 2002; Schlienger & Teufel, 2003). They emphasize the importance of repeated measurement in order to propose recommendations that establish, improve, and maintain a strong security culture (Chia et al., 2003). Unfortunately, very little research has been carried out into how organizational security culture should be evaluated (Chia et al., 2003), and only a few measuring tools have been created worldwide (Schlienger & Teufel, 2005).

Effective tools for measuring organizational security culture enable businesses to uncover critical issues and risk areas, formulate recommendations, and implement improvements over time. Therefore, an overview of the tools that are currently available could provide useful insights for practitioners and highlight areas for further research (Chia et al., 2003). While van Nunen et al. (2018a) have explored the tools used and developed in Belgian organizations to
measure safety culture, an overview of the existing instruments that measure security culture is lacking. Therefore, the aim of this paper is to provide a systematic overview of the science-based instruments that are used to assess security culture within organizations worldwide. Below, we first give an overview of the state-of-the-art insights into security culture. We then provide information about the methodological approach of our systematic review, followed by a comparison of the characteristics of the measuring tools that have been reviewed. Finally, we discuss the findings and provide recommendations for organizations and future research.

3.2. Security culture

Lundy and Cowling (1996) argue that security culture can be seen as a subculture of the organizational culture. The latter can, in simplest terms, be described as "the way things are done in an organization". According to Schein (2009, p. 27), organizational culture is 'a pattern of shared tacit assumptions that is learned by a group'. When developed well, this can solve internal and external organizational problems. Nosworthy (2000) argues that organizational culture has a strong impact on security culture. A first definition of security culture was formulated within the domain of information security by Schlienger and Teufel (2003, p. 405), who stated that security culture is 'all socio-cultural measures that support technical security measures'. Malcolmson (2009, p. 361) presented a more extensive definition, arguing that 'security culture is indicated in the assumptions, values, attitudes and beliefs, held by members of an organization, and behaviours they perform'. Importantly, security culture should not be confused with the security climate, which refers to employees’ shared perceptions about the organization’s security policy. The security climate should therefore be seen as a part of the whole security culture of a company (Vierendeels et al., 2018).

A distinction can be made between information security, such as the protection of computer networks and the data therein, and physical security, such as the protection of infrastructure and employees. According to van Niekerk and von Solms (2005), who based their ideas on Schein’s (2004) model of organizational culture, information security culture consists of four levels: (1) artifacts, (2) espoused values, (3) shared tacit assumptions, and (4) information security knowledge. The artifacts reflect the visible and measurable security aspects in an organization, such as the behaviour of employees, security handbooks, or technology. Espoused values are a partially visible layer of security culture, such as the goals, strategies,
or documents that describe the principles and values of the company. The shared tacit assumptions form the core of the organization’s culture when the values and beliefs of the organization become shared. The fourth level, information security knowledge, supports the other three levels. According to the authors, in order to create a strong security culture, employees need to have enough security knowledge, they need to know the security needs of the organization, and they need to be aware of why security measures have been taken (van Niekerk & von Solms, 2005). Other researchers (Schlienger & Teufel, 2005; Vroom & von Solms, 2004; Zakaria, 2004) also link their model of security culture to Schein’s (2004) organizational model and identify similar aspects of information security culture.

Focusing on physical security culture in chemical plants, Reniers and Dullaert (2007) identify three crucial domains: people, procedures, and technology. They argue that the people domain comprises individuals’ ideas about the organization’s security and the way they handle security. The procedures domain refers to the measures that are implemented to safeguard the security of the organization. Finally, the technology domain comprises the technical devices used to protect company from criminal acts. Starting from the same theoretical foundation as Reniers and Dullaert (2007), a more elaborate description of physical security culture is proposed by van Nunen et al. (2018b), who focus on the similarity between aspects of a safety culture presented in The Egg Aggregated Model (TEAM) (Vierendeels et al., 2018). According to the authors, both safety and security culture can be separated into three domains: technological, organizational, and human. Focusing on security culture, the technological domain consists of aspects such as the security technology, equipment, and material of the organization. The organizational domain comprises the security policy, the resources available for security, and the security management. Finally, the human domain contains aspects such as security knowledge, attitudes, priorities, decisions, and the behaviour of employees. Van Nunen et al. (2018b) argue that the organizational and human domains are manifested at two levels. At the first level are the observable security aspects that are noticeable when walking around the company. The second level consists of the non-observable, or not immediately apparent, aspects of security that can still be measured. In contrast to the organizational and human domain, the technological domain comprises only observable aspects of security.
Measuring security culture

In addition to the aspects related to the characteristics of the organization, the influence of external factors is emphasized. Factors such as the socio-economic status, level of technological development, or regulations and legislation of the country or region where the organization is based affect its security culture. Security culture is also determined by the security threats, such as theft, terrorism, or espionage, that an organization is exposed to. Organizations’ vulnerability to these threats differs depending on the company’s characteristics. For instance, nuclear companies are more vulnerable to terrorism or activism, whereas in the financial sector security threats such as fraud or theft are more prominent.

When measuring security culture, van Nunen et al. (2018a) recommend a multi-method approach in order to take into account the technological, organizational, and human aspects. The authors argue that quantitative methods such as questionnaires are needed to measure the non-observable domains of security culture, for instance the security knowledge of employees. Qualitative tools such as observations, interviews, or focus groups are required to measure the observable security domains, for instance the written security procedures. Qualitative methods can also provide a broader view of the non-observable aspects, such as the management’s security priorities. Alvesson and Berg (1992) point out that qualitative and quantitative methods have both weaknesses and strengths, and therefore a mixed method approach should be used to measure the security culture in depth. The International Atomic Energy Agency (IAEA) (2017) agrees, and states that a triangulated approach is needed to gather data from multiple points of reference. For instance, surveys could be followed by interviews to clarify ambiguities and fill in possible gaps.

Despite researchers’ increased interest in security culture, there is no widely accepted or validated tool available for measuring security culture within different kinds of organization. However, a few researchers have developed tools that measure culture within a specific security domain. As part of this study, in order to get a clear view of the different approaches, a systematic overview was conducted. It was hoped that identifying the characteristics of current measuring tools would enable researchers and organizations to gain more insight in order to develop a standardized and validated instrument. The methodological approach used for the systematic overview is presented below.
3.3. **Methodology**

3.3.1. **Search strategy**

Two online databases, Google Scholar and Web of Science, were searched for measuring tools. The following keywords were used: [instrument OR survey OR measuring tool OR assessment OR questionnaire] AND [security OR security culture OR security behaviour OR security climate]. In addition, other relevant studies were retrieved by manually screening the references of all the full-text articles that were included in the study. When necessary details about a measuring tool were missing in the article or related studies, the developer of the tool was contacted via email in order to gather more information. No limits were put on where or when studies were conducted. However, as research on security culture is still at an early stage, only studies between 2000 and 2019 were found and selected.

3.3.2. **Inclusion criteria**

Studies were selected for inclusion by reviewing each article for its relevance and content. The inclusion process was based on five criteria:

1. **A focus on security culture:** Because numerous researchers argue that security awareness should be seen as only a part of the security culture (Alnatheer et al., 2012; van Niekerk & von Solms, 2005), studies from authors who indicate that they only focus on security awareness among employees of an organization were excluded from the review.

2. **Original tool:** Only articles that contain a description of a tool by its original developers are included in the review. Studies containing information about a tool developed by someone other than the article authors were excluded. In such cases, the original tools were checked for their relevance to this study.

3. **Sufficient information about the content of the instrument:** The article must contain sufficient, and detailed, information about the content and application of the measuring tool, to enable this study to provide a comprehensive overview of the different options. Articles that contain only limited details, even after contacting the author, were excluded.
(4) Possible applications of the tool: Because this article aims to give an overview of the existing tools within very different security domains, it is important that a specific comparison is possible. For instance, Maidabino and Zainab (2011) developed a tool that can only be used to measure the security culture in libraries, so its application possibilities are limited to one specific sector. Only studies that provide a tool with more or less generalizable content were included.

(5) Practical approach: In order to understand how the tool can be used in practice, only articles that contain a clear description of the application process are included. Solely theoretical approaches were excluded.

3.3.3. Results of the search

In total, 12 tools were retrieved during the search using the keywords, while four other relevant studies were retrieved by manually screening the references of all the full-text articles included in the overview (see Figure 3.1). Application of the inclusion criteria resulted in a number of exclusions. Four tools were excluded because of their narrow focus on security awareness instead of security culture (criterion 1). One tool was excluded because the tool had been created by someone other than the article authors (criterion 2). Two tools were excluded because of a lack of sufficient information about the content of the instrument (criterion 3). One tool was excluded because the tool could not be generalized to other situations (criterion 4). Two tools were excluded because they were solely theoretical (criterion 5). In the end, six tools were eligible for inclusion in the systematic overview.

Figure 3.1. Results of the search for security culture measuring tools.
3.3.4. Information collected per tool

Table 3.1 provides an overview of the general characteristics of the reviewed tools. Firstly, the domain the instrument was developed for is specified. Next, the key indicators of each tool are listed; this shows which aspects of a security culture the developers of the tool have prioritized. Details about the theoretical foundation of the tool are included, followed by the main objectives of the instrument.

In order to understand the practical application of the tool, the methodological strengths and limitations of its reliability and validity are presented. The table specifies whether a multi-method approach was applied and, when a questionnaire was used, the type of survey, number of items, type of answers and target population. For tools that required a qualitative approach, the target population of the interviews or observations is included. These methodological characteristics are presented in Table 3.2.
### Table 3.1. General characteristics of the measuring tools.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Information security</th>
<th>Physical security</th>
<th>Physical security</th>
<th>Information security</th>
<th>Information security</th>
<th>Information security</th>
<th>Information security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key indicators</td>
<td>- Artefacts (e.g. behaviour, technology, security handbooks)</td>
<td>- Beliefs and attitudes</td>
<td>- Beliefs, principles and values</td>
<td>- Organizational level: policy, benchmarking, risk analysis and budget</td>
<td>- Top management involvement in information security</td>
<td>- Strategy (S) (e.g. policies, guidelines, best practices)</td>
<td>- Technology (T) (e.g. hardware, software, services)</td>
</tr>
<tr>
<td></td>
<td>- Official values (i.e. the perception of the company on security)</td>
<td>- Leadership behaviour</td>
<td>- Characteristics (e.g. leadership, accountability, competency)</td>
<td>- Group level: management and trust</td>
<td>- Information security policy enforcements</td>
<td>- Organization (O) (e.g. beliefs, values, norms)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- True values (i.e. the individual attitude towards security)</td>
<td>- Management systems (e.g. processes, procedures, programs)</td>
<td>- Documented expectations (e.g. security policy, responsibilities) and behaviours</td>
<td>- Individual level: awareness and ethical</td>
<td>- Information security training</td>
<td>- People (P) (e.g. behaviour of employees)</td>
<td>- Environment (E) (e.g. national culture, ethical conduct, legal systems)</td>
</tr>
</tbody>
</table>


| Main objectives | Measurement and improvement of security culture | Measurement of security culture | Measurement and improvement of security culture | Measurement and improvement of security culture | Measurement of security culture | Measurement and improvement of security culture |
Table 3.2. Methodological characteristics of the measuring tools.

<table>
<thead>
<tr>
<th>Measuring security culture</th>
<th>Methodological characteristics of the measuring tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability and validity</td>
<td>- Tool consists of a multi-method approach - No formal guidelines or established framework was used when conducting the interviews, document analysis and observations (difficult to repeat the exact same assessment in other organizations or by other researchers)</td>
</tr>
<tr>
<td>Measurement approach</td>
<td>Questionnaire + interviews + document analyses + observations</td>
</tr>
<tr>
<td>Type of questionnaire</td>
<td>Self-assessment</td>
</tr>
<tr>
<td>No. of items</td>
<td>42</td>
</tr>
<tr>
<td>Type of answers</td>
<td>Three answer options (true-false-I don’t know)</td>
</tr>
<tr>
<td>Target population</td>
<td>- Questionnaire: Employees from different job levels - Interviews: Chief Security Officer - Observations: Employees from different job levels</td>
</tr>
</tbody>
</table>
3.4. Results

3.4.1. General characteristics of the tools

Based on the systematic overview, it is clear that the tools only focus on two security domains. Four of the six included instruments were specifically developed to measure information security culture within organizations, while the other two measure physical security culture. The information security domain has a predominant position within research on security culture; as organizations rely ever more heavily on technology to run their businesses, so interest in information security has rapidly increased (Kruger and Kearney, 2006).

A more detailed analysis of the measuring tools shows that the authors emphasize similar aspects of the security culture within organizations. Based on the TEAM model of Vierendeels et al. (2018), security culture consists of both observable and non-observable security domains. A comparison of the tools’ key indicators shows that they all aim to measure the non-observable security domain, which includes the security climate or shared security perceptions and individuals’ views on security. For instance, Alnatheer et al. (2012) focus on the security climate by measuring top management involvement in information security and who is responsible for security. Schlienger and Teufel (2003) include the company’s perceptions of security as a key indicator in order to assess shared security perceptions. To measure individuals’ mindsets on security issues, IAEA (2017) focuses on employees’ beliefs and attitudes, while WINS (2011) included employees’ beliefs, principles, and values as a key indicator.

The security culture also consists of an observable domain, which includes organizational, human, and technological security aspects (Vierendeels et al., 2018). The overview revealed that all instruments aim to measure organizational security aspects. Martins and Eloff (2002) include the organizational security policy and budget as key indicators, while AlHogail and Mirza (2015) focus on the security policies, guidelines, and best practices with their key indicator strategy. Subsequently, each tool focuses on human aspects or the security behaviour of employees. For instance, IAEA (2017) measures personnel behaviour and Schlienger and Teufel (2003) include the indicator artifacts which also includes the behaviour of employees. In contrast to the organizational and human domains, only half of the tools included key indicators to measure technological security measures. While Martins and Eloff
Measuring security culture

(2002), AlHogail and Mirza (2015), and Schlienger and Teufel (2003) explicitly mention that they measure the technological security aspects of the organization, Alnatheer et al. (2012), IAEA (2017) and WINS (2011) do not focus on any technological aspects. Although IAEA (2017) indicates that the human and organization aspects are inextricably linked to the technological measures, the tool does not assess the technological aspects. Finally, only AlHogail and Mirza (2015) focus on the impact of external security aspects, such as national culture, laws, and regulations on the security culture of the organization, while other tools only focus on internal security aspects.


Finally, when analysing the main objectives of the measuring instruments, it becomes clear that only half focus explicitly on improving the security culture by formulating specific recommendations. For instance, WINS (2011) and Martins and Eloff (2002) state that goal of their measuring process is the formulation of well-founded recommendations. In contrast, IAEA (2017) and Alnatheer et al. (2012) emphasize the measuring process without making specific recommendations based on the results.

3.4.2. Methodological characteristics of the tools

Only Schlienger and Teufel (2003) and IAEA (2017) make use of a multi-method approach to assess security culture, with the other tools only including a questionnaire. When analysing the methodological strengths and limitations of the reliability and validity of the tools, the use of a multi-method approach can be seen as a strength. Although questionnaires can be used to measure the security climate of an organization, qualitative methods are vital to obtain a clear picture of the whole security culture. For instance, our comparison of the tools’ key indicators showed that they all emphasize employee behaviour. However, depending on the methodological approach used, different forms of behaviour will be measured. When the instrument only includes a quantitative approach, such as a survey, the focus is on self-
reported behaviour. When qualitative methods such as observations are used, the actual behaviour of individuals can be observed and measured. While it can be very time-consuming and difficult to observe behaviour in various situations, a combination of two methods would provide a more global view of individuals’ security behaviour. For instance, Schlienger and Teufel (2003) conduct unstructured interviews with the chief security officer of an organization, and IAEA (2017) proposes a semi-structured approach that includes staff members from the entire organization. Both use document analysis to obtain an overview of the organization’s security policy and carry out audits to verify the answers provided by respondents, and to get a deeper insight into their actual behaviour. Although IAEA (2017) emphasizes the importance of formal guidelines when carrying out the interviews, document analysis, and observations, Schlienger and Teufel (2003) did not use any formal guidelines when conducting these qualitative methods. Unfortunately, this makes it very difficult to repeat the exact same approach in other settings or by other researchers.

According to the articles’ authors, most of the tools show good results on reliability and validity. Although the tools already contain numerous strengths, the developers themselves indicate that some adjustments still have to be made in order to fully develop them. For instance, Alnatheer et al. (2012) developed a tool for measuring the information security culture in Saudi Arabian companies, and it is not clear whether the tool could be used in other countries. The authors indicate that the business environment of Saudi Arabia is different from that of Western countries. While Saudi Arabian information technology companies are still developing, most international information security standards are written from the perspective of more technologically advanced Western countries. The different technological levels combined with the cultural differences between Western countries and Saudi Arabia cause challenges when implementing the same measuring tool in both contexts.

When a questionnaire is included in these measuring tools, it is always as a self-assessment. The number of items varies between 19 and 79. Alnatheer et al. (2012) have developed the shortest questionnaire (19 items), while AlHogail and Mirza (2015) have expanded their survey to 79 items. Five of the six questionnaires utilize a Likert scale. Only Schlienger and Teufel (2003) use a categorical answering scale with the options ‘True,’ ‘False,’ or ‘I don’t know.’ Employees from different job levels are included in the research samples. For instance, WINS (2011) gathers data from staff at all levels, including the board of directors.
3.5. Conclusion and discussion

This article identified and analysed tools that measure organizational security culture. Six tools were eligible for inclusion in the systematic overview. It was found that the tools focus on two security domains, namely information security and physical security. The tools were compared based on their general characteristics and methodological approach. While they all included similar key indicators, notable differences were found in their methodology.

As has already been mentioned, a common view on or widely accepted theoretical approach to security is lacking. While some researchers and practitioners do get involved in the debate about security culture, their attention is focused on certain security domains (e.g. information security) and sectors (e.g. nuclear companies). Indisputably, in scientific research, information security culture holds a dominant position. Despite the actual threats related to information security, the vulnerability of organizations to other threats, such as terrorism, cannot be underestimated. For companies to prevent and be prepared for threats related to security, more research about physical security culture is needed.

Additionally, there is no widely accepted and consolidated approach or unique toolset available that can be used in different sectors or by different organizations (Schlienger & Teufel, 2003). Therefore, a standardized measuring tool needs to be developed. Collaboration between researchers and practitioners is required in order to create a strong, practical-based instrument that can be validated in scientific research. By adjusting the tool to the characteristics of the company in the preparation phase of the measuring process, a standardized instrument could be used by different organizations and sectors. As the overview showed that tools that only measure information security or physical security contain similar key indicators, an instrument that combines these two security domains could readily be developed. Most importantly, a tool must be adaptable to an organization’s specific characteristics. For instance, different organizations are more or less exposed to security threats, so this should be taken into account in the developing process. This means that a one-size-fits-all approach must be avoided. Additionally, there are some benefits for benchmarking when different organizations use the same instrument and the results can be compared. The insights obtained by a company comparing its results to those of a similar one can enable it to improve its security culture.
In creating a standardized instrument, much can be learned from adapting the knowledge about safety culture to the measurement of security culture. In contrast to the limited number of tools that are currently available to measure security culture, several tools already exist to measure safety culture. While safety and security were long seen as independent of each other, more recent research shows that there are a lot of similarities between these domains (Kria et al., 2015; van Nunen et al., 2018b). Both domains focus on the prevention of undesirable events, such as injuries to people, and material or environmental damage. The main difference is in the origin of these events – damage is unintentional in the field of safety and intentional in the case of a security incident. Additionally, there is a difference between risks related to the domain of safety and threats in the field of security. As safety risks are mostly rooted inside the organization and therefore are well known, security threats are predominantly rooted outside of the organization and are more difficult to uncover. The greatest similarity is that both safety and security are part of the overall culture of the organization. This implies that a focus on the technological, organizational, and human aspects in both fields is needed to ensure an integrated and strong organizational culture (van Nunen et al., 2018b). Therefore, it can be useful to consider to what extent the existing tools for measuring safety culture can be applied to the security context. Adjustments or additions could be made to pre-existing tools by altering the aspects included in the tool to the different aspects of a security culture. This process would result in the creation of a measuring tool for security culture based on an already existing framework developed for measuring safety culture.

### 3.6. Recommendations

Based on the systematic review, some recommendations can be made about creating an effective tool for assessing the security culture within an organization.

Firstly, a multi-method approach should be used, as it provides a more detailed picture of the security culture of an organization. All tools in the systematic review used a quantitative approach, while only two add qualitative methods. Due to their statistical robustness, questionnaires can be included without major costs (Da Veiga, 2008). Additionally, completing the survey could create more security awareness among employees. On the other hand, as there is no certainty as to how respondents interpret the specific questions, the reliability of
this method remains uncertain. In contrast, qualitative methods have the benefit of revealing more detailed insights in the results (Kaplan & Duchon, 1988), but also have their limits, especially in terms of generalizability and time (Alvesson & Berg, 1992). Considering both the weaknesses and strengths of qualitative and quantitative methods, it is believed that a multi-method approach is needed to measure security culture (Alvesson & Berg, 1992). As the results of one method can be verified with those of other approaches, there are greater opportunities for data analysis (Schlienger & Teufel, 2005). Additionally, the researcher is able to explore different points of view when interpreting the results (Fleeger, 1993). Considering the very different domains of a security culture, it is recommended that both quantitative and qualitative methods be used. For instance, while data about the observable security aspects can be gathered through qualitative methods such as interviews, focus groups, document analyses, or observations, a quantitative approach is needed to explore employees’ perceptions of security issues (van Nunen et al., 2018b). The multi-method approach makes the measuring process more time-intensive but ensures a more detailed and realistic result that can be translated into substantiated recommendations for the organization. As culture has a very comprehensive structure, it is impossible to measure it well in a short period of time.

Secondly, it is recommended that the entire organization should be involved in the measuring process. Numerous authors argue that the involvement of both staff and top management is necessary to measure and improve a security culture (Chia et al., 2003; Da Veiga & Elof, 2007; Kraemer et al. 2009; Schlienger & Teufel, 2003). As cultural change in an organization should always start with the support of top management, a strong security culture can only be created and maintained with the consistent involvement and support of those at the top of the organization (Alnatheer et al., 2012; O’Donovan, 2006). Ownership of and commitment to security by both management and employees is necessary for them to understand their role in the security policy and to be convinced that security is important (Connolly, 2000).

Thirdly, external security threats should be included in the measuring process, in addition to internal security aspects. Organizations are always more or less exposed to certain external security threats, such as theft or fraud, depending on the company’s characteristics. It is important that these ‘standard’ threats are considered when developing a measuring instrument. In addition, the external aspects or the general characteristics of the country or
Measuring security culture

region where the company is based also have an influence on the security culture of an organization. For instance, national culture, socio-economic or technological development, and legislation could all have a substantial impact (van Nunen et al., 2018b). Therefore, as organizations are always exposed to these security threats and external factors, it is important to take them into account when measuring security culture.

Finally, the formulation and implementation of well-founded recommendations and systematic follow-ups are required to achieve a strong security culture. This review found that only two tools explicitly mention possible improvements to the security culture of the organization. Other tools were still being developed and therefore only their methodology could be reviewed. However, all authors focus on identifying weaknesses and strengths in the field of security, so it is highly recommended that those results are used when formulating recommendations. Assessing the security culture helps an organization to discover its strengths and weaknesses in order to make the right strategic choices (Ross, 2011; Schein, 2009). Also, the results of regular assessments can show whether recommendations from previous measurements were actually implemented, and the extent to which these measures effectively improved the security culture of an organization (Martins & Eloff, 2002). If newly implemented measures are found to be inefficient, there may be some shortcomings with the measuring tool. Therefore, it is important that tools contain easily applicable criteria to translate measurement results into well-founded recommendations for an organization. Only in this way can security culture be improved and maintained.
3.7. References


Measuring security culture


CHAPTER 4

Measuring CPTED and disorder through different systematic social observation methods: In-situ observations, original photographs and Google Street View images

This study focuses on the measurement of Crime Prevention Through Environmental Design (CPTED) and disorder by means of Systematic Social Observations (SSO). To improve ecometric measures of the physical properties of neighbourhoods, a three different SSO are carried out: in-situ observations, original photographs and Google Street View (GSV) images. Based on an evaluation of the methodological quality of the observation methods, the results of our study suggest that virtual SSO approaches have considerable promise for the reliable and valid assessment of neighbourhood-level physical properties. Challenges are discussed and avenues for future research provided to keep evolving towards a more valid and reliable measurement approach for the physical environment.

This chapter is based on:
4.1. Introduction

This study addresses the challenge of measuring the physical properties of neighbourhoods. Neighbourhood disorder is one of the processes that is studied extensively, because it affects several aspects of daily life, such as mental and physical health (Hill and Angel, 2015; Feng et al., 2010), fear of crime (Kelling & Coles, 1996; Perkings & Taylor, 1996) and violent victimization (Morenoff, 2001; Sampson & Raudenbush, 2001). Neighbourhood theories, such as The Broken Windows theory, which focuses on the relationship between disorder and crime, has inspired a variety of policy programs (Skogan, 1990; Wilson & Kelling, 1982). The Crime Prevention Through Environmental Design (CPTED) approach assumes that also other characteristics of the urban environment, such as the extent of surveillance (e.g., security guards, shop keepers), access control (e.g., detection mechanisms), territoriality (e.g., fences, property signs), maintenance (e.g., building conditions) and activity support (e.g., parks, shops, bars) are related to crime (Crowe, 2000). Moreover, the CPTED approach proposes that crime can be reduced by implementing a proper architecture design and by modifying physical features of the environment (Jeffery, 1971; Mihinjac & Saville, 2019; Saville & Cleveland, 2008).

In order to measure neighbourhood characteristics, scholars have traditionally used administrative data (Raudenbush & Sampson, 1999) or (nationally) representative victim surveys or self-reported delinquency surveys (Gracia et al., 2012; Ross & Mirowsky, 2009). While administrative census data proved to be valuable for describing the socio-demographic composition of (small) geographic entities like municipalities and neighbourhoods, surveys are useful to measure more subjective data that is otherwise difficult to obtain, such as resident’s fear of crime, feelings of security or perceived disorder (Marco et al., 2017). While both methods have their strengths, they are less useful for assessing visible neighbourhood phenomena such as the presence of social disorder like public drinking or loitering and physical disorder such as vacant buildings or dilapidation. As a consequence, systematic social observation (SSO) by trained observers has become fundamental in neighbourhood-level studies (e.g., Mastrofski, 1998; Raudenbush & Sampson, 1999), particularly for measuring disorder (Hinkle & Yang, 2014; Hoeben et al., 2018; Johnson et al., 2016). By carrying out SSO, well-known validity threats of surveys, such as social desirability, unit non-response and
sampling error are eliminated (see for an overview of validity problems in survey research: Rossi et al., 2013; Wolf et al., 2016).

While in-situ SSO could provide rich details of the presence of disorder and CPTED measures, some concerns arise when conducting observations within a specific neighbourhood (Gracia & Herrero, 2007). Travel costs and human resources of researchers who need to travel to the observation area could be very high (Rundle et al., 2011) and carrying out in-situ observations in less secure neighbourhoods could create danger and fear of crime among observers, thus creating additional bias (Griew et al., 2013). These important theoretical, epistemological and methodological concerns have let to more innovative techniques to conduct research in neighbourhood settings, such as the utilization of virtual instead of in-situ SSO, often carried out by using Google Street View (GSV) images (Ben-Joseph et al., 2012; Clarke et al., 2010; Rundle et al., 2011) or original photographs (e.g., Cannuscio et al., 2009; Yang & Pao, 2015).

In order to move beyond the traditional assessment of psychometric properties of ecological measures, Raudenbush and Sampson (1999) propose ecometric assessments, which allow to measure item inconsistency within face blocks, or micro places in our case, and micro places variation within neighbourhoods (Raudenbush & Sampson, 1999). To improve ecometric (ecologically reliable) measures of the physical properties of neighbourhoods and other small-scale areas, it is the aim of the present study to evaluate the methodological quality of in-situ observations, original photographs and GSV images. More specifically, observations by trained observers were carried out to assess the presence of CPTED and disorder in four neighbourhoods. It is an important disadvantage that in-situ observations, original photographs and GSV images are always a snapshot in time. Not only for measuring social disorder, but also for linking in-situ observations to virtual observations, this temporal invariance is an obvious challenge. Temporal invariance should therefore be addressed as a potential measurement error when evaluating SSO (Raudenbush & Sampson, 1999). Additionally, a multi method approach is accompanied by potential mode-effects, or measurement and selection effects. Measurement effects occur when the results of the same items differ across modes (De Leeuw, 2005; Dillman et al., 2009). Selection errors occur when the observation points of different modes differ on the variables of interest (Vannieuwenhuyze et al., 2012). This study departs thus from a total error perspective (Lavrakas, 2013).
Measuring CPTED and disorder

Given the potential strengths and limitations associated with in-situ and virtual SSO, different measurement approaches are carried out to evaluate their inter-rater reliability, inter-modus reliability and convergent validity. With ‘inter-rater reliability’, we refer to the extent to which the same ratings are obtained by different observers. Inter-modus reliability refers to the extent to which the same results are obtained by different methods. With convergent validity, we refer to the extent to which theoretically linked measures ought to correlate.

In order to guide our analyses and explicate our expected results, we put forward the following five predefined hypotheses:

H1: Due to the extensive training of observers, we hypothesize that we will not find significant differences in inter-rater reliability over the different methods.

H2: Due to temporal incongruences, and in particular due to the prevailing measures against COVID-19\(^3\) at the time of the in-situ observations and the photographs taken at that moment, we hypothesize that we will find significant differences between observations from GSV imagery compared to the other two methods.

H3: Due to temporal congruences, we hypothesize that we will not find significant differences between observations from photographs and in-situ observations.

H4: We hypothesize that there will be more agreement across the different modes on the CPTED measures than on the measures regarding physical and social disorder, expecting that the CPTED measures are more stable over time.

H5: We hypothesize that there will be more agreement across the different modes on the measures of physical disorder than on the measures of social disorder, expecting that physical disorder is more stable over time.

\(^3\) At the time of the observations, the following measures against COVID-19, that are relevant for this study, applied: (1) at the University of Antwerp, only 20% of students were allowed to be physically present in the auditoriums, all other students had to follow classes online from home, (2) telework was highly recommended for staff members, several days a week, (3) all bars had to be closed at 11 p.m., (4) non-organized gatherings outside were limited to a maximum of four people, except for family members who lived under the same roof, (5) there was a limitation of a maximum of three close contacts per month for everyone, (6) extra efforts in the field of enforcement had to ensure that the above measures were applied everywhere.
4.2. Data and methods

4.2.1. Data collection

4.2.1.1. Research area

In the current study, SSO was applied within the neighbourhood of the campuses of the University of Antwerp. The city of Antwerp consists of approximately 526,000 inhabitants and is, based on its population, the largest city of Belgium. The university has four main campuses which are spread over the territory of the city and located in four different neighbourhoods. The university neighbourhood serves as an interesting research setting as it can be considered as an attractive environment for motivated offenders to engage in crime. The combination of crime attractors, such as the presence of intoxicated students or insecure housing largely vacant during the day, and crime generators, such as the presence of bars and shopping venues, creates conditions conducive to opportunities for crime (Cundiff, 2020). In total, 36 observation points within the four university neighbourhoods were selected to be included in the study, indicated by x,y-coordinates. The selection was based on three criteria, taking into account both physical and virtual characteristics of the observation point:

- only observation points with a direct access to the university campus were selected to ensure that all observation points were located in the university neighbourhood;
- only observation points that are at least 100 meters apart from each other were selected to avoid overlapping observations;
- only observation points of which the GSV images were recently captured (after May 2017) were selected to address the limitation of temporal invariance.

Observers who carried out in-situ observations (see below for more information) were instructed to observe in 360° from the exact x,y-coordinates they received. From the observation point, they had to capture four photographs which offered a clear overview of the observation point (see Figure 4.1). The observers were free to choose a date and time to carry out the observations, within the period of the 1st of October and the 23rd of October 2020. In the end, in-situ observations were carried out between 10 a.m. and 20.15 p.m. from October 3 to October 20.
4.2.1.2. **Observers**

Trained observers⁴ (N=203) were divided in groups of four to six persons. Before they carried out the observations, all observers followed an extensive training in which they were instructed about the checklist and the practical performance of the observations. Additionally, they received theoretical information about crime prevention, disorder and CPTED.

Each group received an observation point with address and specific x,y-coordinates. While two persons of every group travelled to the observation point to carry out in-situ observations, the other group members observed the same observation point based on photographs they received from their group members on location. Additionally, every group member was instructed to observe the observation point by means of GSV images. In the end, 174 female, 28 male and one non-binary observer carried out two observations which led to 406 individual observations in total. 71 observations were performed in-situ, 132 observations were executed based on original photographs and 203 observations were virtually carried out by means of GSV images.

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⁴ All observers were trained Master students in Criminological Sciences at Ghent University. They received course credit for their observation efforts.
4.2.2. Materials and measures

All observations were carried out by using a standardized checklist. The observation checklist consisted of 40 items to assess the presence of CPTED measures and social and physical disorder (see Appendix Table 4.2). To examine CPTED, the five key principles (i.e., surveillance, access control, territoriality, maintenance and activity support) were included in the checklist. Surveillance was measured by using seven items (e.g., presence of formal surveillance (police patrol, security guards)). For access control, three items were included (e.g., there are visible campus entrances and exits). Also territoriality was measured by three items (e.g., there are physical barriers (e.g., fences, shrubs) that separate campus from public space). All aforementioned key principles were scored on a scale from 0 (=none (=0)) to 3 (=many (>4)). In order to measure maintenance, nine items were used (e.g., in general, the observation point appears to be well maintained in terms of infrastructure; the condition of the buildings on the observation point is...). Items were scored on a scale from 1 (=totally not agree) tot 4 (=totally agree) or on a scale from 1 (=very bad) to 4 (=very good). Finally, activity support was assessed by six items (e.g., there is a cultural activity going on (e.g., performance, festival) at the observation point), which were scored on a scale from 0 (=none (=0)) to 3 (=many (>4)).

In order to measure the presence of physical and social disorder, respectively eight and four items were included in the checklist. For physical disorder, a distinction was made between the cleanliness of the observation point (e.g., there are waste bins on the observation point) and the presence of broken infrastructure (e.g., there are broken windows/doors at the observation point). Answers were scored based on a scale ranging from 0 (= none (=0)) to 3 (=many (>4)). For social disorder, the presence of people who disturb public order (e.g., there are people who are drunk on the observation point) was examined, based on a scale ranging from 0 (=none (=0)) to 3 (=many (>4)).

4.2.3. Analytical strategy

For all analyses SPSS Statistics (version 26) was used. To assess inter-rater reliability, the Intra Class Correlation (ICC) coefficient is used. The ICC is represented in equation 1, where σ² represents the variance and B and W respectively stand for between and within groups (Heck et al., 2010).
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\[ \rho = \frac{\sigma_B^2}{\sigma_B^2 + \sigma_W^2} \]  

(1)

In assessing both inter-modus reliability and convergent validity, correlational analyses are used. To examine inter-modus reliability the correlation per modus and per observation point is assessed for all items together. In these analyses the dataset is transposed to the extent that the concepts related to CPTED and disorder are represented as cases. To examine convergent validity the mean per observation point is compared over the different modes and for the different concepts related to CPTED and disorder.

4.3. Results

4.3.1. Inter-rater reliability

ICC coefficients (one-way random, single measures) were computed for the three observation methods. Figure 4.2 shows that the variation in ICCs per observation point was higher, and highly similar for the observations by means of photographs (M\text{photo}) and GSV imagery (M\text{GSV}), compared with the in-situ observations (M\text{in-situ}). The average ICCs are 0.974 (SD=0.034) for M\text{in-situ}, 0.829 (SD=0.117) for M\text{photo} and 0.844 (SD=0.078) for M\text{GSV}. These averages indicate strong levels of agreement between the raters. The highest ICCs were found for M\text{in-situ}, which are also characterized by small variations. The lowest ICCs, but still high, were obtained for M\text{photo} and M\text{GSV} and show larger variations.

These results suggest that the first hypothesis can be confirmed. Although the ICCs differ by observation method, in particular regarding M\text{in-situ} that yield higher inter-rater reliability, the average ICC of each method is high. Considering these ICCs, very similar results were obtained by different observers carrying out the same observation method.
4.3.2. Inter-modus reliability

The inter-modus reliability of the three observation methods is shown in Figure 4.3. This reliability measure refers to correlations between different methods for the observations of all 40 items that were considered in this study (see 4.2.2). Average Spearman Rho correlations range from .756 to .942, indicating a strong inter-modus reliability. Low variations and the highest correlations were found between $M_{photograph}$ and $M_{GSV}$ (mean $r=.942$, SD=.039) This finding reveals that there is a strong agreement between the virtual observation methods. Similar variations and correlations were obtained between $M_{in-situ}$ and $M_{GSV}$ (mean $r=.750$, SD=.125) and between $M_{in-situ}$ and $M_{photograph}$ (mean $r=.756$, SD=.124). Although these correlations are not as high as the correlations between $M_{photograph}$ and $M_{GSV}$, they still can be considered as high.

These results show that the second hypothesis cannot be confirmed as $M_{photograph}$ and $M_{GSV}$ yield very high correlations. We can also not confirm the third hypothesis. Although the correlations between $M_{in-situ}$ and $M_{photograph}$ are high, some correlations around $r=.500$ were found. This indicates that at particular observation points, lower correlations between the two observation methods were obtained.

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5 For $M_{in-situ}$ at location point 31 an ICC coefficient cannot be determined, because there was only one observation for this location in this mode.
4.3.3. Convergent validity

The convergent validity was first investigated by comparing the average scores per observed measure over the three observation methods (see Figure 4.4). These results indicate that the average scores for $M_{\text{in-situ}}$ are the highest. Except for the constructs maintenance and social disorder, higher average scores were found compared to $M_{\text{photo}}$ or $M_{\text{GSV}}$. It should, however, be noticed that social disorder items were included in the observation checklist, but they were not observed during the in-situ observations. Subsequently, although $M_{\text{GSV}}$ yield higher scores for all constructs on average, the results show that the mean scores on the constructs observed via $M_{\text{GSV}}$ and $M_{\text{photo}}$ are comparable.
Figure 4.4. Mean scores for constructs related to CPTED and disorder per method.

Figure 4.5 reveals the average correlations between the different observation methods per group of items (i.e., constructs). The results show the highest correlations between M_{photo} and M_{GSV} (mean \( r=0.708, SD=0.194 \)). Lower correlations were found between M_{in-situ} and M_{photo} (mean \( r=0.460, SD=0.237 \)) and M_{in-situ} and M_{GSV} (mean \( r=-0.538, SD=0.261 \)). These findings indicate that average correlations between the two virtual methods, M_{photo} and M_{GSV}, are higher compared to correlations between M_{in-situ} and the two virtual observations, even while this comparison is not subject to temporal incongruences.

Figure 4.5. Correlation of observations between different methods per construct.
Measuring CPTED and disorder

To evaluate the agreement across the different modes, we computed the standard deviations (SD) of the average correlations for the three methods per construct (see Table 4.1). The results show that the SD range from .107 to .533. The highest agreement was found for the construct territoriality, while the lowest agreement was obtained for social disorder. Importantly, regarding social disorder it should be remarked that three of four items were not included, because the scores of $M_{\text{in-situ}}$ are nihil.

<table>
<thead>
<tr>
<th>Item</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPTED</td>
<td></td>
</tr>
<tr>
<td>Surveillance</td>
<td>.152</td>
</tr>
<tr>
<td>Access control</td>
<td>.169</td>
</tr>
<tr>
<td>Territoriality</td>
<td>.107</td>
</tr>
<tr>
<td>Maintenance</td>
<td>.119</td>
</tr>
<tr>
<td>Activity support</td>
<td>.130</td>
</tr>
<tr>
<td>Disorder</td>
<td></td>
</tr>
<tr>
<td>Physical disorder</td>
<td>.218</td>
</tr>
<tr>
<td>Social disorder</td>
<td>.533</td>
</tr>
</tbody>
</table>

Our findings are in line with hypothesis 4, because stronger agreement was found across the different modes regarding the CPTED measures compared to physical and social disorder. But, caution is warranted because only one of four items were included for social disorder. Our findings also align with hypothesis 5 as there is more agreement across the different modes on the measures of physical disorder compared to the measures of social disorder. Again, it should however be mentioned that we were not able to compare the observations across modes, as there was no social disorder observed during the in-situ observations.

### 4.4. Discussion and conclusion

It was the aim of this article to evaluate the methodological quality of three different observation methods to improve the ecometric measures of physical properties of an environment. To assess the presence of CPTED and disorder at street segment level, in-situ observations, observations via original photographs and observations by means of GSV images were carried out. Considering the potential strengths and weaknesses of physical and virtual SSO, we evaluated their inter-rater reliability, inter-modus reliability and convergent validity.
In general, our findings support the use of observations by original photographs and by means of GSV images as reliable and cost-effective tools for gathering information about the presence of physical cues in the neighbourhood.

High levels of inter-rater agreement are found, indicating that similar results were obtained by different observers for each of the three observation methods. An evaluation of the inter-modus reliability shows that the agreement between in-situ observations and photographs, and in-situ observations and GSV imagery is strong. A higher correlation is obtained between the virtual observation methods, indicating that there is a stronger agreement between the observations based on secondary material. Overall, the items measured by means of in-situ observations are characterized by the highest mean scores. Additionally, more agreement is found between CPTED items compared to disorder, while physical disorder items show a stronger agreement in comparison to social disorder. Based on these findings, despite high correlations and agreement, we can conclude that by means of in-situ observations, that is considered the best measurement of the actual scores, on average more disorder and CPTED measures are observed, and the virtual methods seem to miss an equal amount of aspects (as well as the same aspects) of reality due to the specific characteristics of these methods (e.g., objects obstructing the view, limited view due to the specific position of observation).

Although our study provides valuable insights, the results must be interpreted in light of a number of limitations and challenges which may be useful to take into account in future research. The first challenges refer to the way the study design affects the inter-rated reliability. Although the inter-rater reliability for all three methods proved to be high, a variation in the number of observers may have contributed to these results. 71 observers carried out in-situ observations, while respectively 132 and 203 observers performed observations by means of photographs and GSV images. The high ICCs for in-situ observations may have been influenced by the lower number of unique observations that were included in the analysis. Ensuring an equal number of observers performing each observation method, is recommended for future research. Subsequently, the inter-rater reliability is a parameter that is difficult to control. In our study, it is possible that the coherence between the raters was artificially increased due to the varying number of observers per observation point. A potential limitation arises because the in-situ observations were almost all times carried out per two observers. This implies that, even though they were instructed to perform the observation...
Measuring CPTED and disorder

independently, the observers were able to discuss the measures they observed. For future studies, ensuring that observers are not influenced by other raters is recommended.

A second challenge refers to the evaluation of the inter-modus reliability. Although strong correlations were found, these results may be influenced by the task setting of the observers. Every student was asked to perform two different observations and they all performed the observations by means of GSV imagery. This implies that every rater observed one observation point twice. The first observations they carried out, could have biased the observations that were performed second. Ensuring that observers are not biased with previous observations of the same observation point is recommended for future research. Additionally, future research could assess these limitations quantitatively by performing cross-classified multilevel models, because, unfortunately, the number of observations in this study was too low to conduct this analysis.

A third challenge is that social disorder was not observed during the in-situ observations. The prevailing measures against COVID-19 at the time of the observations could have limited the presence of social incivilities at the observation points. These external factors, that we could not control, may have influenced our results. Additionally, social disorder can be considered as a snapshot in time, especially compared to the other concepts, which implies that this is more difficult to determine via observations at one moment in time.

A fourth challenge concerns the convergent validity and arose because of the temporal incongruence of combining physical and virtual observations. This challenge emerges in various studies (Clarke et al., 2010; Rundle et al., 2011; Taylor et al., 2011). Both physical and social disorder are considered temporally variable items, which may lower the correlation among the measured items over the different methods. The CPTED measures may be seen as items that are more stable over time. Remarkably, our study showed high correlations between photographs and GSV images indicating that there is a stronger effect of the modus, than an actual shift in levels of CPTED and disorder. In other words, the concepts studied seemed to be relatively stable over time. It is therefore recommended for future research to further examine this spatial stability. Additionally, consistent with previous studies, convergent validity tended to be lower for disorder compared to CPTED measures. Clarke et al. (2010) explain this finding by stating that characteristics that require a qualitative
judgement (e.g., condition of the buildings) and items requiring highly detailed observations at street level (e.g., presence of litter), may be less obviously observed, especially using virtual methods.

The fifth and final challenge refers to the characteristics of GSV imagery. The quality of the images is not always optimal, due to different reasons, such as the quality of the initial recording, compression of the data or resolute blurring of the data because of privacy considerations (Google, n.d.). Furthermore, GSV images are recorded by a car from the roadway, that does mean that all facets of the streets are mapped due to objects blocking the view at the time of the recording. These aspects in sum make that it is generally not easy to capture, detect and/or recognize smaller objects with the use of GSV imagery (Aghaabbasi et al., 2018; Rzotkiewicz et al., 2018). Additionally, not applicable for this study, but it may be relevant when this study is extended: GSV imagery are not available for all geographical regions and/or all the micro places within these geographical regions (Bloch, 2020).

Despite the number of limitations and challenges, the results of our study still suggest that virtual SSO approaches have considerable promise for the reliable and valid assessment of neighbourhood-level physical properties. Our study contributes, moreover, to the few existing studies that investigate the extent to which virtual observations are complementary to other methods. By doing so, we did not only evaluate the quality of observations by means of GSV images, but also investigated a second virtual observation method, or original photographs. In future research, the challenges that our study identified should be taken into account in order to keep evolving towards a more valid and reliable measurement approach for the physical environment. Finally, future research could explore the replacement of human observers by computers, because, although the results are eminently satisfactory, it remains a labour-intensive process. Therefore, it is necessary to conduct similar research, but test the reliability and validity of both type of observers instead of the reliability and validity over observation methods. Exploratory studies provide promising results regarding the classification of various types of urban disorder (and by extension more aspects in public space, such as presence of CCTV) on a micro-level scale (Sukel et al., 2020).
4.5. References


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Sampson, R. J., & Raudenbush, S. W. (2001). Disorder in urban neighbourhoods: Does it lead to crime. US Department of Justice, Office of Justice Programs, National Institute of Justice.


Appendix

Table 4.2. Descriptive statistics of CPTED and disorder items.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mode 1: In-situ Mean</th>
<th>Mode 2: Photographs Mean</th>
<th>Mode 3: Google Street View Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of observers</td>
<td>1.97 (0.17)</td>
<td>3.67 (0.53)</td>
<td>5.64 (0.59)</td>
</tr>
<tr>
<td><strong>Surveillance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal surveillance</td>
<td>0.21 (0.44)</td>
<td>0.02 (0.07)</td>
<td>0.03 (0.10)</td>
</tr>
<tr>
<td>Natural surveillance</td>
<td>2.19 (0.56)</td>
<td>1.48 (0.77)</td>
<td>1.93 (0.55)</td>
</tr>
<tr>
<td>CCTV</td>
<td>0.54 (0.69)</td>
<td>0.28 (0.46)</td>
<td>0.25 (0.36)</td>
</tr>
<tr>
<td>Icons indicating presence of CCTV</td>
<td>0.39 (0.68)</td>
<td>0.21 (0.38)</td>
<td>0.13 (0.24)</td>
</tr>
<tr>
<td>Lighting</td>
<td>2.25 (0.73)</td>
<td>1.87 (0.81)</td>
<td>2.05 (0.64)</td>
</tr>
<tr>
<td>Windows</td>
<td>2.32 (0.93)</td>
<td>2.40 (0.76)</td>
<td>2.37 (0.81)</td>
</tr>
<tr>
<td>Open spaces</td>
<td>1.14 (0.97)</td>
<td>1.11 (0.82)</td>
<td>1.11 (0.84)</td>
</tr>
<tr>
<td><strong>Access control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrances and exits</td>
<td>1.15 (0.82)</td>
<td>0.92 (0.67)</td>
<td>1.05 (0.60)</td>
</tr>
<tr>
<td>Icons indicating presence of entrances</td>
<td>0.82 (0.83)</td>
<td>0.55 (0.56)</td>
<td>0.61 (0.57)</td>
</tr>
<tr>
<td>Alarm systems</td>
<td>0.49 (0.73)</td>
<td>0.15 (0.29)</td>
<td>0.24 (0.47)</td>
</tr>
<tr>
<td><strong>Territoriality</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical barriers</td>
<td>1.60 (1.22)</td>
<td>1.32 (1.03)</td>
<td>1.43 (1.04)</td>
</tr>
<tr>
<td>Icons indicating presence of university</td>
<td>1.46 (0.97)</td>
<td>0.85 (0.78)</td>
<td>0.96 (0.68)</td>
</tr>
<tr>
<td>Icons indicating presence of private properties</td>
<td>0.61 (0.66)</td>
<td>0.33 (0.47)</td>
<td>0.45 (0.49)</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleanliness</td>
<td>2.06 (0.76)</td>
<td>2.21 (0.55)</td>
<td>2.37 (0.42)</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>1.94 (0.67)</td>
<td>2.26 (0.58)</td>
<td>2.21 (0.45)</td>
</tr>
<tr>
<td>Garbage</td>
<td>0.89 (0.81)</td>
<td>0.50 (0.62)</td>
<td>0.40 (0.38)</td>
</tr>
<tr>
<td>Garbage bins</td>
<td>0.65 (0.76)</td>
<td>0.55 (0.60)</td>
<td>0.72 (0.74)</td>
</tr>
<tr>
<td>Graffiti</td>
<td>0.49 (0.67)</td>
<td>0.34 (0.59)</td>
<td>0.30 (0.57)</td>
</tr>
<tr>
<td>Icons indicating importance of cleanliness</td>
<td>0.14 (0.33)</td>
<td>0.05 (0.15)</td>
<td>0.04 (0.14)</td>
</tr>
<tr>
<td>Car wrecks</td>
<td>0.01 (0.08)</td>
<td>0.01 (0.04)</td>
<td>0.00 (0.03)</td>
</tr>
<tr>
<td>Bicycle wrecks</td>
<td>0.01 (0.08)</td>
<td>0.01 (0.06)</td>
<td>0.02 (0.06)</td>
</tr>
<tr>
<td>Broken windows/doors</td>
<td>0.13 (0.40)</td>
<td>0.03 (0.10)</td>
<td>0.04 (0.17)</td>
</tr>
<tr>
<td>Vacant buildings</td>
<td>0.26 (0.49)</td>
<td>0.10 (0.20)</td>
<td>0.15 (0.24)</td>
</tr>
<tr>
<td>Maintenance of buildings</td>
<td>3.21 (0.58)</td>
<td>3.31 (0.55)</td>
<td>3.34 (0.54)</td>
</tr>
<tr>
<td>Maintenance of pavements</td>
<td>3.42 (0.68)</td>
<td>3.46 (0.42)</td>
<td>3.37 (0.40)</td>
</tr>
<tr>
<td>Maintenance of sidewalks</td>
<td>3.32 (0.69)</td>
<td>3.34 (0.55)</td>
<td>3.39 (0.47)</td>
</tr>
<tr>
<td>Maintenance of lighting</td>
<td>3.29 (0.68)</td>
<td>3.24 (0.58)</td>
<td>3.24 (0.44)</td>
</tr>
<tr>
<td>Maintenance of CCTV</td>
<td>4.25 (0.97)</td>
<td>4.60 (0.66)</td>
<td>4.52 (0.68)</td>
</tr>
<tr>
<td>Maintenance of alarm systems</td>
<td>4.31 (0.92)</td>
<td>4.67 (0.55)</td>
<td>4.63 (0.60)</td>
</tr>
<tr>
<td>Maintenance of vegetation</td>
<td>3.63 (0.86)</td>
<td>3.54 (0.60)</td>
<td>3.68 (0.57)</td>
</tr>
<tr>
<td>Activity</td>
<td>Homeless people</td>
<td>Drunk people</td>
<td>People using drugs</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------</td>
<td>--------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Homeless people</td>
<td>0.00</td>
<td>0.00</td>
<td>1.54</td>
</tr>
<tr>
<td>Drunk people</td>
<td>0.00</td>
<td>0.00</td>
<td>2.12</td>
</tr>
<tr>
<td>People using drugs</td>
<td>0.03</td>
<td>0.17</td>
<td>2.18</td>
</tr>
<tr>
<td>People fighting</td>
<td>0.00</td>
<td>0.00</td>
<td>1.63</td>
</tr>
<tr>
<td><strong>Activity support</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bars and restaurants</td>
<td>0.64</td>
<td>0.59</td>
<td>0.33</td>
</tr>
<tr>
<td>Shops</td>
<td>0.18</td>
<td>0.38</td>
<td>0.13</td>
</tr>
<tr>
<td>Picnic tables</td>
<td>0.43</td>
<td>0.78</td>
<td>0.19</td>
</tr>
<tr>
<td>Cultural activities</td>
<td>0.11</td>
<td>0.40</td>
<td>0.03</td>
</tr>
<tr>
<td>Playgrounds</td>
<td>0.04</td>
<td>0.18</td>
<td>0.07</td>
</tr>
<tr>
<td>Park</td>
<td>0.64</td>
<td>0.98</td>
<td>0.55</td>
</tr>
</tbody>
</table>
CHAPTER 5

The impact of training sessions on physical security awareness: Measuring employees’ knowledge, attitude and self-reported behaviour

Today, the need to deal with workplace security threats has become an important matter for many organisations. While companies have invested in technological and organization measures, the human processes behind these techniques are often ignored. However, employees’ awareness of security procedures and policy of the organisation may strengthen or weaken the implemented security measures. This article assessed in an empirical way employees’ security awareness and has a twofold aim. First, a study was conducted to examine the associations between three dimensions of employees’ security awareness. By the use of a survey (n=1,443; mean age=42.5; 60.4% female, 30.4% male), the relationship between employees’ knowledge about security procedures and policy, the attitudes towards security and the self-reported security behaviour is measured. Second, a case study was carried out to examine the impact of training sessions on employee’s level of security awareness. By organizing an awareness training, its effect on employees’ knowledge, attitude and behaviour was measured (n=74; mean age=51.7; 70.3% female, 29.7% male). While the first study found a significant relationship between employees’ knowledge and attitude and their self-reported behaviour, the second study showed that the training session had a positive effect on employees’ level of security awareness. Based on the findings from both studies, recommendations for practice and future research are presented.

This chapter is based on:
5.1. Introduction

Workplace security threats, and how to handle them, are important issues worldwide (Villa et al., 2016). An increase in the use of digital information and communication techniques, complex modern infrastructures and a closer connection between different systems and organisations have all created greater vulnerability to security breaches. Companies have invested in numerous technological and organisational security measures in an attempt to address this issue, but both researchers and professionals suggest that even the most sophisticated security techniques cannot work effectively unless every member of an organisation acts in a secure way (Wiley et al., 2020). In recent years, there has been a noticeable shift of focus on to the importance of ‘human processes’ in dealing with security threats (Ghafir et al., 2018; Hassija et al., 2020). These human processes refer to employees’ security awareness – the extent to which a member of an organisation understands the importance of security and the level of security required (ISF, 2002). An individual’s security awareness can be categorised using three levels: perception, comprehension and protection, depending on the employee’s degree of understanding of security issue (Shaw et al., 2009). An employee with the lowest level of awareness may be aware of the potential security risks but does not know how to mitigate them. At the comprehension level of awareness, the employee knows what the potential risks are, and knows how to act in a preventive way. At the protection level, the employee might have already experienced a similar security scenario and decides to act in a preventive way based on this earlier experience.

Researchers have experimented with various learning mechanisms to strengthen the role of employees in security, including online training, poster campaigns, email messages and face-to-face training sessions (ENISA, 2008; Johnson, 2006; Khan et al., 2011a). All these programmes are designed to affect employees’ behaviour by increasing their knowledge about the threats and security policy and procedures of the organisation, in order to achieve more secure and compliant behaviour. However, the implementation of a security awareness programme does not guarantee that every employee has understood the information they are given. It is therefore important to measure how effective the specific method is in fulfilling its purpose (Khan et al., 2011b). In previous studies, the effectiveness of security awareness programmes has often been evaluated by measuring three equivalent dimensions (cf. the
Knowledge, Attitude and Behaviour (KAB) model of Baranowski et al., 2003): what people know (knowledge), how people feel (attitude) and what people do (behaviour) (Kaur & Mustafa, 2013; Khan et al., 2011a; Kruger & Kearney, 2006; McCormac et al., 2017).

Baranowski et al. (2003) propose that human functioning in relation to these dimensions can be fragmented in these dimensions. Acquiring knowledge may result in changes in attitudes, which in turn can lead to changes in behaviour. For instance, when employees have more knowledge about the potential security threats and understand the importance of security procedures, their attitude might change, which may result in more security-compliant behaviour. However, the authors underline that although a person’s knowledge, attitude and behaviour are definitely interrelated, they are not necessarily linear or dependent on each other.

Previous studies show ambiguous results about the validity of the KAB model in practice. On the one hand, Chang and Liao (2009) found that an aviation safety education programme positively affected participants’ knowledge, attitude and behaviour; Rosenbloom et al. (2008) concluded that an active learning programme in Israeli elementary schools resulted in an increase in children’s knowledge and an improvement in behaviour regarding road safety; Van der Linden (2012) reviewed past studies dedicated to climate change and found significant associations between knowledge, attitude and behaviour; and Miller et al. (1990) stated that the KAB approach supported an AIDS prevention programme, as an increase in knowledge led to a change in behaviour among the participants. On the other hand, Shaftel and Shaftel (2005) indicated that, while universities observe the influence of teaching on students’ knowledge and skill development, less is known about the impact on their attitudes and behaviour; and in a study relating to oral health Singh (2009) found no correlations between high school students’ knowledge, attitude and behaviour.

Within the field of security, very little research has been carried out on how employees’ security awareness can be improved. The few studies that have explored this have mainly focused on the impact of security training and education on employees’ awareness regarding information security. Wahyudiwan et al. (2017), for instance, showed that knowledge-based programmes improved the knowledge, attitude and behaviour of employees regarding topics such as password management and email usage. Also, Parsons et al. (2014) found significant associations between a person’s knowledge, attitude and behaviour when using a work
Impact of training on security awareness

computer. Kaur and Mustafa (2013) found significant relationships between end users’ attitudes and behaviour, and their information security awareness. However, no significant association was found between knowledge and information security awareness.

While the aforementioned studies examined employees’ awareness of security threats in an online environment, very few – if any – studies exist about employees’ awareness of physical security, or security in the offline world. In order to fill this research gap, the aim of the current research was twofold. In a first study (Study 1) we examined whether employees’ knowledge of physical security procedures and policy was associated with their attitudes towards security and their self-reported security behaviour. Using a questionnaire distributed among staff at a university, we measured the relationship between physical security knowledge, attitude and behaviour. In a second study (Study 2) security training sessions were organised, and their impact on staff members’ knowledge, attitude and behaviour concerning physical security was measured.

Both studies were conducted among staff members of a university in Antwerp, Belgium. Universities function as interesting research objects for this type of study for several reasons. Higher educational institutions are increasingly confronted with various types of crime (Doss et al., 2017; Jacobsen, 2017; Jennings et al., 2007; Schokkenbroek et al., 2020). While minor crimes such as theft and vandalism occur regularly, universities’ characteristics, such as the presence of a large number of young people, server rooms that store valuable information and laboratories with potentially harmful substances make them an attractive target for more serious crimes such as terrorism or espionage (Boynton, 2003; Grubbs, 2019). Moreover, most European universities consist of various (semi-) publicly accessible spaces, which implies that it is not always possible or desirable to implement significant physical security measures, and that security is strongly dependent on the strength of the human factor. A university security model must therefore include initiatives that increase and maintain the level of security awareness among staff members.

Based on the results of both studies, concluding remarks and recommendations are made that are applicable to both higher educational institutions and other types of organisations.
5.2. Study 1: The association between knowledge, attitude and behaviour

5.2.1. Hypotheses

Study 1 examined the interconnectedness between the three dimensions of security awareness. To measure the relationships between employees’ security knowledge, attitudes and behaviour, three hypotheses were proposed:

H1: More knowledge about security procedures and policy leads to a better attitude towards security.

H2: A better attitude towards security leads to more secure self-reported behaviour.

H3: More knowledge about security procedures and policy leads to more secure self-reported behaviour.

5.2.2. Data and methods

5.2.2.1. Data collection

A questionnaire was distributed among staff members of a Belgian university between June 3 and August 7, 2019. All employees (N=5,924) working at the university during this period were eligible to participate in the study. Staff members could therefore voluntarily choose to complete the questionnaire, utilising self-selection processes. With the cooperation of the central administration of the university, every employee received an email with a link to the questionnaire, which was developed in Qualtrics. After ten days, a polite reminder was sent via email and an announcement was placed on the university’s intranet.

To fulfil the first aim of the study, the survey included questions regarding the three dimensions of the KAB model. A first draft of the questionnaire was developed after a review of existing questionnaires and an analysis of the security information presented on the university’s intranet. All questions were self-developed and presented to a panel of ten security experts at the university. Each security expert represented a department related to security (e.g., Department of Infrastructure). They were asked about their understanding of
the questions and whether they wanted to include other security topics of importance to them in the survey. Based on their comments and suggestions, the proposed questions were kept, but were adjusted and finalised. In order to measure knowledge, five items were included (e.g., ‘At the university, I know where I can report crimes of which I am the victim’). For each item, respondents had to indicate a number on a five-point Likert scale ranging from not at all (=1) to totally (=5). To measure employees’ attitudes, three items were included in the questionnaire (e.g., ‘The university provides its staff members with sufficient information about security’). Each item was scored on a five-point Likert scale ranging from totally disagree (=1) to totally agree (=5). Employees’ self-reported behaviour was measured using three items (e.g., ‘If I noticed something or someone suspicious at the university, I would report it’). Respondents had to indicate their answer on a five-point Likert scale ranging from (almost) never (=1) to (almost) always (=5).

5.2.2.2. Data analysis

Structural equation modelling (SEM) was applied to the collected data using Mplus 8 (Muthén & Muthén, 2017) to examine the relationships between the KAB constructs. First, a measurement model was built to test whether the observed variables reliably reflected the hypothesised latent variables. Second, we estimated a structural model. The SEM results were obtained with the maximum likelihood mean adjusted, because preliminary tests suggested that all three constructs were not normally distributed. Given the large sample size, p-values <0.01 are considered significant.

The model fits of the measurement and path models were evaluated according to several fit indices. Given that the χ2 is almost always significant and not an adequate test of the model fit (Kline, 2011), we also reported the comparative fit index (CFI), root mean square error of approximation (RMSEA), and the standardised root mean square residual (SRMR). The CFI ranges from 0 to 1.00, with .95 or higher indicating that the model provides a good fit (Hu & Bentler, 1999). RMSEA and SRMR values below .05 indicate a good model fit, and values from .06 to .08 indicate an adequate fit (Ponnet, 2014).
5.2.3. Results

5.2.3.1. Demographic data

In total, 1,443 employees participated in the study, which yields a response rate of 24.4%. Table 5.1 provides an overview of the demographic characteristics of the participants. 35.5% of respondents had been working at the university for 10 years or more. The gender split was 60.4% females \((n=871)\) and 39.6% males \((n=572)\). A small majority of the study’s participants were administrative and technical staff (51.6%). More than 80% of participants had a full-time equivalent between 76% and 100% at the time they filled in the questionnaire.

Table 5.1. Demographic characteristics of respondents in Study 1 \((N=1,443)\).

<table>
<thead>
<tr>
<th>Gender</th>
<th>(n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>572</td>
<td>39.6</td>
</tr>
<tr>
<td>Female</td>
<td>871</td>
<td>60.4</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-29</td>
<td>249</td>
<td>17.3</td>
</tr>
<tr>
<td>30-39</td>
<td>412</td>
<td>28.6</td>
</tr>
<tr>
<td>40-49</td>
<td>340</td>
<td>23.6</td>
</tr>
<tr>
<td>50-59</td>
<td>275</td>
<td>19.1</td>
</tr>
<tr>
<td>(\geq 60)</td>
<td>163</td>
<td>11.3</td>
</tr>
<tr>
<td>Missing</td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>Staff category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professors</td>
<td>169</td>
<td>11.7</td>
</tr>
<tr>
<td>Assistants</td>
<td>125</td>
<td>8.7</td>
</tr>
<tr>
<td>Researchers</td>
<td>358</td>
<td>24.8</td>
</tr>
<tr>
<td>Administrative and technical staff</td>
<td>745</td>
<td>51.6</td>
</tr>
<tr>
<td>Educational staff</td>
<td>45</td>
<td>3.2</td>
</tr>
<tr>
<td>Length of career at university</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 year</td>
<td>169</td>
<td>11.7</td>
</tr>
<tr>
<td>Between 1 and 5 years</td>
<td>483</td>
<td>33.5</td>
</tr>
<tr>
<td>Between 6 and 10 years</td>
<td>282</td>
<td>19.5</td>
</tr>
<tr>
<td>More than 10 years</td>
<td>509</td>
<td>35.3</td>
</tr>
<tr>
<td>% full time effort</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\leq 25%)</td>
<td>50</td>
<td>3.5</td>
</tr>
<tr>
<td>Between 26% and 50%</td>
<td>122</td>
<td>8.5</td>
</tr>
<tr>
<td>Between 51% and 75%</td>
<td>76</td>
<td>5.3</td>
</tr>
<tr>
<td>Between 76% and 100%</td>
<td>1,195</td>
<td>82.8</td>
</tr>
</tbody>
</table>
The questionnaire included 11 items, related to the three dimensions of the KAB model: knowledge (5 items), attitude (3 items) and behaviour (3 items). The reliability, or internal consistency, of a set of scale items was checked using Cronbach’s alpha. Items that would increase Cronbach’s alpha in their absence were deleted (Attitude: 1 item\(^6\); Behaviour: 1 item\(^7\)). Table 5.2 provides an overview of all study variables with their descriptives (mean and SD) and internal reliability of each scale. The composite mean score per scale refers to the mean of all scores on the individual items for that scale.

### Table 5.2. Descriptives of the variables in Study 1 (N=1,443).

<table>
<thead>
<tr>
<th>Scale</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge (α=0.90)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1 – At the university, I know where I can find information about preventive security tips (e.g., tips for the prevention of theft)</td>
<td>3.20</td>
<td>1.31</td>
</tr>
<tr>
<td>Item 2 – At the university, I know where to report crimes of which I am the victim (e.g., theft, violence)</td>
<td>3.40</td>
<td>1.34</td>
</tr>
<tr>
<td>Item 3 – At the university, I know how to report suspicious behaviour</td>
<td>3.25</td>
<td>1.29</td>
</tr>
<tr>
<td>Item 4 – At the university, I know what to do if there is an emergency situation (e.g., bomb alert, active shooter)</td>
<td>3.14</td>
<td>1.30</td>
</tr>
<tr>
<td>Item 5 – At the university, I know where to go when I am confronted with unacceptable behaviour (e.g., stalking, inappropriate sexual behaviour)</td>
<td>3.26</td>
<td>1.27</td>
</tr>
<tr>
<td><strong>Attitude (α=0.77)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1 – The university has sufficient security measures</td>
<td>3.13</td>
<td>0.93</td>
</tr>
<tr>
<td>Item 2 – The university takes sufficient action in case of an emergency situation</td>
<td>3.51</td>
<td>0.79</td>
</tr>
<tr>
<td>Item 3 – The university provides its staff members with sufficient information about security</td>
<td>3.10</td>
<td>0.96</td>
</tr>
<tr>
<td><strong>Behaviour (α=0.60)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1 – If I noticed someone in the hallway who does not seem to belong to the university, I would approach him/her</td>
<td>3.13</td>
<td>1.26</td>
</tr>
<tr>
<td>Item 2 – If I noticed someone or something suspicious at the university, I would report it</td>
<td>3.55</td>
<td>1.10</td>
</tr>
<tr>
<td>Item 3 – If I witnessed an incident at the university (e.g., violence, theft), I would report it</td>
<td>4.50</td>
<td>0.78</td>
</tr>
</tbody>
</table>

\(^6\) The item that was deleted is ‘minor incidents (vandalism, verbally aggressive behaviour) must always be reported to the university’.

\(^7\) The item that was deleted is ‘Every time I leave my workplace, I lock my door’.

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All constructs were significantly related to each other at the p<.001 level. The associations between knowledge and attitude, and knowledge and behaviour were .36 and .37 respectively. The association between attitude and behaviour was .16.

5.2.3.3. Measurement model

The measurement model provided a good fit for the data: χ²(41)=230.65, p < .001; CFI=.968, RMSEA=.057, CI [.050, .065], and SRMR=.047. All factor loadings were significant and above .48. We subsequently included gender, age, % full-time effort, length of career and staff category (professor, assistant, researcher, administrative and technical staff, educational staff) as covariates in the analyses and examined the relationships between these covariates and the study variables.

Age was significantly associated with behaviour (β=.265, p < .001) and knowledge (β=.11, p < .001), which implies that older staff members had more security knowledge and behaved in a more secure way. Percentage full-time effort was significantly related with knowledge (β=.148, p<.001), suggesting that staff members with a higher % full-time effort at the university knew more about the university’s security procedures and policy. Length of career was significantly related to knowledge (β=.204 p<.001), suggesting that staff members who had worked for a longer time at the university had more knowledge about the security procedures and policy. The staff category ‘administrative and technical staff’ was significantly related to knowledge (β=.366, p<.01). The structural model was adjusted for these covariates.

5.2.3.4. Structural model

The results of the structural model are presented in Figure 5.1. The results of the fit statistics indicated an adequate model fit: χ²(80)=350.95, p<.001; CFI=.959, RMSEA=.049, CI [.044, .054], and SRMR=.047.

Our analyses revealed that knowledge explained 18.6% of the variance in attitude, and that knowledge and attitude explained 28.0% of the variance in behaviour. Knowledge was significantly associated with attitude (β=.431, p < .001) and behaviour (β=.365, p < .001), thus confirming that staff members who knew more about security procedures and policy had better attitudes towards security and behaved in a more secure way. Unexpectedly, attitude
was not significantly associated with behaviour ($\beta=.065$, $p=.087$). As a result, the indirect effect from knowledge to behaviour was not significant ($\beta=.028$, $p=.091$).
Figure 5.1. Structural model for the KAB model of security awareness. Note. Know1-5, Att1-3 and Beh1-3 represent the items presented in Table 5.2. All reported coefficients are standardised values, adjusted for the influence of covariates. The dashed lines indicate non-significant paths. *p < .01; **p < .001.
5.3. Study 2: The impact of training sessions on security awareness

5.3.1. Hypotheses

In Study 2, three hypotheses were formulated in order to check whether participation in the training session had an impact on employees’ level of security awareness: (i) participating in the training sessions significantly improved employees’ knowledge of security procedures and policy, (ii) participating in the training sessions significantly improved employees’ attitude regarding security, (iii) participating in the training sessions significantly improved employees’ self-reported security behaviour.

5.3.2. Data and methods

The aim of the second study was to examine to what extent training sessions have an impact on participants’ level of security awareness. In order to do this, training was organised for the employees of a Belgian university (the same sample as in Study 1) between March 21 and April 19, 2018. Various security procedures and topics of importance to the university were included in the training. Before the content of the training session was devised, ten security experts from the university (the same experts as in Study 1) were interviewed to explore which topics were relevant. The experts suggested that the focus should be on four topics: terrorism, radicalisation, incident reporting and employees’ own security responsibilities at the university. Based on their insights, a training session with a focus on all of these security topics was developed.

The training sessions were held during the working day between 12:00 and 14:00 hours. Three sessions were held on three different dates and at different locations, each with a maximum capacity of 55 participants. All university employees were informed about the training sessions via an announcement on the intranet and a personal email, both of which included a registration link. Registration was entirely voluntary. To analyse the impact of the training sessions on employees’ levels of security awareness, two questionnaires were developed and distributed among the participants before and after the sessions. The pre-test questionnaire was sent immediately after employees registered for the training. The post-test questionnaire was distributed among the participants about two weeks after the training session. The aim
was to examine whether the training sessions had improved participants’ security-related knowledge, attitude and behaviour.

Based on the KAB model, questions regarding knowledge, attitude and behaviour were included in both the pre-test and post-test questionnaire. All questions focused on the specific topics that were discussed during the training sessions. After the questions were formulated, they were presented to the university security expert panel and then adjusted. The final pre-test questionnaire consisted of 24 questions. Five statements were developed to assess employees’ knowledge about the university’s security procedures and policy (e.g., ‘I know how to report suspicious behaviour’). Answers were scored on a five-point Likert scale ranging from totally disagree (=1) to totally agree (=5). To measure employees’ attitude towards security, three statements were included (e.g., ‘Every suspicious behaviour or situation must be reported, even if it turns out to be nothing’). Each item was scored on a five-point Likert scale ranging from totally disagree (=1) to totally agree (=5). Additionally, three items referring to employees’ self-reported behaviour were included in the questionnaire (e.g., ‘If I noticed someone or something suspicious at the university, I would report it’). Staff members indicated their answer on a five-point Likert scale ranging from (almost) never (=1) to (almost) always (=5). The post-test questionnaire consisted of exactly the same questions as those in the pre-test questionnaire, together with a couple of additional statements asking participants to evaluate the training session.

Changes in employees’ scores on knowledge, attitude and behaviour between the pre-test and post-test were analysed by using Wilcoxon signed-rank tests, as normality assumptions were unsatisfied. The criterion for significance was set at 0.05.

5.3.3. Results

5.3.3.1. Demographic data

In total, 157 employees registered for one of the three sessions, 116 of whom attended a session. As shown in Table 5.3, the sample comprised 74 employees who both attended the training sessions and completed the pre- and post-questionnaire. A majority of women (70.3%) participated, while every respondent indicated they were over 25 years of age. The defined age groups were approximately equally represented. When asked about the length of
their career at the university, most respondents had either worked at the university for between one and five years (39.2%), or for more than 10 years (47.3%). Only three participants indicated that they had worked at the university for less than a year.

Table 5.3. Demographic characteristics of respondents of Study 2 (N=74).

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>52</td>
<td>70.3</td>
</tr>
<tr>
<td>Male</td>
<td>22</td>
<td>29.7</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25-35</td>
<td>15</td>
<td>20.3</td>
</tr>
<tr>
<td>36-45</td>
<td>21</td>
<td>28.4</td>
</tr>
<tr>
<td>46-55</td>
<td>19</td>
<td>25.7</td>
</tr>
<tr>
<td>&gt;56</td>
<td>19</td>
<td>25.7</td>
</tr>
<tr>
<td>Length of career at university</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 year</td>
<td>3</td>
<td>4.1</td>
</tr>
<tr>
<td>1-5 years</td>
<td>29</td>
<td>39.2</td>
</tr>
<tr>
<td>6-10 years</td>
<td>7</td>
<td>9.5</td>
</tr>
<tr>
<td>&gt;10 years</td>
<td>35</td>
<td>47.3</td>
</tr>
</tbody>
</table>

5.3.3.2. Results of the pre-test and post-test

The results showed that the training session had a positive effect on employees’ knowledge of the university’s security procedures and policy (see Table 5.4). For all statements, significant differences (p<0.05) between the two tests were found. The biggest improvement is noticed when comparing the pre- and post-test results for the statements ‘I know the difference between the procedures for a fire alarm and a bomb alert’ (z=6.816, p>0.001) and ‘I know how to report signs of radicalisation among students or staff members’ (z=6.832, p<0.001). Sixty-one of 73 respondents (83.6%) indicated they were more aware of the difference in procedures for a fire alarm and a bomb alert. Additionally, 63 of 74 respondents (85%) were convinced that after the training session they were more knowledgeable about the internal reporting tools for radicalisation. Based on the results of all knowledge statements, it can be concluded that respondents scored significantly higher on self-reported knowledge about security after their participation in the training session. Therefore, the first hypothesis is confirmed.
Table 5.4. Changes in employees’ knowledge regarding security procedures and policy (n=74).

<table>
<thead>
<tr>
<th>Statements</th>
<th>Pre-test M (SD)</th>
<th>Post-test M (SD)</th>
<th>z-score</th>
<th>p-value</th>
<th>Sample</th>
<th>Scoring higher</th>
<th>Scoring lower</th>
<th>Scoring even</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know the difference between the procedures for a fire alarm and a bomb alert</td>
<td>2.32 (1.218)</td>
<td>4.04 (0.841)</td>
<td>6.816</td>
<td>&lt;0.001</td>
<td>73</td>
<td>n=61</td>
<td>n=3</td>
<td>n=9</td>
</tr>
<tr>
<td>I know how to report suspicious behaviour</td>
<td>3.14 (1.162)</td>
<td>4.51 (0.503)</td>
<td>6.215</td>
<td>&lt;0.001</td>
<td>74</td>
<td>n=51</td>
<td>n=2</td>
<td>n=21</td>
</tr>
<tr>
<td>I know where to report crimes of which I’m the victim</td>
<td>3.51 (1.317)</td>
<td>4.57 (0.526)</td>
<td>6.461</td>
<td>&lt;0.001</td>
<td>74</td>
<td>n=54</td>
<td>n=2</td>
<td>n=18</td>
</tr>
<tr>
<td>I know how to report signs of radicalisation among students or staff members</td>
<td>2.61 (1.259)</td>
<td>4.30 (0.677)</td>
<td>6.832</td>
<td>&lt;0.001</td>
<td>74</td>
<td>n=63</td>
<td>n=4</td>
<td>n=7</td>
</tr>
<tr>
<td>I know where to go with questions about security</td>
<td>4.07 (0.912)</td>
<td>4.45 (0.708)</td>
<td>3.220</td>
<td>&lt;0.001</td>
<td>73</td>
<td>n=33</td>
<td>n=9</td>
<td>n=31</td>
</tr>
</tbody>
</table>

Note. A composite mean score of 3.13 (SD = .92) was found. Reliability analysis indicated the scale has a Cronbach’s alpha of .84. ‘Scoring higher’, ‘scoring lower’ and ‘scoring even’ refer to a comparison between the post-test and pre-test scores.

For employees’ attitudes towards security, the Wilcoxon signed-rank tests showed a significant improvement on two of three statements (see Table 5.5). After the training session, more employees were convinced about their personal responsibility with respect to security and the need to report suspicious situations. However, when asked to what extent security is an important topic, a majority of 48 respondents indicated the same score. Remarkably, only 11 employees indicated a higher score after the training session, while 14 of them indicated lower scores. Although a limited number of participants scored higher on the post-test, it should be noted that the pre-test mean (4.46) was already very high. Based on the majority of the statements, there was a significant improvement in the attitude of employees towards security. This implies that the second hypothesis is confirmed.
Table 5.5. Changes in employees’ attitude towards security (N=73).

<table>
<thead>
<tr>
<th>Statements</th>
<th>Pre-test M (SD)</th>
<th>Post-test M (SD)</th>
<th>z-score</th>
<th>p-value</th>
<th>Sample</th>
<th>Scoring higher</th>
<th>Scoring lower</th>
<th>Scoring even</th>
</tr>
</thead>
<tbody>
<tr>
<td>The security of the university is an important topic</td>
<td>4.46 (0.894)</td>
<td>4.48 (0.669)</td>
<td>0.044</td>
<td>0.965</td>
<td>73</td>
<td>n=11</td>
<td>n=14</td>
<td>n=48</td>
</tr>
<tr>
<td>Every suspicious behaviour or situation must be reported, even though it turns out to be nothing</td>
<td>4.01 (0.884)</td>
<td>4.30 (0.639)</td>
<td>2.868</td>
<td>0.004</td>
<td>73</td>
<td>n=28</td>
<td>n=10</td>
<td>n=35</td>
</tr>
<tr>
<td>I feel responsible for the security of the university</td>
<td>4.01 (0.630)</td>
<td>4.26 (0.578)</td>
<td>2.999</td>
<td>0.003</td>
<td>73</td>
<td>n=21</td>
<td>n=6</td>
<td>n=46</td>
</tr>
</tbody>
</table>

Note. A composite mean score of 4.16 (SD = .61) was found. Reliability analysis indicated the scale has a Cronbach’s alpha of .60. ‘Scoring higher’, ‘scoring lower’ and ‘scoring even’ refer to a comparison between the post-test and pre-test scores.

Regarding employees’ self-reported security behaviour, no significant differences were found between the pre-test and post-test questionnaires (see Table 5.6). The large majority of employees indicated an even score on both pre-test and post-test. For all three statements, only a very limited number of respondents indicated higher scores in the post-test. Based on these results, it can be concluded that the training sessions had less of an impact on the self-reported behaviour of employees than on their knowledge and attitude. Hence, when looking at all statements, the third hypothesis cannot be confirmed.

Table 5.6. Changes in employees’ self-reported security behaviour (N=71).

<table>
<thead>
<tr>
<th>Statements</th>
<th>Pre-test M (SD)</th>
<th>Post-test M (SD)</th>
<th>z-score</th>
<th>p-value</th>
<th>Sample</th>
<th>Scoring higher</th>
<th>Scoring lower</th>
<th>Scoring even</th>
</tr>
</thead>
<tbody>
<tr>
<td>If I noticed someone suspicious, I would report it</td>
<td>4.51 (1.024)</td>
<td>4.28 (0.759)</td>
<td>1.775</td>
<td>0.076</td>
<td>71</td>
<td>n=13</td>
<td>n=22</td>
<td>n=36</td>
</tr>
<tr>
<td>If I were the victim of a crime, I would report it</td>
<td>4.95 (0.571)</td>
<td>4.87 (0.335)</td>
<td>0.727</td>
<td>0.467</td>
<td>71</td>
<td>n=5</td>
<td>n=14</td>
<td>n=52</td>
</tr>
<tr>
<td>If I were confronted with an emergency situation, I would report it via the internal reporting tools</td>
<td>4.73 (0.926)</td>
<td>4.83 (0.377)</td>
<td>1.050</td>
<td>0.294</td>
<td>71</td>
<td>n=13</td>
<td>n=13</td>
<td>n=45</td>
</tr>
</tbody>
</table>

Note. A composite mean score of 4.73 (SD = .70) was found. Reliability analysis indicated the scale has a Cronbach’s alpha of .74. ‘Scoring higher’, ‘scoring lower’ and ‘scoring even’ refer to a comparison between the post-test and pre-test scores.
5.4. Discussion

Most companies want their employees to exhibit security-compliant behaviour, therefore a clear understanding of the effectiveness and impact of security awareness initiatives is indispensable. To provide more insight into this topic, the aim of the current article was twofold: examining the relationship between employees’ security knowledge, attitudes and self-reported behaviour (Study 1) and measuring the impact of security training on their level of security awareness (Study 2). The first study found that employees who have more security knowledge also displayed a better attitude towards security issues. Additionally, employees who reported having more security knowledge and better attitude towards security indicated they would behave in a more secure way. No significant relationship was found between employees’ attitudes towards security and their self-reported security behaviour. Taking into account employees’ socio-demographic characteristics, positive associations were found between their age, length of career and % full time effort, and their security knowledge. Older employees also indicated that they behaved in a more secure way. The results of the second study showed that the training session had a positive effect on employees’ security knowledge and attitudes towards security. The impact of the training on staff members’ self-reported behaviour was also found to be positive, but less strong compared to knowledge and attitude. A comprehensive overview of the findings from both studies indicates that more security knowledge and better attitudes towards security are related to more self-reported security-compliant behaviour. Moreover, training sessions were found to be effective in increasing employees’ security knowledge and attitudes. Extra attention should, however, be given to the impact of training on participants’ behaviour.

Regarding the validity of the KAB model, our results showed that employees’ attitudes towards security were not significantly related to their self-reported behaviour. In this light, it should be acknowledged that other factors could have played a mediating role in the KAB model. Parsons et al. (2014), for instance, state that employees may well know the security procedures and behave in a secure way, even when their attitudes towards security issues are negative. The desire to keep their job may be a mediating factor in employees choosing to act in a security-compliant way. Previous studies in healthcare (Baranowski et al., 2003) and environmental awareness (Newbould & Furnell, 2009) support this statement, and indicate that individuals’ knowledge and attitude are not sufficient to explain changes in behaviour. A
potential explanation for this complex relationship between attitude and behaviour can be found in the Theory of Planned Behaviour of Azjen (1991), which assumes that a person’s behavioural change is dependent on three beliefs: behavioural beliefs, or beliefs about the consequences or other attributes of behaviour; normative beliefs, or beliefs about the normative expectations of other people; and control beliefs, or beliefs about the presence of factors that may support or hinder performance of the behaviour. The intention towards particular behaviour will be higher if the person has a positive attitude about it, more of a subjective norm towards the behaviour and a high perception of behavioural control.

In addition to the impact of mediators, moderators could also influence this attitude–behaviour inconsistency. A potential explanation is provided by the Attitude, Behaviour and Structural Conditions (ABC) model of Guagnano et al. (1995). According to this model, a person’s behaviour depends not only on their attitudes, but also on contextual conditions. The relationship between an individual’s attitude and behaviour is strongest when contextual factors are neither too strong nor too weak, providing the right level of support. This implies that employees who work in highly supportive structural conditions but have a negative attitude towards security may still act in a secure way. In reality, and adapted to the field of physical security, this means that the organisation must possess the tools and structures that are needed to simulate employees to act in a security-compliant way. Insufficient support or a weak organisational culture could create the opposite result. Another moderating factor may be found in the processes that contribute to people’s attitude formation. Regan and Fazio (1977) indicate that individuals who form their attitudes based on direct behavioural interaction with the attitude’s object will show significantly greater attitude–behaviour consistency than people whose attitudes were formed by other means. The authors start from the assumption that direct behavioural experiences form an attitude that is more stable than an attitude produced through indirect means. Related to the field of physical security, this would, for instance, imply that people who have themselves been a victim of crime will demonstrate higher attitude–behaviour consistency compared to individuals who have not. Bulgurcu et al. (2010) found that prior negative experiences, both direct and indirect, with information security increased employees’ level of information security awareness. In this light, the organisation of more interactive training sessions where people gain experience with the topic may increase the relationship between their attitudes and behaviour. More practical
Impact of training on security awareness

awareness initiatives, such as penetration tests, red teaming, simulation attacks or interactive demos may therefore be recommended.

Furthermore, when implementing security awareness programmes, one should keep in mind the exact level of security awareness that is expected by the organisation. The level of security awareness that is expected of an employee at a university may differ from that required of an employee of a chemical or nuclear company. Therefore, it is important for an organisation to identify the level of security awareness it expects of its employees and adapt its security awareness programmes to these predefined goals. Moreover, any security awareness programme needs to be continually measured and monitored to respond to all relevant threats at that time. Physical security processes are dynamic because they are dependent on continuously changing threat profiles. This implies that employees have to be updated about these changes, and in order to do that security awareness training should be an integral part of the security culture of the organisation. In each and every organisation, regardless of its type of business, location or size, people are always a key factor for successful physical security management. Furthermore, as Study 1 showed that employees’ age, % full-time effort, length of career and staff category are significantly related to their knowledge about security, it is vital to involve everyone in awareness initiatives. Specific attention should be paid to new employees and staff members who only occasionally work at the organisation. In this light, employees who are not formally part of the organisation, such as contractors or consultants, should also be encouraged to participate in security awareness programmes.

Although this article has provided valuable insights into the knowledge–attitude–behaviour relationship regarding physical security, some limitations have to be born in mind when interpreting the results of the two studies. First, employees participated in both studies on a voluntarily basis, which implies that the participants represent a self-selected sample of the targeted population or a non-random selection. Unfortunately, the researchers could not control for the self-selection process of voluntary, online surveys. While the high response rate of Study 1 increases the validity of the study, the much smaller number of participants in Study 2 contributes to a lower generalisability of the research findings. Therefore, it is not known how the participants compare to other employees who did not fill in the questionnaire. Even though previous research showed that self-selection does not necessarily bias the results of surveys used in studies conducted at higher educational institutions (Brown et al., 2014;
Rosenthal & Freyd, 2018), this limitation should be kept in mind. Additionally, the results of both studies may be influenced by socially desirable behaviour. To overcome this limitation, questionnaires were filled in anonymously and the confidentiality of the answers was emphasised at the beginning of the surveys. However, as with most self-reported data, the results may not be a true reflection of the actual security knowledge, attitude and behaviour of employees. Moreover, we can expect that employees who decided to participate in the first study or who engaged in the training session may already have been more interested in security issues at the university than those who did not choose to take part. This implies that caution is needed when generalising these conclusions to the whole staff member population of the university. Furthermore, in both questionnaires, only a limited number of items were included to measure employees’ knowledge, attitude and behaviour. To the authors’ knowledge, no measurement tools for physical security awareness were available at the start of the current study. Therefore, all items had to be created based on the security aspects that were relevant for the university where the study was conducted. For future studies, we suggest the question items for each awareness dimension should be redefined. The items should ideally be adapted to the security policy and procedures of the organisation where the study is conducted.

The current research also has the limitation that the results may only be valid for short-term conclusions. Both studies were conducted on a cross-sectional basis, which implies that it was not possible to explore the long-term effect of employees’ security level of awareness and the impact of the training sessions. In the first study, the questionnaire was distributed over a period of two months. Factors such as criminal incidents at the university or communication about security from the university could have influenced employees’ security knowledge, attitude or self-reported behaviour at the time they filled in the survey. In the second study, the post-test questionnaire was distributed approximately two weeks after the training session. It is possible that participants scored higher on some questions because they remembered what had been discussed during the training. This implies that, for both studies, only short-term conclusions can be made. Further research is needed to examine whether employees’ level of security awareness varies across time, and to what extent training causes a long-term improvement in employees’ awareness. Finally, both the studies discussed in this article were conducted among staff members of a university. While this type of organisation
functioned as an interesting research environment, one should keep in mind the specific contextual features of higher educational institutions. Caution should be exercised when generalising the conclusions of these studies to populations outside of the specific university where they took place. Similar studies conducted in other types of organisations are needed in order to examine whether the organisational culture and context have a substantial impact on the outcomes.

Despite these limitations, the results provide valuable information for security officers of universities, but also other types of organisation. Empirical results on the association between employees’ security knowledge, attitude and behaviour and the efficiency of training programmes in enhancing security awareness were provided. While this study offered a first insight into physical security awareness in a university context, future research is needed in other types of organisations.
5.5. References


Impact of training on security awareness


Impact of training on security awareness


van der Linden, S. (2012, July 3-6). *Understanding and achieving behavioural change: towards a new model for communicating information about climate change* [Paper
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CHAPTER 6

Nudging as a crime prevention strategy: The use of nudges to improve cyclists’ locking behaviour and reduce the opportunities for bicycle theft

As policy makers are developing new alternative strategies to prevent bicycle theft, a nudging approach could provide useful insights in this field. In the current study, two different nudges were implemented at a selection of bicycle parking facilities in the neighbourhood of a Belgian university campus. To measure the effectiveness of the nudges, a multi-method approach was used with a combination of observations (N=3,963) and questionnaires (N=197). The results showed that both nudges had a positive impact on cyclists’ locking behaviour. Based on these findings it can be concluded that nudging can be a rather cheap and easy way to improve secure behaviour. However, concerns such as the limitations of increased awareness on behaviour and the excessive focus on the victim need to be taken into account when implementing nudges in the field of security.

This chapter is based on:

6.1. Introduction

While for a long time safety and security policies have been controlled within the framework of penal law, more recent evolutions show that governments are developing new alternative ways to ensure a safe and secure environment (Schuilenburg & Peeters, 2015). As crime prevention and social control strategies have become more popular, the concept of nudging could provide useful insights in this field. The nudging approach, which stems from the emerging behavioural research domain, suggests that it should be the aim of policy makers to guide people into making the most positive decisions. In this view, policy makers are considered as ‘choice architects’ who regulate the environment in which individuals make decisions (Alemanno, 2012). Nudges have gained widespread recognition through the book ‘Nudge’ (2008) by Richard Thaler and Cass Sunstein, who describe nudging as ‘any aspect of choice architecture that alters behaviour in a predictable way without forbidding alternatives or significantly changing economic incentives’ (Thaler & Sunstein, 2008, p.6).

To be qualified as a nudge, it is indispensable that the intervention fully preserves freedom of choice without using any material incentives or disincentives such as taxes, subsidies or a fine (Sunstein, 2015). This implies that there always has to be an easily available escape clause for the nudged individual. However, the suggested freedom of choice has been criticized extensively. Wertheimer (2014, p.10) indicated that there is never a complete freedom of choice as we ‘always choose from among a limited set of options’. In this light, Hausmann and Welch (2010) suggest broadening the definition of nudges because according to them, rational agents are not only responsive to economic incentives. The authors define nudges as ‘the ways of influencing choice without limiting the choice set or making alternatives appreciably more costly in terms of time, trouble, social sanctions, and so forth’ (Hausmann & Welch, 2010, p.126).

Since the first experiment with nudging, the etching of the image of a black housefly in urinals in the men’s rooms at Schiphol Airport in Amsterdam, proved to be a major success (Thaler & Sunstein, 2008), nudges are frequently used in various domains. Examples can be found in the health sector, where healthy food is placed at eye level in order to nudge people to choose meals low in calories (Thorndike et al., 2012), or in the traffic sector, where the narrowing of
the distance between white stripes on the road nudges drivers to limit their speed (Lindhout & Reniers, 2017).

Two groups of nudges can be identified, reflecting different underlying brain processes: automatic thinking (system 1), which is associated by fast and instinctive processes, and reflective thinking (system 2), which is characterized by deliberate and conscious processes (Hansen & Jespersen, 2013). System 1 nudges have an impact on the automatic thinking or the non-conscious part. Putting food on eye level or narrowing the distance between the stripes on the road are examples of this kind of nudge. System 2 nudges focus on the slow and reflective way of thinking or the conscious processes, such as the alarm that goes off when one is not wearing a seatbelt in the car (Kahneman, 2011; Lindhout & Reniers, 2017; Thaler & Sunstein, 2008). Additionally, seen from the point of view of the person who is nudged, nudges can be transparent or non-transparent. Nudges such as stickers of footprints placed on the ground leading to a sink or garbage bin are transparent as both the nudge itself and the intention behind it are noticeable by the individual. The inclusion of defaults in a registration form for organ donation is a non-transparent nudge as the intention of the means by which the behavioural change is persecuted is not directly noticeable by the person who is nudged (Lindhout & Reniers, 2017).

It can be stated that this nudging approach overlaps with techniques of crime prevention. Reference can be made to Crime Prevention Through Environmental Design (CPTED) approach which has the aim to prevent crime and fear of crime by manipulating the social and physical environment (Cozens et al., 2005). Additionally, nudges can be considered as a form of Situational Crime Prevention (SCP), which has the aim to reduce the opportunities of crime by increasing the risks and difficulties associated with it (Clarke, 1995, 1997). Based on the assumption that criminals weigh their costs and benefits before they act, SCP aims to hardening the target and reducing the rewards of crime by changing the physical environment (Clarke, 1997). Whereas CPTED and SCP are both grounded in the rational choice theory and target a criminal’s ability to make rational choices, nudges are based on the principle that some of the choices that people make are irrational (i.e. not consciously calculated). By manipulating the choice architecture, (system 1) nudges seek to influence the unconscious choices of people. However, (system 2) nudges can also be used to provoke criminals into thinking about the consequences of their decisions before they act. Sharma and Kilgallon Scott
Nudging as a crime prevention strategy

(2015), for instance, suggest that theft from shops might be reduced if retailers displayed signs showing how savings made from reductions in losses due to shop-theft, would be donated directly to charity. Additionally, while it is one of the key principles of the nudging approach to preserve full freedom of choice, some of the most effective situational interventions within the CPTED and SCP frameworks involve the removal of choice (Sidebottom & Tilley, 2017). For instance, the removal of accessible cash boxes on buses in the United States have led to the near disappearance of bus robberies in the 1960s (Chaiken et al., 1974).

In the current study, system 2 nudges are used to provoke cyclists into thinking about the consequences of their decisions. By implementing contextual cues, it is the aim to reduce the number of opportunities for bicycle theft and increase the efforts for criminals. Due to the unavailability of official police statistics, the number of bicycle thefts before and after the nudging experiment is unknown. While these data cannot be included in the evaluation of the nudging approach, changes in cyclists’ preventive locking behaviours will be assessed by carrying out observations. First, an overview of earlier experiments with nudges in the field of security will be provided. Additionally, the methodological approach of the current study will be presented. After the presentation of the results, the most remarkable conclusions are discussed. At the end of the paper, some limitations of the current research and recommendations for future studies will be presented.

6.2. Nudges in the field of security

Although some nudging techniques are already sporadically used in cyber security environments (see Almuhimedi et al., 2015; Balebako et al., 2011; Turland et al., 2015), examples in the field of physical security are scarce. Only a limited number of researchers have carried out experiments to examine whether nudging can be effective in the reduction of criminal offenses or individuals’ fear of crime. A first example can be found in the prevention of crimes occurring around cashpoints. Drawings of coloured boxes on the pavement right before the cashpoint operate to deliver greater distance between the users of the cash points and the pedestrians on the street behind them. This ‘safety spot’ has the aim to increase the privacy of the cash point user and to ensure greater social control. As previous experiments proved to be effective, this type of nudge has already been implemented in some cities in the United Kingdom and the Netherlands (Gamman & Willcocks, 2010; Kuiper et al., 2016).
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In May 2008, the airports of Schiphol and New York started a nudging experiment with biometric data from American and Dutch travellers with a low security risk. Travelers who agreed to participate in this project were screened for extra security risks. In case they were considered safe, they received a chip card with their identity data, fingerprints and iris scan. With this pass travellers could cross the border without any delay due to the interrogation by security guards at the airport. This way, travellers were ‘rewarded’ with speed and ease if they are willing to share some personal data (Romein & Schuilenburg, 2008).

In 2015 the municipality of Hilversum, a town in the Netherlands, rolled out a red carpet with mirrors next to it to reduce crime in the main entertainment street of the city. While the red carpet referred to a high status, the mirrors ensured that passers-by saw a reflection of themselves. The two interventions had the aim to suppress the tendency towards aggressive behaviour. A survey indicated that passers-by felt much more secure after the implementation of the red carpet and the mirrors (Kuiper et al., 2016). In Roermond, another town in the Netherlands, portrait photos were placed behind the benches of the train station and quiet music sounds were provided in the waiting area of regional transport. While the placement of several eyes on the walls had the aim to create the feeling that people are watched, the music offered people a warm and welcome feeling. As a result, individuals unconsciously showed socially desirable behaviour and the train station was perceived as more atmospheric, colourful and secure (Kuiper et al., 2016). In the study of Nettle et al. (2012) posters with watching eyes were placed in bicycle parking facilities to reduce bicycle theft which caused a reduction of 62% of bicycle thefts. Unfortunately, a displacement effect took place as the amount of theft increased at other parking facilities in the neighbourhood by 65%.

In order to prevent vehicle theft in Durham in the United Kingdom, Roach et al. (2017) developed a leaflet campaign to nudge vehicle owners into locking their vehicle when leaving it unattended. Results showed that the number of thefts committed against insecure vehicles in the treatment areas was reduced significantly in comparison with the control areas where no nudges were implemented. In a more recent study, Roach et al. (2020) developed a questionnaire to raise awareness among the residents of the twelve most victimized streets of Durham. It was the second aim of the survey to nudge the residents into reflecting on their preventing behaviour. The experiment led to a decrease in recorded burglaries during and soon after the distribution of the survey. Moreover, the authors indicated that the
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questionnaire had a positive nudging effect on residents’ preventive behaviour regarding burglary.

In the current study, nudges were implemented to improve cyclists’ locking behaviour to reduce the opportunities for bicycle theft. While worldwide bicycles are promoted as an alternative and sustainable way of transport, the widespread use of bikes creates a large number of challenges, not only for traffic safety but also seen from a criminological perspective. An increase in bicycle use raises the opportunities for potential perpetrators of bicycle theft. While over the past years international crime rates show a decrease of criminal offenses, this is not the case for registered bicycle thefts (Swanepoel, 2017). Previous research has shown that the most attractive locations for bicycle thieves are in or around the home, at railway stations and in the neighbourhood of educational institutions (Mercat & Heran, 2003; Nicholas et al., 2005; Zhang et al., 2007). Additionally, it is shown that bicycle theft and the fear of theft could discourage cycle use (Sidebottom et al., 2009). Moreover, the abundance of not properly locked bikes not only facilitates bicycle theft, it also encourages it (Felson & Clarke, 1998).

In this light, Sidebottom et al. (2009) examined the use of targeted publicity to limit the opportunities for offenders of bicycle theft in public bicycle parking facilities. Although not badged so, the targeted publicity approach can be considered as an example of nudging. Stickers with a short advisory tag line and an illustration were placed on cycle parking furniture. At the end of the experiment, the authors concluded that the stickers did have a positive impact on the locking practices of cyclists. Similar to this study, the current research has the aim to examine whether the use of nudges can have an impact on cyclists’ locking behaviours. Different from the study of Sidebottom et al. (2009), the impact of two different nudging interventions will be measured in the neighbourhood of a university campus in Antwerp (Belgium). Additionally, a multi-method approach will be used with a combination of observations and a survey. Focus lies on a measurement of the change in cyclists’ locking behaviours instead of the reduction in the amount of bicycle thefts.
6.3. Methodology

6.3.1. Research design

In the current study, focus lies on the improvement of cyclists’ locking behaviours to reduce the opportunities for crime. A multi-method design was used in which observations and questionnaires are combined. In a first research stage, observations were carried out to examine the impact of the nudges on the locking behaviour of cyclists. In a second stage, a quantitative survey was conducted to verify to what extent a change in locking practices could be attributed to the implementation of the nudges. In order to set up the nudging experiment for this study, the guidance of Lindhout and Reniers (2017) for the development, implementation and evaluation of a safety nudge was used. Based on their literature review, six steps were identified for the design and development of a nudge in practice: (1) assessment of the situation, (2) focus on the individual behaviour, (3) selection of a nudge type, (4) design, construction and pre-test of the nudge, (5) implementation of the nudge and (6) evaluation of the nudge.

6.3.1.1. Assessment of the situation

The most recent Belgian crime statistics show that for several years, the number of bicycle thefts has been around 35,000 offences per year (Federale Politie, 2019). In 2018, 3,672 bicycle thefts were registered in Antwerp, the second largest city of Belgium. The Safety Monitor, a national population survey on various safety and security topics, showed that 17.23% ($n=265$) of respondents ($n=1538$) indicated that they had become a victim of bicycle theft in the city of Antwerp in 2018. Additionally, in the same year 40.44% ($n=74$) of respondents ($n=183$) indicated that they reported bicycle theft to the Police Department (Federale Politie, 2018). National crime statistics show that the total amount of bike thefts is much higher in the vicinity of universities. In the whole city of Antwerp, 6.27 bikes per 1000 inhabitants were stolen in 2018 in comparison to 25.11 bikes per 1000 inhabitants in the vicinity of the university campuses (Lokale Politie Antwerpen, 2019). These findings are similar to conclusions based on international crime statistics where the environment of educational institutions is considered as an attractive location for perpetrators of bicycle theft (Van Dijk et al., 2007). In this light, the bicycle parking facilities in the neighbourhood of a university campus in the city of Antwerp were selected for carrying out the nudging experiment.
6.3.1.2. **Focus on the individual behaviour**

Nudges affect the psychological processes that determine the individual’s automatic or choice behaviour. As this study has the aim to urge cyclists to lock their bike in a secure way, the choice behaviour of individuals has to be influenced. At the moment they park their bicycle, cyclist choose whether they lock it decently or leave the bike behind in an unsecure way. Based on the instructions of the Belgian police department, opportunities for bicycle theft can be reduced by ensuring that bicycles are secured with attaching the frame and (one of) the wheels to the parking furniture. Therefore, it is the aim of this study to stimulate cyclists to make the effort to secure their bike with two locks.

It should be mentioned that while it is the goal of the interventions of the current study to influence cyclists’ decision process, the nudges cannot have any impact on situational factors. For instance, it is possible that a student, who has noticed the nudge, needs to be on time in class to follow a course and decides to leave their bike unsecured in a rush. In another situation, it is possible that there are no available parking spots left which hinders cyclists to lock their bike to the bicycle stand. In order to obtain a more clear view on the impact of situational factors in this study, the nudges will be evaluated by making use of a multi-method approach (see 6.3.1.6.).

6.3.1.3. **Selection of a nudge type**

In the current study, the nudges have to stimulate the ‘system 2’ or reflective behaviour of individuals as it is the aim to make cyclists aware of the potential risks of leaving their bike in an unsecure way in order to stimulate them to improve their locking behaviour. One strategy to guide behaviour in a certain direction can be found in theories and research about normative social norms (Cialdini, 2003). Although there exists little research involving the use of social norms to promote more secure behaviour, their ability to stimulate human behaviour has been demonstrated in other contexts (Aldrovandi et al., 2015; Lehner et al., 2016). Recent literature has distinguished two different types of social norms: injunctive norms, which involves the individuals’ perceptions of which behaviours are approved or disapproved, and descriptive norms, involving the individuals’ perceptions of which behaviours are typically performed (Loschelder, 2019). Previous research showed that both kinds of norms motivate human behaviour as people tend to do what is socially approved as well as what is popular.
(Dolan et al., 2012; Lindhout & Reniers, 2017; Ponnet et al., 2015). As a consequence, a combination of injunctive (intervention 1) and descriptive (intervention 2) norms may be the most effective way to induce normative behaviour (Cialdini, 2003).

6.3.1.4. Design, construction and pre-test of the nudge

For the first intervention, a nudge including an injunctive social norm was developed (see Figure 6.1). With a very clear and transparent visual sign of both a poorly secured and a good secured bicycle, cyclists were informed about the expected norm of their locking behaviour. A green satisfied smiley emoticon was placed next to the secured bike to show that this behaviour is approved. A red unsatisfied smiley emoticon was added next to the poorly secured bicycle to disapprove this behaviour. In order to make the nudge more transparent, the slogan (in Dutch and English) ‘Lock your bike twice… and don’t suffer from theft’ was added next to the images of the bicycles.

![Figure 6.1. The first nudging intervention (110x45mm).](image1)

A descriptive social norm was included in the second nudge (see Figure 6.2). The same visual sign of a good secured bicycle, which was used in the first nudge, was developed in a larger format. Additionally, the message (in Dutch and English) that ‘80% of students of University [name blinded for review purposes] fix wheel and frame… to prevent theft’ was placed above and beneath the image in order to influence their perception of which behaviour is typically performed by other cyclists.

![Figure 6.2. The second nudging intervention (297x210mm).](image2)
While the first intervention involved a sticker, the second nudge was presented in the form of a poster. Both were developed in a format that could easily be attached to the bicycle parking furniture. For the sticker and the poster, three possible designs were developed and presented to a panel of researchers, students and staff members of the university. In total, 21 respondents were asked to draw up a ranking of the six designs, based on three criteria: (1) the design of the sticker and poster, (2) the clarity of the message and (3) the perceived effect of the included social norm. Based on their ranking, two designs were selected and printed on stickers and posters.

6.3.1.5. **Implementation of the nudge**

After the development of the two nudges, the stickers and posters were attached in the bicycle parking facilities (see Figure 6.3). In order to select the bicycle parking locations, a couple of choices had to be made. First, based on the crime statistics, it became clear that the environment of educational institutions is a very attractive location for perpetrators of bicycle theft. This means that only bicycle parking facilities in the close neighbourhood of the campus were selected. Secondly, based on the differences in infrastructure of these parking facilities, a selection was made of parking spots that only contained bicycle stands between each bicycle. This criterion was necessary to attach the stickers. In total, six bicycle parking facilities were selected. The maximum capacity of the parking facilities varied between 86 and 164 bikes. All parking locations are public, which implies that they are accessible to students and staff members of the university, but also for external people such as inhabitants of Antwerp or tourists. Thirdly, the selected bicycle parking locations were randomly split up in three control sites and three treatment sites. The maximum number of parking options per site was taken into account when randomizing the parking facilities. It was the aim to create two groups that consisted of, to the extent possible, an equal number of available parking spots.
Figure 6.3. Example of the implementation of the sticker and poster at treatment site.

As the timeline of the experiment indicates (see Figure 6.4), no stickers or posters were attached in the parking facilities belonging to the control group. At the treatment sites, no nudges were implemented in the first four weeks. In the fifth week, the stickers were attached to every bicycle stand between two bikes, which made it very easy for cyclists to read the message when they parked their bike. In the ninth week, the stickers remained and posters were attached to the walls or railing of the parking infrastructure. Depending on the surface of each bicycle parking, minimum three and maximum eight posters were attached.

Figure 6.4. Chronological timeline of the experiment at treatment (n=3) and control (n=3) sites.

6.3.1.6. Evaluation of the nudge

Similar to the research of Sidebottom et al. (2009), weekly observations were carried out in order to observe the locking practices of cyclists (N=3,963) at both treatment (n=2,271) and control (n=1,692) sites. In total, an average number of 329 bicycles were observed each week. This made it possible to examine whether cyclists improved their locking practices before and after each intervention at the treatment sites. Importantly, the observations were carried out in a way that the observers attempted to remain unnoticed in order to minimize the impact
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of their presence on the behaviour of cyclists. During the experiment, three researchers operated as observers and registered cyclists’ locking practices. By making use of a rotation system, at each observation moment two of three observers were responsible for the registration of bicycles. During 12 weeks, observations were carried out one day a week and two times a day, starting between 9.00 am and 10.00 am in the morning and between 3.00 pm and 4.00 pm in the afternoon. Before the experiment started, different observations days were picked randomly, which means that, for instance, observations took place on Monday in the first week and on Wednesday in the second week. All observations were carried out before the outbreak of the COVID-19 pandemic. Moreover, during the 12 weeks of observations there were no holiday periods or other interruptions in students’ class schedules. Each researcher was assigned the same three parking facilities in the morning and the afternoon. At the first observation moment, the three observers registered all the bicycles at the six parking spots together in order to adjust the observation criteria and to minimize observer bias.

In order to register the observations as uniform as possible, the researchers used a standardized observation sheet to categorize the locking practices according to three criteria:

- **Good**: The use of two locks; or the frame and one (or both) wheels are attached to the bicycle stand.

- **Acceptable**: The use of a single lock; or the frame or one wheel are attached to the bicycle stand.

- **Poor**: The use of no lock or a single lock; neither the frame, nor one wheel are attached to the bicycle stand.

In order to decide whether or not an improvement in cyclists’ locking practices took place, the researchers decided that at least one out of three criteria had to be fulfilled: (1) an increase in good locking practices, (2) an increase in acceptable locking practices and/or (3) a decrease in poor locking practices.

Besides the locking practices, seven other characteristics of the bicycles were registered on the observation sheet: (1) whether it is a male or female bike, (2) the brand of the bike, (3) the colour of the bike, (4) the colour of the lock, (5) whether the bike has bicycle bags, (6)
whether the bike is marked and (7) other remarkable characteristics, such as the presence of a child’s seat or a remarkable colour of the saddle. The inclusion of these extra categories made it possible to identify duplicate observations as counting the same bike would distort the results and would lead to the wrong conclusions. Therefore, registered bicycles with exactly the same characteristics were removed out of the data collection. For instance, if a particular bike was poorly locked in the morning and the bike is still there in the afternoon, only the first registration was retained. Additionally, observers were instructed to leave clearly abandoned bicycles out of the data collection.

In order to find out whether a possible change in behaviour was caused by the interventions or whether or not other factors had an impact on the behaviour of cyclists a survey was carried out. Two days after the last observations took place in the 12th week of the experiment, five researchers orally questioned arriving and departing cyclists at the six bicycle parking facilities. Two very similar surveys were developed, one directed to cyclists who used the bicycle parking facilities on the control site, and one directed to cyclists who used one of the treatment sites to park their bike. In order to not disturb the cyclists before or after they went to class or work, the surveys were very short.

6.4. Results

6.4.1. Observations

Figure 6.5 presents an overview of the locking practices at both the control and treatment sites before and after the two interventions took place. Based on the results, it can be noticed that in the baseline condition, locking practices at both control and treatment site are quite similar: around 30% of cyclists locked their bicycle in a poor way, around 30% in an acceptable way and around 40% in a good way. After the first intervention, a small increase in good locking practices of 4.1% and a small decrease of acceptable locking practices of 3.8% at the control sites can be noticed. For the poor locking practices, the results remain almost the same. At the treatment sites, a decrease in poor and acceptable locking practices of respectively 6.4% and 3.8% can be noticed. This decrease is accompanied with a large increase of 10.2% in good locking practices. After the second intervention, the locking practices at the control sites are quite similar with the baseline condition. At the treatment sites, a further
increase of 2.8% in acceptable locking behaviour can be noticed after the second intervention, compared with the first intervention.

Figure 6.5. Overview of the locking practices at control and treatment sites at baseline condition, after the first intervention and after the second intervention ($N=3,963$).

In order to measure the impact of the nudges on the locking behaviour of cyclists, a Pearson chi-square test was used. In order to know which specific categories differ significantly from each other, partitioned Pearson chi-square tests were carried out.

When comparing cyclists’ behaviour at control and treatment sites in the baseline condition, the Pearson chi-square test showed that there were no significant differences in locking practices ($\chi^2(2)=0.274, p=0.872$). After the first intervention, no significant differences were found in poor, acceptable or good locking practices at the control sites ($\chi^2(2)=2.396, p=0.302$). At the treatment sites, significant differences were observed in locking practices after the attachment of the stickers ($\chi^2(2)=15.928, p<0.001$). A partitioned Pearson chi-square test (see Table 6.1) showed a significant increase in good locking practices compared to poor locking practices ($p<0.001$). Additionally, a significant decrease was observed in acceptable locking behaviour compared to good locking behaviour ($p=0.004$). Poor locking practices were found to be less frequent compared to acceptable locking behaviour, but non-significant before and after the implementation of the first nudge ($p=0.484$).
Table 6.1. Partitioned Pearson chi-square comparisons of locking practices in the baseline condition and after the first intervention at the treatment sites.

<table>
<thead>
<tr>
<th></th>
<th>Baseline condition</th>
<th>First intervention</th>
<th>Total n</th>
<th>$X^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>49.8</td>
<td>47.3</td>
<td>841</td>
<td>.490</td>
<td>.484</td>
</tr>
<tr>
<td>Acceptable</td>
<td>50.2</td>
<td>52.7</td>
<td>841</td>
<td>8.432</td>
<td>.004*</td>
</tr>
<tr>
<td>Acceptable</td>
<td>43.0</td>
<td>34.4</td>
<td>1089</td>
<td>8.432</td>
<td>.004*</td>
</tr>
<tr>
<td>Good</td>
<td>57.0</td>
<td>65.6</td>
<td>1089</td>
<td>13.124</td>
<td>&lt;.001**</td>
</tr>
<tr>
<td>Poor</td>
<td>42.8</td>
<td>32.0</td>
<td>1079</td>
<td>13.124</td>
<td>&lt;.001**</td>
</tr>
</tbody>
</table>

*p < 0.01, **p < 0.001

After the second intervention, a Pearson chi-square test showed non-significant increases in poor and acceptable locking behaviour and a non-significant decrease in good locking behaviour at the control sites ($\chi^2(2)=1.394, p=0.498$). At the treatment sites, also only non-significant changes were observed as poor and good locking conditions decreased and acceptable locking behaviours were more frequent ($\chi^2(2)=2.083, p=0.353$).

When comparing the locking behaviours of the baseline condition with these of the period after the second intervention, no significant changes were found at the control sites in poor, acceptable and good practices ($\chi^2(2)=0.186, p=0.911$). At the treatment sites, significant changes in cyclists’ locking behaviour were observed ($\chi^2(2)=21.578, p<0.001$). A partitioned chi-square test (see Table 6.2) showed a significant decrease in poor locking practices in comparison to acceptable locking practices ($p=0.018$), while a significant increase was found in good locking behaviour compared to poor locking behaviour ($p<0.001$). Additionally, a significant decrease in acceptable locking practices was observed in comparison with good locking practices ($p=0.030$).
Table 6.2. Pearson chi-square comparisons of locking practices in the baseline condition and after the second intervention at the treatment sites.

<table>
<thead>
<tr>
<th></th>
<th>Baseline condition</th>
<th>Second intervention</th>
<th>Total</th>
<th>$X^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>n</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Poor</strong></td>
<td>49.8</td>
<td>41.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acceptable</strong></td>
<td>50.2</td>
<td>58.1</td>
<td>906</td>
<td>5.577</td>
<td>.018*</td>
</tr>
<tr>
<td><strong>Acceptable</strong></td>
<td>43.0</td>
<td>36.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Good</strong></td>
<td>57.0</td>
<td>63.1</td>
<td>1214</td>
<td>4.702</td>
<td>.030*</td>
</tr>
<tr>
<td><strong>Good</strong></td>
<td>57.2</td>
<td>70.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Poor</strong></td>
<td>42.8</td>
<td>29.6</td>
<td>1150</td>
<td>21.367</td>
<td>&lt;.001**</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.001

At the end of the experiment, significant differences were found between cyclists’ locking behaviour at the control and treatment sites ($\chi^2(2)=16.018, p<0.001$). A partitioned chi-square test (see Table 6.3) showed that significantly less poor locking practices in comparison to acceptable locking behaviour was observed at the treatment sites ($p=0.043$). Additionally, more good locking practices in comparison to poor locking practices were found at the treatment sites ($p<0.001$). Finally, at the control sites, more acceptable locked bikes in comparison to good locked bikes were observed. The differences between the control sites and treatment sites were, however, non-significant ($p=0.061$).

Table 6.3. Differences in locking practices at the control and treatment sites after the second intervention.

<table>
<thead>
<tr>
<th></th>
<th>Control sites</th>
<th>Treatment sites</th>
<th>Total</th>
<th>$X^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>n</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Poor</strong></td>
<td>49.3</td>
<td>41.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acceptable</strong></td>
<td>50.7</td>
<td>58.1</td>
<td>739</td>
<td>4.092</td>
<td>0.043*</td>
</tr>
<tr>
<td><strong>Acceptable</strong></td>
<td>42.7</td>
<td>36.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Good</strong></td>
<td>57.3</td>
<td>63.1</td>
<td>1026</td>
<td>3.523</td>
<td>.061</td>
</tr>
<tr>
<td><strong>Good</strong></td>
<td>58.0</td>
<td>70.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Poor</strong></td>
<td>42.0</td>
<td>29.6</td>
<td>959</td>
<td>15.874</td>
<td>&lt;.001**</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.001
6.4.2. Survey

6.4.2.1. Demographic characteristics of respondents

In total, 197 cyclists were surveyed at the bicycle parking facilities at the control and treatment sites. Table 6.4 shows the demographic characteristics of the respondents at both sites.

Table 6.4. Overview of demographic characteristics of respondents at treatment \( (n=139) \) and control sites \( (n=58) \).

<table>
<thead>
<tr>
<th></th>
<th>Treatment sites</th>
<th>Control sites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number (%)</td>
<td>Number (%)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Man</td>
<td>66 (47.5)</td>
<td>30 (51.7)</td>
</tr>
<tr>
<td>Women</td>
<td>70 (50.4)</td>
<td>28 (48.3)</td>
</tr>
<tr>
<td>Missing</td>
<td>3 (2.2)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>20 (14.4)</td>
<td>10 (17.2)</td>
</tr>
<tr>
<td>20-29</td>
<td>84 (60.4)</td>
<td>30 (51.7)</td>
</tr>
<tr>
<td>30-39</td>
<td>16 (11.5)</td>
<td>6 (10.3)</td>
</tr>
<tr>
<td>40-49</td>
<td>10 (7.2)</td>
<td>6 (10.3)</td>
</tr>
<tr>
<td>&gt;49</td>
<td>9 (6.5)</td>
<td>6 (10.3)</td>
</tr>
<tr>
<td><strong>Position</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>112 (80.6)</td>
<td>34 (58.6)</td>
</tr>
<tr>
<td>Staff member</td>
<td>18 (12.9)</td>
<td>18 (31.0)</td>
</tr>
<tr>
<td>External</td>
<td>9 (6.5)</td>
<td>6 (10.3)</td>
</tr>
</tbody>
</table>

6.4.2.2. Awareness and effectiveness of nudges at treatment sites

At the treatment sites, 77.7% of cyclists \( (n=108) \) indicated that they had noticed the sticker, while 59% of cyclists \( (n=82) \) indicated to be aware of the poster, and 84.9% \( (n=118) \) had noticed the sticker and/or the poster. Remarkably, while many people at the treatment sites were aware of the interventions, only 11.5% \( (n=14) \) of them indicated that the sticker had an impact on their locking practices in the last couple of months, and only 7.2% of cyclists \( (n=9) \) confirmed that their improvement in locking practices is due to the second intervention or poster. 8.6% \( (n=12) \) gave other explanations for an improvement in their locking practices. An earlier experience with theft \( (n=4) \) and the risk of the public character of the bicycle parking \( (n=3) \) were the most common reasons.
6.4.2.3. **Awareness and effectiveness of nudges at control sites**

At the control sites, cyclists were asked if they ever park their bike at other parking locations in the neighbourhood of the university. If they confirmed, they were asked whether they had noticed stickers or posters at one of the locations of the treatment group. In total, 60.4% cyclists (\(n=35\)) indicated that they sometimes park their bike at another location. 22.4% of them (\(n=13\)) did park their bike in the last couple of months at one of the treatment sites. Eight of them had noticed the sticker and two of them had noticed the poster. Additionally, four individuals indicated that they had noticed the sticker without parking their bike at one of the parking facilities of the treatment group. We could observe a significant difference between cyclists' awareness of stickers or posters and their locking practices (\(p=0.031\)), which implies that cyclists who indicated to be aware of the nudges locked their bike in a more secure way. Of the 14 individuals that noticed the sticker and/or poster, only one individual confirmed that the sticker had an effect on his/her locking practices. The other 13 cyclists gave other explanations, such as an earlier experience with theft (\(n=9\)) or theft warnings by their parents (\(n=2\)).

**6.5. Discussion**

6.5.1. **The relationship between awareness and conscious behaviour**

The nudging interventions of the current study had the aim to improve cyclists' locking practices and therefore to reduce the opportunities for bicycle theft. By developing a sticker and poster, cyclists were stimulated to think consciously about their locking practices and the potential risk of bicycle theft. After the first intervention, the observations showed an improvement in locking practices as significantly more cyclists locked their bike in a good way after implementing the stickers. Based on the results of the survey it became clear that almost 80% of cyclists indicated that they had noticed the stickers at the treatment sites. Remarkably, only 12% of them confirmed that the sticker had an impact on their behaviour, while almost 9% indicated that other factors influenced their locking practices.

Although it was the aim of the nudges to influence the conscious and reflective thinking of cyclists, these findings suggest that almost 80% of cyclists who noticed the sticker, changed their locking behaviour apart from the intervention or other factors. An explanation could be that the cyclists improved their locking practices in an unconscious way. This would imply that
the stickers served more as a system 1 nudge, which influences the automatic thinking of people, instead of a system 2 nudge, which aims to impact the reflective decision process. Following this explanation, cyclists unconsciously could have paid more attention their locking practices after they noticed the first intervention. As the results of the current study cannot confirm whether these assumptions are correct, further research is needed.

6.5.2. More awareness does not directly lead to better behaviour for everyone

At the beginning of the experiment, it was expected that an increase in awareness would cause a change in behaviour. Based on the results of the survey, almost 85% of cyclists indicated that they were aware of one or both interventions. While the results show that the nudges led to a significant improvement in good locking practices, almost 20% of cyclists still locked their bike in a poor way at the end of the experiment. This finding may support the findings of other studies that an increase in the awareness of individuals does not always lead to a change in behaviour for everyone. For instance, Reniers et al. (2014) concluded in their study that lab safety interventions within higher educational chemical labs did change the safety knowledge of students but did not change student’s safety behaviour. Kempton et al. (1995) examined the relationship between the awareness of environmental issues and pro-environmental behaviour and concluded that environmental knowledge is not a prerequisite for behaving in a good environmental way. Yet, the majority of the existing policy tools for changing rational behaviour are often guided by the assumption that availability of information is needed to make rational choices.

According to Sidebottom et al. (2009) the distinction between an improvement in awareness and behaviour is caused by an ‘incubation period’, or a sort of acclimatization time for people to adapt to the changes in the environment. For instance, if cyclists decide at a certain moment to change their behaviour, it is possible that they still have to buy an extra lock or take other precautions. In the current study, it was not possible to examine the effect of the incubation period as the experiment was only limited to 12 weeks. Previous research on the long-term effects of nudging provides mixed evidence (see Dupas, 2012; Gneezy et al., 2011). Therefore, more research is needed to examine whether it is suggested that policy makers make use of nudges as a long-term intervention tool (Marchiori et al., 2016).
6.5.3. Careful with blaming the victim

In contrast to the study of Nettle et al. (2012), the interventions in this study did not focus on perpetrators but on the responsibility of potential victims of bicycle theft. The nudges had the aim to empower cyclists by providing them with information about the risk on bicycle theft and a possible way to avoid this risk. In previous research, these victim-oriented strategies have received some criticism. In the most extreme example women are considered responsible for rape for wearing short skirts or other ‘sexually provocative’ clothing. However, in other situations people are happy to receive some advice about possible ways to minimalize their risk on crime. For example, informing car owners that it is best to park their vehicle in their garage at night could reduce the risk of vehicle crime by twenty-fold. Based on this information, they can decide for themselves whether the risk is worth the effort of parking the car in the garage (Clarke & Mayhew, 1998).

Additionally, providing information to potential victims could unintentionally cause some side-effects, such as increased fear of crime. Depending on the used strategy, preventive communication can result in inflated estimates of victimization risk or a strengthening of the perceived negative impact of victimization (Winkel, 1991). However, in the study of Davis and Smith (1994), the authors found that encouraging people to take responsibility for their own security did not lead to higher levels of fear of crime (Davis & Smith, 1994). Winkel (1991) concluded that an adaptation of the communication strategy to the target population can control these negative side-effects. According to Barthe (2006), information given to potential victims should always be complemented by initiatives by the police or government. Publicity campaigns proved only to be successful in the context of a broader response to the problem. In this light, it can be useful for this experiment to combine the nudging techniques that focus on the responsibility of the potential victims with security measures that improve the bicycle parking facilities or discourage perpetrators. In this way, the responsibility is shared between the potential victim and the law enforcement institutions.

6.5.4. Limitations and further research

As this study was not carried out in a laboratory but in a natural setting, there are some limitations to the research design, which can create opportunities for future research. First, the presence of observers at the busiest hours of the day may have caused an impact on the
locking behaviour of cyclists. Although the observers received the instructions that they had to stay on the background, it is still possible that cyclists were aware that their behaviour was observed and that they locked their bicycle in a better way. Especially at the treatment sites, where stickers and posters were attached, the combination of these interventions with the presence of the observers could have led to a change in behaviour.

Secondly, the locations of the bicycle parking facilities may have caused a contamination on the effect of the interventions. As all parking facilities were located in the same neighbourhood, they are within walking distance of each other. This means that it could be possible that cyclists who normally park their bike at one of the control sites, for once choose to store it at a treatment site and noticed the interventions. These cyclists could have experienced an effect of the nudges and therefore decided to lock their bicycle in a better way. In order to examine the impact of this limitation on the results, a survey was carried out at the end of the experiment. Based on the answers of the respondents, it became clear that only a very small number of cyclists at the control locations had noticed the interventions on the treatment sites. It should be interesting for further research to select parking facilities spread over a whole city or region in order to eliminate the contamination. In case of the university context, it could be interesting to include parking facilities of different campuses or universities in the experiment.

Thirdly, a major limitation of this research is the limited time frame. As the experiment only lasted for 12 weeks, it was not possible to examine the long-term effect of both interventions. For future research, it should be interesting to test the nudges over a longer period. This way, some interesting hypotheses could be framed which could explore what nudges may and may not be able to do. For example, one conjecture could be that nudges are good for altering behaviour of the moment (although not changing longer-term habits or reasoning). Another could be that nudging is educative and leads those nudged to change their longer-term intentional behaviour in the preferred direction. A third could be that novelty nudges are noticed at first and then lose their saliency over time. Each would lead to rather different outcome patterns, but an experiment on long term would need to be designed to allow those outcome patterns to emerge (or not to do so).
Fourthly, based on this study it was not possible to ascertain the impact size of the second intervention on itself. As the attachment of posters took place four weeks after the stickers were applied, only the impact of the first intervention and the effect of both interventions together could be measured. Based on the results, it can be concluded that the impact of the posters was smaller than the influence of the stickers. However, in this study it was not possible to find out whether the poster on itself did have little impact on the cyclists’ behaviour or whether it can be assumed that one intervention is more effective than a combination of two nudges. Therefore, it should be interesting for further research to focus on the effectiveness of this second intervention on itself.

Finally, it was not possible to examine whether the interventions caused a reduction in bicycle theft at the parking facilities that were included in the experiment. Due to the unavailability of official crime statistics for this specific neighbourhood of the university, the number of bicycle thefts before and after the experiment is unknown. This also means that it was not possible to examine whether the interventions caused a displacement effect. Previous research on place-based crime prevention strategies has raised concerns that the interventions displace the offences to other places (Gabor, 1990). In about 25 per cent of evaluation studies on place-based security measures, a displacement effect was found (Guerette & Bowers, 2009). Also Nettle et al. (2012) concluded in their study that a reduction of bicycle thefts in the parking facilities that were included in the experiment caused an increase of crime in bicycle facilities on other locations.

Furthermore, earlier experiments with crime prevention techniques have shown that besides displacement also diffusion can be an effect of the intervention. Diffusion can be seen as the reverse of displacement and occurs ‘when reductions of crime (or other improvements) are achieved in areas that are close to crime-prevention interventions, even though those areas were not actually targeted by the intervention itself’ (Guerette & Bowers, 2009, p. 1334). Diffusion effects have been found in several crime prevention studies in the past (Bowers & Johnson, 2003; Weisburd & Green, 1995; Weisburd et al., 2006). Therefore, when interpreting the results of this study, it is important to keep these limitations in mind.
6.6. Conclusion

This study had the aim to examine whether nudging could be useful as a crime prevention strategy. To figure out whether the nudging approach could have an impact, an experiment was carried out where nudges were used to reduce bicycle theft at public parking facilities in a university neighbourhood. Based on the results, it can be concluded that the nudges led to a significant improvement in cyclists' locking behaviour. The first intervention caused a large and significant improvement at the treatment sites. The second intervention led to a further, but smaller and non-significant, improvement. Meanwhile, the locking practices at the control sites remained the same during the whole experiment. This means that a combination of both nudges had an effect on the behaviour of cyclists. These conclusions confirm the results of the study of Sidebottom et al. (2009) where the attachment of stickers with a similar message caused a significant improvement of cyclists’ locking practices. Based on these findings, it can be concluded that nudging can be a rather cheap and easy way to improve secure behaviour. However, as pointed out in the discussion, it is important to keep in mind the limitations of increased awareness on behaviour and an excessive focus on victims of crime.
6.7. References


Nettle, D., Nott, K., & Bateson, M. (2012). ‘Cycle thieves, we are watching you’: Impact of a simple signage intervention against bicycle theft. PloS one, 7(12), e51738.
Nudging as a crime prevention strategy


Nudging as a crime prevention strategy


Unravelling college students’ fear of crime: The role of perceived social disorder and physical disorder on campus

The current study explores the role of individual and environmental determinants on students’ fear of crime. Based on a large-scale survey among students of a Belgian university (N=1,463), the relationship between perceived social and physical disorder and the three dimensions of fear of crime (perceived risk of victimization, feelings of anxiety, avoidance behaviour) is examined. Support was found for a relationship between perceived social and physical disorder and perceived risk of victimization. Moreover, a relationship was found between students’ perception of social disorder and anxiety and students’ perception of physical disorder and avoidance behaviour. Based on the results, this study suggests that preventing or reducing visible signs of disorder on campus should inevitably be included in the university’s security policy. This research offers universities more insight in the determinants of students’ fear of crime and potential measures to increase their (perception of) security.

This chapter is based on:

7.1. Introduction

While campuses are often seen as environments that are immune for crime, previous studies (Jennings et al., 2007; Paulson & Sherer 2007; Woolnough, 2009) evoke questions about this status of a safe haven. Research has shown that crimes such as vandalism, physical violence or sexually undesirable behaviour are prevalent in higher educational institutions. The high student population, the prevailing freedom, lack of guardians and homogenous nature of the campus setting create an environment with opportunities for crime to occur (Petherick, 2000). Moreover, the open structure of university campuses and the easy access through public roads may contribute to the perception of risk (Gomme & Micucci 1997; Rasmussen & Johnson 2008). Although empirical data suggest that college campuses are more secure than the communities in which they are located (Baum & Klaus 2005; Hart, 2003; Shariati & Guerette 2019), students may feel vulnerable and at risk for being victimized.

In the past decades, authors focused on students’ perceptions on their risk of victimization by referring to the concept ‘fear of crime’ (Bohmer & Parrot, 1993; Brown & Andy, 2007). Recent findings show that approximately one-quarter of students reported to experience fear of crime on campus (Maier & DePrince, 2019; Robinson & Roh, 2013; Sani et al., 2020). Fear of crime can be considered as a complex phenomenon that can be influenced by different variables. In a campus environment, numerous studies have shown that students’ individual characteristics, such as gender, age or nationality, may strengthen or reduce fear of crime (May & Dunaway 2000; Tomsich et al., 2011; Williams & Konrad, 2004). Moreover, earlier experiences with victimization could make students more fearful (Lee & Hilinski-Rosick, 2012; Maier & DePrince, 2019). To date, limited efforts have been applied to understanding the influence of environmental features of campuses on students’ fear (Hibdon et al., 2016). Research conducted in other contexts, for instance in communities and neighbourhoods, suggest that environmental cues, such as the presence of disorder, can have a significant impact on individuals’ fear of crime (Franklin et al., 2008; Hardyns et al., 2019). Studies indicate that certain areas can send signals that can cause people to develop feelings of anxiety (Scarborough et al., 2010; Steinmetz & Austin, 2013). Many environmental dynamics that generate fear of crime in community contexts, may also occur on campus. Scholars state that college campuses can be considered similar to communities as they have three components in common: a fixed geographic location, common ties among students, faculty
and other people and many social interactions (Mansour & Sloan, 1992; Poplin, 1972; Sloan et al., 1996). Still, a campus may also have characteristics that are not typically found in a community, which could reduce students’ fear of crime. However, because of the limited research on the influence of perceived disorder on fear of crime in a campus setting, the specifics of fear generating processes on campus are uncertain (Sloan et al., 1996).

An overview of the literature shows that most studies on fear of crime on campus were conducted among American college students. While there exists a large body of scientific research on topics such as the prevalence of sexual assault (Klein & Martin, 2019), the impact of school shootings (Kaminski et al., 2010) and the effect of security legislation (Janosik & Gering, 2003) on American campuses, caution is needed to extrapolated the conclusions of these studies to European universities (Sani et al., 2020). Contrary to European universities, campuses in American countries are characterized by large populations of students living on campus and spending their free time on campus (e.g. in fraternities and sororities, campus gyms, campus restaurants) (Huesman et al., 2009). Moreover, empirical evidence shows that there are differences in victimization rates between American and European countries. For instance, a comparative study of Fisher and Wilkes (2003) showed that English college students reported slightly higher rates of victimization (37.5%) compared to American students (36.1%).

Therefore, the current research has the aim to fill a gap in the literature by examining the role of perceived social and physical disorder on students’ fear of crime on campus in a non-American context. By conducting a large-scale survey among students of a Belgian university, a better understanding of the influence of environmental cues on students’ risk perception, feelings of anxiety and avoidance behaviour will be provided. Based on the results of this study, suggestions for universities to reduce students’ fear of crime will be provided.

### 7.2. Fear of crime on campus: a literature review

Campuses are public spaces where students and staff members are studying, working and living close to each other. The daily campus activities create an environment where many people function in a close proximity to criminal offenders (Robinson & Mullen, 2001). While security can decrease the risks of becoming a victim, it is almost impossible to monitor all
individuals working or visiting the campus. This implies that it is realistic that students become victimized or report higher levels of fear of crime (Paulson & Scherer, 2007).

In previous research, authors often measured fear of crime by referring to the emotional aspects of individuals’ feelings of anxiety. In this light, the question ‘How safe do you feel or would you feel being alone in your neighbourhood at night?’ and a parallel question for ‘during the day?’ have long served as the standard measurement method. Criminologists Ferraro and LaGrange (1987) were one of the first researchers who criticized this narrow view and emphasized on a multidimensional approach. Since the remarkable publication of the authors, three main dimensions of fear of crime are distinguished: a cognitive dimension, or the risk perception of crime victimization; an affective or emotional dimension, or the experienced fear of more general feelings of, or concerns about security; and an expressive dimension, or the behavioural attitudes or measures taken in response to feelings of fear (Hardyns & Pauwels, 2010).

With perceived risk, authors refer to the individual’s perception of the likelihood that they will become a victim of a crime (Rader et al. 2007). Numerous studies found a one-way relationship between risk perception and feelings of anxiety (Ferraro & LaGrange 1987; Warr & Stafford, 1983). Ferraro (1995) even argued that perceived risk can be considered as the strongest predictor of anxiety. Regarding the campus environment, a majority of studies, which were conducted among students of American universities and colleges, suggest that a difference can be made between perceived risk during the day and at night. For instance, Tomsich et al. (2011) concluded that students’ perceived risk of victimization at night was almost double of their perceived risk during the day. Moreover, gender differences have been found. Jennings et al. (2007) concluded that females perceived higher levels of risk compared to males. Fisher and Sloan (2003) also found higher levels of perceived risk for female students, both during the day and at night. Other studies provide evidence that gender differences in perceived risk are dependent on the type of crime. For instance, Reid and Konrad (2004) found that women had lower levels of perceived risk for robbery than men but showed higher levels of perceived risks for sexual assault and burglary.

As a continuation of the growing research on perceived risk and feelings of anxiety on campuses, authors began to examine the behavioural changes originating from these feelings
Unravelling college students’ fear of crime

(Hibdon 2016). With constrained behaviour researchers refer to behavioural adaptations that individuals make when they have the perception that there is a possibility of crime and they want to reduce the victimization risk. These constrained behaviours include avoidance behaviours (e.g., avoiding certain areas or classes in the evening) and defensive (or protective) behaviours (e.g., carrying keys in case of self-defence or asking someone to walk with you) (Ferraro & LaGrange, 1987). Studies have shown that students who express high levels of fear report more avoidance and defensive behaviours (Wilcox et al., 2007; Woolnough, 2009). For instance, Tewksbury and Mustaine (2003) found that 22% of American students indicated that they carry a mace for self-protection while 17% reported to carry a gun to the university. McCreedy and Dennis (1996) concluded that 27% of students of East Carolina University (United States) avoid following classes after dark because of their feelings of anxiety. Prior studies have indicated that women tend to report engaging in higher levels of avoidance behaviour, while men are more likely to engage in defensive behaviours (Jennings et al., 2007; May et al., 2010; McCormick et al., 1996).

7.2.1. Individual factors

As previous research indicated, individual characteristics can contribute to the experienced level of fear (Schreck and Miller 2003). Numerous authors emphasize on age and gender differences in fear of crime, both in the general population and among university students (Fisher, 1995; Jennings et al., 2007; Woolnough, 2009). Studies have shown that people who are less able to protect themselves from crime, such as female or younger students, experience higher levels of fear since they consider themselves as more vulnerable to become a victim (Alvarez & Bachman, 1997; McDevitt & Panniello, 2005; Schreck & Miller, 2003). Fox et al. (2009) found that female students at a south-eastern American university experienced more fear of crime at the campus in comparison to male students. Fisher and Sloan (2003) considered gender as the strongest predictor of fear of crime and found that women reported higher levels of fear on another American campus.

Additionally, previous studies showed that younger college students express more fear of crime than older peers (Fisher & Sloan, 2003; Kaminski et al., 2010). Patton and Gregory (2014) found that younger students, those from 18–24 years of age, generally felt more secure while on campus than did their older counterparts. Kaminski et al. (2010) concluded that after the
Virginia Tech and Northern Illinois University shootings, younger students indicated to be more fearful of crime on campus (Kaminski et al., 2010). May and Dunaway (2000) focused on the grade level of students instead of their age and also found that grade level is inversely related to fear. Hibdon et al. (2016) explain these differences due to the fact that younger students may be more afraid of crime because they have been on campus for a shorter duration of time and are less familiar with the campus environment.

Furthermore, studies have shown that experiences with previous victimization can increase the level of students’ fear of crime. Researchers have distinguished between the impacts of direct and indirect victimization. The direct victimization model establishes a link between fear of crime and the experience of being victimized in the past (Dull & Wint, 1997; Skogan & Maxfield, 1981). Overwhelmingly, studies show that crime victims are significantly more likely to fear crime than non-victims. For instance, Fox et al. (2009) concluded that victims of theft and stalking reported to be more fearful of crime on campus than students who did not become a victim. Bedenbaugh (2003) also found that prior experiences with victimization had a significant impact on students’ fear of crime on campus. Other authors have found a very weak or even no relationship between victimization and fear of crime. For instance, Jennings et al. (2007) found no impact of previous victimization on fear of crime at the university campus.

The indirect victimization model, or vicarious victimization model, assumes that people who have not been victimized personally but have been exposed to others who have, can experience higher levels of fear (Fox et al., 2009). del Carmen et al. (2000) found that after an incident of sexual assault on campus, the percentage of students that reported to be fearful of crime increased from 32 per cent to 41 per cent. Schreck and Miller (2003) also found that vicarious victimization heightens feelings of fear on school. Although many studies have found support for the impact of indirect victimization on fear of crime, some studies indicate that those who experience victimization vicariously are not more likely to be fearful of crime than those who do not (Fisher et al., 1995; Fox et al., 2009). Despite the mixed relationship between victimization and fear of crime, researchers have pointed out that it is part of a more complex issue which involves many other factors which take into account the larger social and physical aspects of campus life (Austin et al., 2002; Skogan & Maxfield, 1981).
7.2.2. Environmental factors

Besides individual risk factors for fear, environmental cues may also matter in the perception of security. The presence of physical or social disorder which alert people to possible criminal victimization would inform the belief that victimization is likely to happen (Barberet & Fisher, 2009; Warr, 2000). Disorder can be considered as violations of community standards, which can be expressed by social disorder, such as the presence of people who are drunk or fighting, or physical disorder, such as the presence of vandalism or dirty spaces. Individuals may consider disorder as visible signs of crime indicating that dangerous elements are present, and their personal security might be compromised and threatened (Fisher & May, 2009).

The link between perceived disorder and fear of crime originates from the Chicago School and has been expressed more clearly in the Broken Window Theory. This theoretical framework indicates that visible symbols of disorder make neighbourhoods vulnerable to criminal offences (Wilson & Kelling, 2003). Visual cues of disorder, such as graffiti, public intoxication or garbage, can signify to criminal offenders that residents are indifferent of what goes on in the neighbourhood and lack the social cohesion that is needed to hinder crime (Sampson & Raudenbush, 2004). More complex is the relationship between fear of crime and community crime rates. Some scholars argue that fear of crime does not necessarily correspond to the actual risk of victimization but is instead an individuals’ subjective estimate of the certainty of being at risk of victimization based on an interpretation of the situation (Cook & Fox, 2011).

Most of the research on disorder and fear of crime has focused on the community setting rather than university campuses (e.g., Hardyns et al., 2019; Scarborouh et al., 2010). Wilson and Kelling (1982) were the first researchers to argue that the presence of physical of social disorder in neighbourhoods is directly linked to greater fear of crime. More recent studies support this finding and indicate that individual perceptions of neighbourhood disorder appear to be the most powerful determinants of both the cognitive and emotional dimensions of fear of crime (Franklin et al. 2008; Hardyns et al. 2019). Other researchers have argued that disorder indirectly affect feelings of anxiety through elevated perceived risk of victimization (Ferraro, 1995; LaGrange et al., 1992; Rountree & Land, 1996). Regarding the campus environment, some research has found that community disorder extends to fear of school-related crime (May & Dunaway, 2000). Alvarez and Bachman (1997) found that the presence
of gangs and the perceived availability of drugs and alcohol had an impact on fear of crime of students. Sloan et al. (1995) and Fisher (1995) reported that a relationship exists among fear of crime and perceived social disorder on campus. Based on these findings, the conceptual model as shown in Figure 7.1 was developed.

![Conceptual model of the determinants of avoidance behaviour](image)

**Figure 7.1.** Conceptual model of the determinants of avoidance behaviour. Note: gender and study years were added as covariates for all variables.

### 7.3. Method

#### 7.3.1. Research setting

The survey was conducted among students of the university of Antwerp, which consists of nine faculties spread among four main campuses. While one campus is located in the centre of the city, the other three campuses are situated in a more rural environment on the outskirts of the city. All campuses are open to the public and are directly accessible by public roads. This implies that campuses are not only visited by students and staff members, but also by inhabitants of the city or tourists. At the time of the study the university enrolled 21,095 students with a majority of 11,918 (56.5%) female students and 9,177 (43.5%) male students.

The city of Antwerp consists of approximately 526,000 inhabitants and is, based on its population, the largest city of Belgium. In 2019, the Local Police Department registered 63,495 crimes on the territory of the University of Antwerp. Theft, disorder, assault and battery and drug related offenses were the most frequently reported crimes (Federale Politie, 2019). In the vicinity of the four university campuses, the same types of crime were registered most
often. Crime rates differed in 2018\textsuperscript{8} from 284 to 1,099 with the highest crime rate measured in the environment of the campus located in the city centre (Lokale Politie Antwerpen, 2019). Unfortunately, no crime rates are available for the university campuses itself.

In the past years, the university of Antwerp increased its security efforts and invested, among other things, in new buildings with CCTV and access control, strengthened the collaboration with external security services and improved the support system for students who became victim of inappropriate behaviour. In order to implement more evidence-based security measures, this study has the aim to provide more empirical foundations about students’ fear of crime on campus.

7.3.2. Procedure and participants

The current study was conducted among students of the University of Antwerp. All students who were enrolled at the university during the spring semester of 2019 were eligible to participate in this study. An online survey was spread among all students of the university \((N=21,095)\) from March 25 until May 25, 2019. With the cooperation of the central administration of the university, every student received an email with a link to the questionnaire, which was developed in Qualtrics. After ten days, a kindly reminder was sent via email and an announcement was placed on the faculty’s internal website. Students voluntarily and anonymously completed the online survey, utilizing self-selection processes.

A total of 1,463 students participated in the study, which yielded a response rate of 7%. The average amount of years that respondents were a student at the university was 2.88 years \((SD=1.93, \text{ range}=1 – 8)\), with 65.1% females \((n=953)\) and 34.9% males \((n=510)\). When comparing these results to the total student population, it should be remarked that the two groups differed in terms of gender. Women were overrepresented among the survey participants.

\textsuperscript{8} While we found crime rates for the year 2019 on city level, unfortunately no crime rates of 2019 were available for the level of the neighbourhood. Therefore, the most recent police statistics of 2018 were consulted.
7.3.3. Measurements

The survey consisted of a structured questionnaire with some socio-demographic questions (e.g., gender and years of study) and questions on students’ victimization experiences, perceived disorder, risk perception, feelings of anxiety and avoidance behaviours. Table 7.1 provides an overview of all study variables with their descriptives (mean and SD).

**Table 7.1.** Descriptives of the variables included in the study (N=1,463).

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived social disorder</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1 – The presence of tramps, homeless</td>
<td>1.46</td>
<td>0.79</td>
</tr>
<tr>
<td>people or beggars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 2 – People who are using drugs (e.g.</td>
<td>1.84</td>
<td>0.95</td>
</tr>
<tr>
<td>weed, hash, ...)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 3 – People who are harassing someone</td>
<td>1.43</td>
<td>0.76</td>
</tr>
<tr>
<td>to get money or other things</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 4 - People who are fighting</td>
<td>1.31</td>
<td>0.61</td>
</tr>
<tr>
<td>Item 5 – People who are drunk</td>
<td>2.20</td>
<td>1.13</td>
</tr>
<tr>
<td><strong>Perceived physical disorder</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1 - Poorly maintained infrastructure</td>
<td>2.49</td>
<td>1.05</td>
</tr>
<tr>
<td>(e.g. broken lights, doors, ...)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 2 - Dirty rooms, hallways or other</td>
<td>2.21</td>
<td>0.97</td>
</tr>
<tr>
<td>spaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 3 - Visible signs of vandalism (e.g.</td>
<td>1.66</td>
<td>0.80</td>
</tr>
<tr>
<td>broken windows, graffiti, ...)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Risk perception</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1 – Verbal abuse</td>
<td>2.76</td>
<td>2.14</td>
</tr>
<tr>
<td>Item 2 – Physical abuse</td>
<td>1.46</td>
<td>1.45</td>
</tr>
<tr>
<td>Item 3 – Threat with physical abuse,</td>
<td>1.97</td>
<td>1.85</td>
</tr>
<tr>
<td>without the threat being executed</td>
<td></td>
<td></td>
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<tr>
<td>Item 4 – Stalking</td>
<td>1.65</td>
<td>1.26</td>
</tr>
<tr>
<td>Item 5 – Being drugged</td>
<td>1.85</td>
<td>1.69</td>
</tr>
<tr>
<td>Item 6 – Cyberbullying</td>
<td>2.00</td>
<td>2.15</td>
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<tr>
<td><strong>Feelings of anxiety</strong></td>
<td></td>
<td></td>
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<tr>
<td>Item 1 – Verbal abuse</td>
<td>1.52</td>
<td>0.79</td>
</tr>
<tr>
<td>Item 2 – Physical abuse</td>
<td>1.32</td>
<td>0.64</td>
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<tr>
<td>Item 3 – Threat with physical abuse,</td>
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<td>0.62</td>
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<tr>
<td>without the threat being executed</td>
<td></td>
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<tr>
<td>Item 4 – Stalking</td>
<td>1.30</td>
<td>0.64</td>
</tr>
<tr>
<td>Item 5 – Being drugged</td>
<td>1.24</td>
<td>0.57</td>
</tr>
<tr>
<td>Item 6 – Cyberbullying</td>
<td>1.26</td>
<td>0.59</td>
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<td><strong>Avoidance behaviour</strong></td>
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</tr>
<tr>
<td>Item 1 – During the day, I avoid certain</td>
<td>1.22</td>
<td>0.56</td>
</tr>
<tr>
<td>places on my campus because I feel</td>
<td></td>
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<tr>
<td>insecure</td>
<td></td>
<td></td>
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<tr>
<td>Item 2 – At night, when it is dark, I</td>
<td>2.09</td>
<td>1.19</td>
</tr>
<tr>
<td>avoid certain places on my campus</td>
<td></td>
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<tr>
<td>because I feel insecure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 3 – I avoid following courses</td>
<td>1.32</td>
<td>0.74</td>
</tr>
<tr>
<td>late at night because I feel insecure</td>
<td></td>
<td></td>
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<tr>
<td>Item 4 – I make sure that I do not have to</td>
<td>1.57</td>
<td>0.95</td>
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<tr>
<td>walk alone through the hallways of my</td>
<td></td>
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<tr>
<td>campus at night because I feel insecure</td>
<td></td>
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<tr>
<td><strong>Study years</strong></td>
<td>2.88</td>
<td>1.93</td>
</tr>
</tbody>
</table>
7.3.3.1. **Perceived social disorder**

Similar to the study of Pauwels and Hardyns (2009) which focuses on communities, respondents were asked how often they noticed some problematic social situations on the campus where they were most present on and in the streets that give direct access to the campus. Five items were measured (e.g., “people who are using drugs”) and responses were made using a five-point Likert scale, ranging from (almost) never (=1) to (almost) often (=5). The internal reliability proved to be good (α=0.78).

7.3.3.2. **Perceived physical disorder**

Again, similar to the study of Pauwels and Hardyns (2009), perceived physical disorder was measured by asking the students how often they have noticed physical disorder on the campus where they are most present on and in the streets that give access to this campus. The scale consists of three items (e.g., “visible signs of vandalism (broken windows, doors, ...”)”). Each item was scored on a five-point Likert scale, ranging from (almost) never (=1) to (almost) often (=5). Reliability analysis indicated that the scale has a Cronbach’s alpha of 0.71.

7.3.3.3. **Risk perception**

Based on the study of Ferraro (1996), respondents were asked to give an estimation of the chance that they could become a victim on campus they were most present on or in the direct neighbourhood of this campus within the next 12 months. The risk perception scale consists of six items (e.g., “stalking”). For each item, respondents had to indicate a number on a scale from no probability (=0) to very high probability (=10). The internal reliability proved to be good (α=0.89).

7.3.3.4. **Feelings of anxiety**

Based on the research of Farall and Gadd (2004), feelings of anxiety was measured by asking respondents about the frequency of their feelings of anxiety for criminal victimization on campus they were most present on or in the direct neighbourhood of this campus in the past 12 months. Six items were used (e.g., “verbal abuse”). Each item was scored on a five-point Likert-scale, ranging from (almost) never (=1) to (almost) often (=5). Reliability analysis indicated the scale has a Cronbach’s alpha of 0.86.
7.3.3.5. **Avoidance behaviour**

To measure avoidance behaviour, students were asked to what extent they adapt their behaviour on campus. The scale consists of five self-constructed items (e.g., “I avoid following courses late at night because I feel insecure”). Each item was scored on a five-point Likert scale ranging from (almost) never (=1) to (almost) often (=5). Reliability analysis showed that the avoidance behaviour scale was reliable (α=0.79).

7.3.3.6. **Direct victimization**

Similar to the studies of Ferraro (1996) and Fisher and Sloan (2003) students were asked about their previous experiences with personal victimization on campus in the past 12 months. Responses were given by indicating ‘yes’ or ‘no’ on a selection of six types of crime (e.g., verbal abuse). Furthermore, students had the possibility to indicate ‘other’ and fill in a criminal offense that was not included in the list above.

7.3.3.7. **Indirect victimization**

To measure the impact of indirect victimization, students were asked if they knew any fellow students who had been a victim of crime on campus in the past 12 months (Ferraro, 1996; Fisher & Sloan, 2003). Similar to the previous question on direct victimization, respondents had to indicate ‘yes’ or ‘no’ on a selection of six crimes (e.g., physical abuse) or had the option to fill in another criminal offense.

7.3.4. **Data analysis**

To test the hypotheses, SEM was applied to the collected data using Mplus 8.4 to examine the relationships between perceived disorder and the three dimensions of fear of crime (Muthén & Muthén, 2017). The analyses were performed using the following approach. First, a measurement model was built to test whether the observed variables reliably reflected the hypothesized latent variables (i.e., perceived social disorder, perceived physical disorder, risk perception, feelings of anxiety and avoidance behaviour). Thereafter, we estimated a structural model with gender and years of study as covariates. The SEM results were obtained with the maximum likelihood mean adjusted because preliminary tests suggested that avoidance behaviour was a not normally distributed dependent variable.
The model fits of the measurement and path models were evaluated according to several fit indices. Given that the $\chi^2$ is almost always significant and not an adequate test of the model fit (Brown, 2012; Kline 2016), we have also reported the comparative fit index (CFI), root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR) (Kline 2016). The CFI ranged from 0 to 1.00, with a cut-off of .95 or higher indicating that the model provided a good fit and .90 indicating that the model provided an adequate fit (Byrne, 2001; Hu & Bentler, 1999). RMSEA values below .05 indicated a good model fit, and values from .06 to .08 indicated an adequate fit (Ponnet, 2014). The SRMR consisted of a standardized summary of the average covariance residuals (Kline, 2011). A relatively good model fit was indicated when the SRMR value was less than .08 (Hu & Bentler, 1999).

### 7.4. Results

Table 7.2 displays the correlations between the research constructs used in the model. All constructs were significantly positive related to each other.

<table>
<thead>
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<th>1</th>
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<th>4</th>
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<th>6</th>
<th>7</th>
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</thead>
<tbody>
<tr>
<td>1. Perceived social disorder</td>
<td>-</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>2. Perceived physical disorder</td>
<td>0.331**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3. Risk perception</td>
<td>0.374**</td>
<td>0.272**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4. Feelings of anxiety</td>
<td>0.346**</td>
<td>0.204**</td>
<td>0.529**</td>
<td>-</td>
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<td></td>
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<tr>
<td>5. Avoidance behaviour</td>
<td>0.189**</td>
<td>0.197**</td>
<td>0.412**</td>
<td>0.455**</td>
<td>-</td>
<td></td>
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<tr>
<td>6. Direct victimization</td>
<td>0.208**</td>
<td>0.079*</td>
<td>0.193**</td>
<td>0.213**</td>
<td>0.138**</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>7. Indirect victimization</td>
<td>0.273**</td>
<td>0.128**</td>
<td>0.180**</td>
<td>0.224**</td>
<td>0.099*</td>
<td>0.311**</td>
<td>-</td>
</tr>
</tbody>
</table>

Note. *p < .01; **p < .001 (N=1,463).

The measurement model provided an adequate fit for the data $\chi^2(236)=1097.55, p<.001$; CFI=.918, RMSEA=.051, CI [.048,.054], SRMR=.056.). All factor loadings were significant and above .56. The results of the structural model are presented in Figure 7.2. The results of the fit statistics indicated an adequate model fit: $\chi^2(318)=1390.81, p<.001$; CFI=.91, RMSEA=.050, CI [.047, .052] and SRMR=.052.

Our analyses revealed that feelings of anxiety, risk perception, perceived social and physical disorder together with the covariates, explained 35.5% of the variance in avoidance
Unravelling college students’ fear of crime

behaviour. In addition, risk perception, perceived social and physical disorder together with the covariates, accounted for 29.6% of the variance in feelings of anxiety. Perceived social and physical disorder and the covariates accounted for 19.3% of the variance in students’ risk perception.

The strongest predictors of students’ avoidance behaviour were feelings of anxiety ($\beta=.24$, $p<.001$) and risk perception ($\beta=.19$, $p<.001$), followed by perceived physical disorder ($\beta=.09$, $p<.01$). Unexpectedly, perceived social disorder ($\beta=.05$, $p=.20$) was not significantly related to avoidance behaviour. These results indicate that students who perceive more physical disorder, have a higher estimate of the risk of victimization, experience more feelings of anxiety and show more avoidance behaviour. Students who perceive more social disorder at their campus or in the direct neighbourhood of the campus do not adapt their behaviour.
Figure 7.2. Full model of determinants of the three dimensions of fear of crime. Note: All reported coefficients are standardized values, adjusted for the influence of covariates. Only significant associations are presented. *p < .01; **p < .001.
Furthermore, the strongest determinants of students’ feelings of anxiety were risk perception ($\beta=.37, \ p<.001$) and perceived social disorder ($\beta=.25, \ p<.001$). This indicates that students who perceive more social disorder, have a higher risk perception and experience more feelings of anxiety. Unexpectedly, no significant direct relationship was found between perceived physical disorder ($\beta=0.003, \ p=0.93$) and feelings of anxiety, which indicates that students who perceive more physical disorder do not experience higher levels of anxiety.

With regard to the gender and years of study, we found a significant relationship between gender and avoidance behaviour ($\beta=.37, \ p<.001$), indicating that female students show significantly more avoidance behaviour on campus in comparison to their male counterparts. Unexpectedly, no significant associations were found between gender and risk perception or feelings of anxiety. Furthermore, years of study was significantly related to perceived physical disorder ($\beta=.15, \ p<.001$), indicating that students who have been studying at the university for a longer time perceive more physical disorder on campus and in the direct neighbourhood of the campus in comparison to students who have been a student at the university for a shorter time. Years of study was not significantly associated with any other study variables.

7.5. Discussion

Crime and victimization on campuses is currently widely recognized not only as an educational concern but also as a social issue. One of the effects of crime and victimization is fear, which can have a considerable impact on the recruitment and the overall quality of the learning environment (Fisher et al., 2010; Fisher & Sloan, 2013). To date, research on the determinants of fear of crime mostly focused on demographic gender differences and other personal characteristics, while limited efforts have been applied to understanding the influence of environmental cues on students’ fear of crime. The present study has attempted to fill this void by examining the influence of perceived social and physical disorder on the three dimensions of fear of crime.

First of all, our findings suggest that a higher perception of physical disorder in combination with a higher estimate of the risk of victimization and higher levels of anxiety lead to more avoidance behaviour on campus. While we expected that both perceived physical and social disorder would have an impact on students’ behaviour, no significant association was found between the perception of social disorder and students’ avoidance behaviour. This indicates
that students adapt their behaviour when they notice physical disorder on campus, such as poorly maintained infrastructure or visible signs of vandalism. Secondly, the study suggests that a higher perception of social disorder in combination with a higher estimate of the risk of victimization increases students’ feelings of anxiety. This indicates that students’ feelings of anxiety strengthen when they notice signs of social disorder in their environment, such as drunk people or people fighting. No significant relationship was found between perceived physical disorder and feelings of anxiety.

Secondly, two conclusions can be made regarding the role of the control variables which can also be important for policy strategies. First, our study suggest that female students show more avoidance behaviour in comparison to their male counterparts. Also, previous studies have indicated that more female students adapt their behaviour, but that this is caused by the fact that they experience higher levels of anxiety and estimated a higher risk of victimization. Unexpectedly, no relation between gender and risk perception and feelings of anxiety was found in our study. This indicates that both female and male students estimate similar levels of risk perception and experience similar levels of anxiety, while mostly female students adapt their behaviour to these cognitive and emotional experiences. Secondly, our study suggests that the amount of years that a student studies at the university has an impact on his or her perceived physical disorder. While previous research showed that older students or students in a higher grade experienced more feelings of anxiety, this finding cannot be confirmed based on our results.

7.6. Conclusions and recommendations

The above findings offer several implications for the different stakeholders who are involved in campus security. First of all, it is indicated that fixing ‘the broken window’ is important to reduce students’ feelings of anxiety and their responding behaviours. In order to reduce social and physical disorder, many scholars have sought solutions in the neighbourhood setting and have suggested collective efficacy (Scarborough et al., 2010). Collective efficacy consists of individuals who have a strong tie to the community or neighbourhood. Research conducted in communities has shown that residents of neighbourhoods with strong social cohesion and collective efficacy are more likely to report lower levels of fear (Hardyns et al., 2018; Scarborough et al., 2010). On college campuses every year incoming students start their
Unravelling college students’ fear of crime

academic career while a large group of older students leave the university and its campus environment. Due to these transitions, forming strong social ties in neighbourhoods is not totally comparable with creating collective efficacy on campus. However, many colleges and universities have student associations, sport teams or other initiatives that unite students which also gives them a platform where they can report concerns about their security on campus.

On the other hand, social bonds do not necessarily have to be formed in order for problems to be identified and addressed. Visible improvements in the campus area, such as planting vegetation, implementing garbage cans or installing extra lighting could reduce social and physical disorder (Woodward et al., 2016). Previous studies have showed that proper landscaping, visibility and clean and well-kept areas increased students’ perceptions of security on campus (Fernandez, 2005). Additionally, lower levels of crime prevention through environmental design (CPTED) have found to be associated with higher levels of fear among college students (Cozens & Sun 2018). Therefore, security stakeholders must be aware of the opportunities of CPTED measures to decrease students’ fear of crime. Furthermore, awareness campaigns can be used to encourage students and staff to keep the buildings of the university clean or to report broken infrastructure or dirty classrooms. Making students more aware of crime victimization on campus and its determinants has already been suggested by many scholars (Jennings et al., 2007; Robinson & Roh, 2013; Sani et al., 2020). Moreover, awareness campaigns have the advantage that they can often be easily implemented, and they are rather inexpensive.

Finally, close cooperation with the police department and local authorities is recommended in order to reduce the visible signs of disorder in the neighbourhood of the campus. In our study, we asked students about their perception of disorder both on campus and in the direct neighbourhood of the campus. This implies that not only the campus buildings but also the areas around the campus may generate fear of crime. Despite the fact that areas bordering a campus may actually considered no property of the university, students may have to travel through these areas on their way to and from campus. Therefore, it should be the responsibility of the university to initiate and maintain partnerships with local authorities.
7.7. Limitations

Although we have uncovered a number of interesting findings, this study is not without limitations. First, the data were obtained cross-sectional, which implies that it is not possible to explore the long-term effect of the determinants on students’ fear of crime. For instance, Hardyns et al. (2018) observed that disorder might influence feelings of fear over a period of time. Other studies are needed in order to examine whether the determinants of students’ fear of crime varies across time. Furthermore, students were asked about their risk perception, feelings of anxiety and avoidance behaviour in the next (risk perception) or past 12 months (feelings of anxiety and avoidance behaviour). While we limited this time frame on purpose, memory bias may have influenced our findings. Moreover, as all data were collected through self-reports, socially desirable answers could be given.

Secondly, the participants of the current study represent a self-selected sample of the targeted population, which is a non-random selection. Unfortunately, the researchers could not control for the self-selection process that comes with this voluntary, online survey. This implies that the results cannot be extrapolated in any statistically or mathematically meaningful way to the entire student population. Therefore, it is unknown how the participants compare to other students who did not fill in the questionnaire. Although previous research showed that self-selection does not necessarily bias the results of surveys used in campus studies (Brown et al., 2014; Rosenthal & Freyd, 2018), this limitation should be considered. Additionally, while a 10% response rate for online surveys is generally considered acceptable, the current study is characterized by a relatively low response rate. Reasons for this low response rate could be factors such as the over-surveying of students at the end of the academic year, students’ perception that the topic is irrelevant or students’ lack of time. Although the current study consists of an adequate sample, this limitation should be kept in mind when interpreting the results.

Thirdly, as our data was obtained from students from one university, caution is needed to generalize the results to other universities. The university’s structure and security policy can have a substantial impact on the results. In the current study, a survey was conducted at a university which consists of four main campuses that are characterized by an open structure and have direct access to the public space. However, not all university campuses have these
open-access character. Consider for instance college campuses where all buildings and student accommodation are located on one central location, well demarcated from public space. The university’s characteristics often depend on the country where it is located. Scholars already stated that the conclusions from the large body of scientific research on students’ fear of crime on American campuses cannot be extrapolated to European universities (Sani et al. 2020). This indicates that caution is needed when adapting the conclusions from the current study to universities within another country or continent. To date, studies on fear of crime among students of European universities are rather scare. Finally, one should be careful to generalize the conclusions to the entire university population, which also include other groups such as faculty or professors. Previous research has stated that college students have unique characteristics which may not necessarily coincide with those of the larger community (Lee & Hilinski-Rosick, 2012). Therefore, it is important that further research gathers data from other college campuses and different groups of the university community. The findings and recommendations of the current study should be interpreted with caution given the generalizability concerns.

Despite these limitations, this study adds a valuable contribution to the research on fear of crime among college students. To date, there is a lack of current research on the impact of environmental cues on fear of crime on campus in general and more specific in a non-American context. Further research needs to be completed to examine whether the physical environment of the campus and the surrounding areas play any role in students’ risk perceptions, feelings of anxiety and avoidance behaviour on campus.
7.8. References


Unravelling college students’ fear of crime


Unravelling college students’ fear of crime


The relationship between crime prevention through environmental design (CPTED) and fear of crime: A multi-method approach in four university campus neighbourhoods

The present study focuses on the relationship between prevention through environmental design (CPTED) and fear of crime on higher educational institutions. A multi-method approach was carried out, combining a survey among students (N=1,463), a survey among staff members (N=1,443) and systematic social observations (N=406) in four campus neighbourhoods. Based on an evaluation of the presence of five CPTED principles (surveillance, access control, territoriality, maintenance and Activity support), the relationship of the built environment on students’ and staff members’ fear of crime on campus was examined. The results show that CPTED principles territoriality, access control and maintenance were most related to students’ and staff members’ fear of crime on campus. Although the presence of physical and social disorder was also associated with students’ fear of crime, these phenomena were less related to staff members’ fear of crime. Taking this into account, this study offers valuable insights for higher educational institutions that have the aim to create a secure environment. Both the implementation of CPTED measures and disorder limiting measures can be recommended to reduce fear of crime among students and staff members.

This chapter is based on:
8.1. Introduction

Over the years, several approaches have been put forward to reduce crime in neighbourhoods. Since the 1970s, Crime Prevention Through Environmental Design (CPTED) has become one of the most popular urban planning strategies for improving neighbourhood’s security. Based on the assumption that human behaviour can be influenced by the surrounding environment, CPTED aims to prevent and reduce crime by the implementation of proper architecture design and a modification of the physical features of the environment (Cozens et al., 2005). The CPTED approach proposes the implementation of five key principles for the reduction of crime: surveillance, access control, territoriality, maintenance and activity support (Jeffery, 2971).

The concept surveillance starts from the assumption that crime is less likely to occur as deviant behaviour can be noticed and reported more easily. It involves the implementation of mechanical surveillance, such as CCTV, or formal and natural surveillance, such as the presence of police patrols or residents, to maximize visibility (Reynald, 2011). Access control focuses on the reduction of opportunities for crime by limiting the access to potential targets and creating a high perception of risk to offenders. Both the implementation of symbolic and real barriers should deter criminal behaviour (Newman, 1972; Shariati & Guerette, 2020). Territoriality involves the creation of visual cues in the built environment to develop clear and discrete spaces. Examples are the use of plants, low walls or other landscaping conventions. The personalization of environmental spaces creates a sense of belonging and ownership among residents which could serve as an effective deterrent to potential crimes (Brower et al., 1983; Cozens & Sun, 2019). Maintenance refers to the absence of physical and social incivilities and arose from the broken windows theory of Wilson and Kelling (1982), which assumed that that norm-setting and signalling can impact social behaviour. Visible incivilities, such as physical disorder (e.g., litter, graffiti) or social disorder (e.g., the presence of drunk people or people fighting) are considered as important predictors of crime. To prevent crime, streets and properties should be maintained to create a perceived image of civility (Gau & Pratt, 2010). The concept activity support starts from the assumption that crime can be reduced in environments where a variety of activities continuously take place and attract people. Places such as bars, parks or shops increase social activity and improve both natural surveillance and territoriality (Jacobs, 2016).
While the impact of CPTED on inducing or hindering crime has been studied multiple times in recent years (Armitage, 2000; Casteel & Peek-Asa, 2000; Teedon et al., 2010), research has only begun to empirically examine the extent to which the built environment is associated with people’s fear of crime (Cozens & Sun, 2019; Lee et al., 2016). Generally, fear of crime can be seen as a complex phenomenon that involves three dimensions: a cognitive dimension, or the perceived risk of victimization, an emotional dimension, or the feelings of anxiety and an expressive dimension, or the behavioural outcomes of feelings of fear (Hardyns & Pauwels, 2010; LaGrange & Ferraro, 1987). Over time, the impact of individual factors, such as age or gender, have often been related to people’s fear of crime in previous research (Fox et al., 2009; Pain, 2001).

Although a few studies have assessed the impact of contextual factors, such as socio-structural characteristics (e.g., Brunton-Smith & Sturgis, 2011; Vauclair & Bratanova, 2017), social processes (e.g., Hardyns et al., 2018; Scarborough et al., 2010) or disorder (e.g., Doran & Lees, 2005; Kohm, 2009) on fear of crime, the impact of the architectural design on the three dimensions of fear of crime can still be considered as insufficiently researched. Moreover, the limited amount of studies that examined the impact of the CPTED approach on fear of crime has shown mixed results. While some studies found a positive impact of CPTED modifications on people’s fear of crime (Armitage & Monchuk, 2011; Cozens & Tarca, 2016; Tseng et al., 2004), other studies showed no statistical relationships between the two concepts (Caughey et al., 2001; Minnery & Lim, 2005).

To provide further insights on this topic, this study uses a multi-method approach, combining surveys and systematic social observations (SSO). Data collected from two large-scale surveys unravel people’s fear of crime. SSO are applied in this study to examine the presence of CPTED. Over time, SSO by trained observers has become a cornerstone of neighbourhood-level research, particularly for measuring physical characteristics of the built environment, given the disparities in perceptual and observed measures of these phenomena (Hinkle & Yang, 2014; Hoeben et al., 2018). While SSO eliminates some of the restrictions of conducting surveys, such as socially desirable answers or interviewer effects, some concerns arise when conducting observations within a specific neighbourhood (Gracia & Herrero, 2007). For instance, travel costs and human resources of researchers who have to move to the study area could be very high (Rundle et al., 2011) and carrying out research in less secure
neighbourhoods could create danger and fear of crime among raters (Griew et al., 2013). These concerns have led to more innovative techniques to conduct research in neighbourhood settings. One of these new approaches is the utilization of virtual instead of physical SSO, often carried out by using Google Street View (GSV).

In this study a combination of three SSO methods is applied: in-situ observations, observations via original photographs and observations by means of GSV images. All observations were carried out in the neighbourhood of the four campuses of the University of Antwerp in Belgium. Additionally, one survey was conducted among students and one survey was conducted among staff members of this university. By making use of this multi-method approach, it is the aim of this study to provide more insight in the relationship between CPTED and fear of crime. In the following paragraphs, details about the used methodological approach will be presented, followed by a discussion of the results. The article will end with some concluding remarks and recommendations for both practitioners and future research.

### 8.2. Methodology

#### 8.2.1. Study area

The study was conducted in four neighbourhoods of the University of Antwerp in Belgium (see Figure 8.1). The university consists of nine faculties, which are spread among four main campuses. While one campus is located in the centre of the city (Campus 1), the other three campuses are situated in a more rural environment at the outskirts of the city centre. Campus 1 consists of five main buildings, which are all located within the same neighbourhood. The buildings house offices where staff members work, auditoriums where students can follow classes and some student facilities, such as a restaurant. The headquarters of the university are located on Campus 2. The campus is adjacent to one of the five main hospitals of Antwerp and is also surrounded by a large city park. In addition to offices and auditoriums, the campus also consists of a fitness centre. Campus 3 is located furthest from the city centre and is surrounded by greenery. The university hospital is located right next to this campus. Campus 4 is located close to Campus 2 and is adjacent to a large city park. In 2016, a completely new building was constructed to house the Faculty of Applied Engineering Sciences. All campuses are open to the public and are directly accessible by public roads. At the time the study was carried out, the university enrolled 21,095 students and 5,924 staff members.
8.2.2. Research design

8.2.2.1. Student survey and staff survey

To examine fear of crime among the university’s students and staff members, two large-scale surveys were carried out. The first survey (student survey) was distributed from March 25, 2019 until May 25, 2019. All students who were enrolled at the university during this period were eligible to participate in the study (N=21,095). With the cooperation of the central administration of the university, every student received an email with a link to the questionnaire, which was developed in Qualtrics. After ten days, a kindly reminder was sent via email and an announcement was placed on the faculty’s internal website. Students
anonymously and voluntarily completed the online survey, utilizing self-selection processes. In total, 1,463 students participated in the study, which yields a response rate of 7%. The average amount of years that respondents were a student at the university was 2.88 years (SD=1.93, rang =1 – 8), with 65.1% females (n=953) and 34.9% males (n=510).

A similar survey (staff survey) was distributed among all staff members of the University of Antwerp between the June 3 and the August 7, 2019. All employees (N=5,924) who were working at the university during this period could voluntarily choose to participate in the study. In the end, a total of 1,443 employees filled in the questionnaire, which yields a response rate of 24.4%. Most respondents were working for 10 years or more at the university (35.3%), with 60.4% females (n=871) and 39.6% males (n=572). Table 8.1 provides an overview of the socio-demographic characteristics of the participants of both surveys.

Table 8.1. Socio-demographic characteristics of respondents of the student survey (N=1,463) and the staff survey (N=1,443).

<table>
<thead>
<tr>
<th></th>
<th>Students</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>510</td>
<td>34.9</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>953</td>
<td>65.1</td>
<td></td>
</tr>
<tr>
<td><strong>Years of studying at university</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 year</td>
<td>434</td>
<td>29.7</td>
<td></td>
</tr>
<tr>
<td>Between 1 and 3 years</td>
<td>565</td>
<td>38.6</td>
<td></td>
</tr>
<tr>
<td>Between 4 and 6 years</td>
<td>403</td>
<td>27.5</td>
<td></td>
</tr>
<tr>
<td>More than 6 years</td>
<td>60</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td><strong>Campus: most present on</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Campus 1</td>
<td>781</td>
<td>53.4</td>
<td></td>
</tr>
<tr>
<td>Campus 2</td>
<td>484</td>
<td>33.1</td>
<td></td>
</tr>
<tr>
<td>Campus 3</td>
<td>154</td>
<td>10.5</td>
<td></td>
</tr>
<tr>
<td>Campus 4</td>
<td>44</td>
<td>3.0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Staff members</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>572</td>
<td>39.6</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>871</td>
<td>60.4</td>
<td></td>
</tr>
<tr>
<td><strong>Years of working at university</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 year</td>
<td>169</td>
<td>11.7</td>
<td></td>
</tr>
<tr>
<td>Between 1 and 5 years</td>
<td>483</td>
<td>33.5</td>
<td></td>
</tr>
<tr>
<td>Between 6 and 10 years</td>
<td>282</td>
<td>19.5</td>
<td></td>
</tr>
<tr>
<td>More than 10 years</td>
<td>509</td>
<td>35.3</td>
<td></td>
</tr>
<tr>
<td><strong>Campus: most present on</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Campus 1</td>
<td>576</td>
<td>39.9</td>
<td></td>
</tr>
<tr>
<td>Campus 2</td>
<td>212</td>
<td>14.7</td>
<td></td>
</tr>
<tr>
<td>Campus 3</td>
<td>446</td>
<td>30.9</td>
<td></td>
</tr>
<tr>
<td>Campus 4</td>
<td>206</td>
<td>14.3</td>
<td></td>
</tr>
</tbody>
</table>
In addition to the socio-demographic questions, students and staff members were asked to fill in the campus where they were most present on. They received the instruction that they had to fill in the whole survey keeping in mind this campus. Most students and staff members indicated that they were most present on Campus 1 (53.4%; n=781 and 39.9%; n=576 respectively). Additionally, related to the research of Ferraro (1996), the survey contained questions about the three dimensions of fear of crime (i.e., cognitive, emotional and behavioural dimension). The cognitive dimension, or the perceived risk of victimization, was measured by asking the respondents to provide an estimation of the chance that they could become a victim of crime on or in the neighbourhood of the campus within the next 12 months. A selection of six crimes (verbal aggressive behaviour, physical aggressive behaviour, threat with physical abuse without the threat being executed, verbally getting bothered for sexual reasons, physically undesirable sexual behaviour, stalking) was presented to the students and staff members. For each of the crimes, respondents had to indicate a number on a scale from 0 (no probability) to 10 (very high probability).

Related to the research of Farrall and Gadd (2004), the emotional dimension of fear of crime, or respondent’s feelings of anxiety, was measured by asking them about the frequency of their anxious feelings regarding criminal offenses on and in the neighbourhood of the campus. Respondents were asked if they had fearful experiences in the past 12 months with regard to the same six types of crime as asked in the previous question. Responses were scored using a Likert-scale, with answers ranging from 1 (=almost never) to 5 (=almost often). Respondent’s behavioural dimension of fear of crime, or their avoidance behaviour on or in the neighbourhood of the campus, was measured by asking them if they sometimes avoided places or activities in reaction to their feelings of anxiety (e.g., ‘I avoid following courses late at night because I feel unsecure’). Four items were scored using a 5-point Likert scale ranging from 1 (=almost) never to 5 (=almost) often. The descriptive statistics of both surveys are presented in Table 8.2.
Table 8.2. Descriptive statistics of key variables of student survey and staff survey.

<table>
<thead>
<tr>
<th>Variables</th>
<th>α</th>
<th>N</th>
<th>Overall</th>
<th>Min.</th>
<th>Max.</th>
<th>Campus 1</th>
<th>Campus 2</th>
<th>Campus 3</th>
<th>Campus 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>mean</td>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
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<td></td>
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<td>(SD)</td>
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<td></td>
<td>(SD)</td>
<td>(SD)</td>
<td>(SD)</td>
<td>(SD)</td>
</tr>
<tr>
<td><strong>Student survey</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk perception</td>
<td>.89</td>
<td>1408</td>
<td>2.07</td>
<td>0</td>
<td>10</td>
<td>2.27</td>
<td>1.90</td>
<td>1.72</td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.61)</td>
<td></td>
<td></td>
<td>(1.62)</td>
<td>(1.58)</td>
<td>(1.54)</td>
<td>(1.52)</td>
</tr>
<tr>
<td>Feelings of anxiety</td>
<td>.86</td>
<td>1395</td>
<td>1.44</td>
<td>1</td>
<td>5</td>
<td>1.50</td>
<td>1.39</td>
<td>1.35</td>
<td>1.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(.59)</td>
<td></td>
<td></td>
<td>(.60)</td>
<td>(.58)</td>
<td>(.58)</td>
<td>(.42)</td>
</tr>
<tr>
<td>Avoidance behaviour</td>
<td>.79</td>
<td>1391</td>
<td>1.55</td>
<td>1</td>
<td>5</td>
<td>1.53</td>
<td>1.65</td>
<td>1.39</td>
<td>1.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(.70)</td>
<td></td>
<td></td>
<td>(.68)</td>
<td>(.75)</td>
<td>(.68)</td>
<td>(.49)</td>
</tr>
<tr>
<td><strong>Staff survey</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk perception</td>
<td>.92</td>
<td>1372</td>
<td>1.75</td>
<td>0</td>
<td>10</td>
<td>1.81</td>
<td>1.64</td>
<td>1.74</td>
<td>1.73</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.49)</td>
<td></td>
<td></td>
<td>(1.58)</td>
<td>(1.46)</td>
<td>(1.48)</td>
<td>(1.40)</td>
</tr>
<tr>
<td>Feelings of anxiety</td>
<td>.89</td>
<td>1219</td>
<td>1.34</td>
<td>1</td>
<td>5</td>
<td>1.31</td>
<td>1.33</td>
<td>1.34</td>
<td>1.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(.53)</td>
<td></td>
<td></td>
<td>(.51)</td>
<td>(.53)</td>
<td>(.53)</td>
<td>(.56)</td>
</tr>
<tr>
<td>Avoidance behaviour</td>
<td>.86</td>
<td>1337</td>
<td>1.89</td>
<td>1</td>
<td>5</td>
<td>1.69</td>
<td>1.87</td>
<td>2.14</td>
<td>1.91</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(.96)</td>
<td></td>
<td></td>
<td>(.88)</td>
<td>(.90)</td>
<td>(1.01)</td>
<td>(1.00)</td>
</tr>
</tbody>
</table>

8.2.2.2. **Systematic social observations (SSO)**

SSO was applied within the neighbourhoods of the four campuses of the university. In total, 36 observation points were selected to be included in the study. Depending on the size of the campus, between two\(^9\) and 19 observation points were chosen per campus neighbourhood. Additionally, the selection of the 36 observation points was based on three criteria, taking into account both physical and virtual characteristics of the location:

- Only observation points with a direct access to the university campus were selected to ensure that all observation points were located in the direct neighbourhood of the campus;
- Only observation points that are at least 100 meters apart from each other were selected to avoid overlapping observations;
- Only observation points of which the GSV images were recently captured (after May 2017) were selected to exclude old images that no longer corresponded to the real physical environment.

\(^9\) On Campus 4, only two observation points were selected as the campus is adjacent to a zone with lots of greenery, which is not accessible via GSV.
All observation points were subject to three different observation methods: in-situ observations, observations via original photographs and observations by means of GSV. Observers were divided in groups of four to six persons. Before they carried out the observations, all observers followed an extensive training in which they were instructed about the checklist and the practical performance of the observations. Additionally, they received theoretical information about crime prevention, disorder and CPTED. Each group received an observation location with address and specific coordinates. While two persons of every group travelled to the location to carry out in-situ observations, the other group members observed the same location based on photos they received from their group members on location. Additionally, every group member was instructed to observe the location by means of GSV images.

Observers who carried out in-situ observations were instructed to observe in 360° from the exact location they received. From the observation point, they had to capture four photographs which offered a clear overview of the location. The observers were free to choose a date and time to carry out the observations, within the period of October 1 and October 23, 2020. In the end, in-situ observations were performed between 10 a.m. and 20.15 p.m. from October 3 to October 20. In total, 174 female, 28 male and one non-binary student carried out two observations which led to 406 individual observations in total: 71 observations were performed in-situ, 203 observations were virtually carried out by means of GSV images and 132 observations were executed based on photographs. High correlations were found between the three observation methods. Inter-modus reliability proved to be very good, with the following average correlations: M1-M2: 0.756 (SD=0.124); M1-M3: 0.750 (SD=0.125); M2-M3: 0.942 (SD=0.039).

All observations were carried out by using a standardized checklist, which consisted of 40 items. Based on a Principle Components Analysis (PCA), items with less than .40 loading were excluded (Nunnally & Bernstein, 1978), resulting in a final scale of 29 items nested within the five CPTED dimensions (i.e., surveillance, access control, territoriality, maintenance and target hardening, and activity support) and two disorder constructs (physical and social disorder).

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10 Master students in Criminological Sciences (N=203) were selected to act as observers. We would like to thank professor Lieven Pauwels and all these students of Ghent University who participated in this study.
Relationship between CPTED and fear of crime

(see Appendix, Table 8.4). Surveillance was measured by using five items (e.g., presence of formal surveillance (police patrol, security guards)). For access control, two items were included (e.g., there are visible campus entrances and exits). Territoriality was measured by three items (e.g., there are physical barriers (e.g., fences, shrubs) that separate campus from public space). All aforementioned key principles were scored on a scale from 1 (=0) to 4 (=4).

In order to measure maintenance, four items were used (e.g., the condition of the buildings on the location is...). Items were scored on a scale from 1 (=very bad) to 4 (=very good). To assess the presence of maintenance more in detail, items regarding the presence of physical and social disorder were included in the checklist. For physical disorder, four items were included (e.g., there are broken windows/doors at the location). Social disorder was measured by including four items regarding the presence of people who disturb the public order (e.g., there are people who are drunk on the location). For both physical and social disorder, answers were scored based on a scale ranging from 1 (=0) to 4 (=4). Finally, activity support was assessed by three items (e.g., there is a cultural activity going on (e.g., performance, festival) at the location), which were scored on a scale from 1 (=0) to 4 (=4).

The data collected by use of the surveys and SSO were merged into one data file and analysed with SPSS26. The descriptive statistics of all key variables included in this study are presented in Table 8.3.

Table 8.3. Descriptive statistics of key variables of SSO.

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Overall mean (SD)</th>
<th>Min.</th>
<th>Max.</th>
<th>Campus 1 Mean (SD)</th>
<th>Campus 2 Mean (SD)</th>
<th>Campus 3 Mean (SD)</th>
<th>Campus 4 Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveillance</td>
<td>406</td>
<td>1.87 (.37)</td>
<td>1</td>
<td>4</td>
<td>1.86 (.36)</td>
<td>2.06 (.39)</td>
<td>1.79 (.32)</td>
<td>1.65 (.28)</td>
</tr>
<tr>
<td>Access control</td>
<td>406</td>
<td>1.82 (.68)</td>
<td>1</td>
<td>4</td>
<td>1.62 (.53)</td>
<td>2.00 (.79)</td>
<td>2.00 (.73)</td>
<td>2.57 (.56)</td>
</tr>
<tr>
<td>Territoriality</td>
<td>405</td>
<td>1.94 (.70)</td>
<td>1</td>
<td>4</td>
<td>1.58 (.52)</td>
<td>1.96 (.79)</td>
<td>2.17 (.52)</td>
<td>2.79 (.48)</td>
</tr>
<tr>
<td>Maintenance</td>
<td>406</td>
<td>3.10 (.59)</td>
<td>1</td>
<td>4</td>
<td>3.27 (.22)</td>
<td>2.94 (.60)</td>
<td>3.33 (.63)</td>
<td>3.24 (.48)</td>
</tr>
<tr>
<td>Activity support</td>
<td>402</td>
<td>1.22 (.41)</td>
<td>1</td>
<td>4</td>
<td>1.01 (.06)</td>
<td>1.64 (.59)</td>
<td>1.41 (.37)</td>
<td>1.21 (.22)</td>
</tr>
<tr>
<td>Physical disorder</td>
<td>406</td>
<td>1.05 (.16)</td>
<td>1</td>
<td>4</td>
<td>1.08 (.18)</td>
<td>1.07 (.20)</td>
<td>1.00 (.00)</td>
<td>1.02 (.07)</td>
</tr>
<tr>
<td>Social disorder</td>
<td>406</td>
<td>.59 (.47)</td>
<td>1</td>
<td>4</td>
<td>.57 (.45)</td>
<td>.69 (.51)</td>
<td>.53 (.47)</td>
<td>.55 (.51)</td>
</tr>
</tbody>
</table>
8.3. Results

Taking into account the mean scores for each variable per campus, associations can be made between students’ and staff members’ fear of crime on and in the neighbourhood of the campus and the presence of CPTED measures in the neighbourhood of these campuses. The integrated results are visualized in four radar charts, shown in Figure 8.2. The grey lines represent the overall mean per variable per campus. The black lines show the mean scores per variable per campus. Below, the results are first presented per campus, and thereafter we compare the four campuses.
Figure 8.2. Overview of the results of student survey (N=1,463), staff survey (N=1,443) and SSO (N=406).
8.3.1. Campus 1

Starting with Campus 1, the results show that this neighbourhood is characterized by the highest presence of maintenance. Measures referring to territoriality and access control were least observed on this campus and also lower scores were found for activity support. The mean score for surveillance is comparable to the overall mean score for this variable. Additionally, compared to the overall mean, more signs of physical disorder were observed. The presence of social disorder was relatively low, scoring beneath the overall mean. Survey data show that students’ risk perception and feelings of anxiety on this campus are higher compared to the other three campuses. Also staff members’ risk perception is the highest on this campus in comparison to the other campuses. Both students and staff members indicated to show less avoidance behaviour compared to the mean scores. Finally, lower scores for staff members’ feelings of anxiety were found on this campus compared to the overall mean for this variable.

Interpreting these results, it can be assumed that students’ and staff members’ high risk perception and students’ more frequent feelings of anxiety are related to a higher presence of physical disorder in the neighbourhood of this campus. Moreover, a greater absence of territoriality and access control could also play a role. The lower scores on avoidance behaviour among both respondent groups and staff members’ less frequent feelings of anxiety may be associated with a higher presence of maintenance and surveillance in the neighbourhood of Campus 1.

8.3.2. Campus 2

The results concerning Campus 2 indicate that this campus is characterized by the highest presence of activity support compared to the other campuses. Also CPTED principles surveillance and access were more present compared to the overall mean for this variable. The presence of territoriality is similar to the mean score for this variable. The observers noticed the lowest presence of maintenance in comparison to the other three campuses. Subsequently, the presence of physical disorder is comparable to Campus 1, showing a higher score than the overall mean. Also social disorder was frequently observed, showing the highest mean scores for this campus compared to the other three campuses. Data collected via the two surveys show that students’ risk perception and feelings of anxiety are lower and
less frequent on Campus 2, compared to the overall mean score. In comparison to the other campuses, they indicated to show more avoidance behaviour on and in the neighbourhood of this campus. Staff members indicated a similar score on feelings of anxiety and avoidance behaviour in comparison to the overall mean scores for these variables. Additionally, they perceive the risk of becoming a victim of crime on campus two as the lowest, compared to the other three campuses.

Based on a comprehensive view on these findings, it may be assumed that more frequent avoidance behaviour among students on this campus could be associated with a lower presence of maintenance in this neighbourhood. Furthermore, a higher presence of social disorder in the neighbourhood of Campus 2 could also have been associated with these findings. Staff members’ average levels of feelings of anxiety and avoidance behaviour may also be related with these findings. Subsequently, a lower perceived risk among students and staff members could be influenced by a higher presence of surveillance, access control and activity support in the neighbourhood of the campus. Also students’ less frequent feelings of anxiety could be explained by the higher presence of these CPTED principles.

**8.3.3. Campus 3**

The results from the observations show that the neighbourhood of Campus 3 is characterized by a higher presence of territoriality and maintenance. The observers noticed also a higher presence of access control and activity support, compared to the overall mean scores for these variables. For surveillance, slightly lower scores were found compared to the overall mean. Additionally, no physical disorder was observed on this campus and also the lowest presence of social disorder was observed compared to the other three campuses. Survey data show that students indicated lower scores on the three dimensions of fear of crime, compared to the overall mean scores. For staff members, their risk perception and feelings of anxiety are comparable to the overall means for these variables. They indicated, however, that they experienced most frequently avoidance behaviour on this campus in comparison to the other three campuses.

Taking the above findings into account, lower levels of fear of crime among students may be related to a higher presence of territoriality and maintenance in the neighbourhood of Campus 3. The higher presence of access control and activity support could have been
associated with these findings. Moreover, as the observers noticed the least signs of visible disorder in this neighbourhood, this could also be related with students’ lower levels of fear of crime. Staff members’ average scores on risk perception and feelings of anxiety may be related to the aforementioned findings. Additionally, more frequent avoidance behaviour among staff members may be related to the slightly lower scores on surveillance.

8.3.4. Campus 4

The results for Campus 4 indicate a higher presence of access control, territoriality and maintenance in this neighbourhood. More specifically, the highest presence of access control and territoriality was found, compared to the other three campuses. Additionally, the lowest presence of surveillance was observed in the neighbourhood of Campus 4 in comparison to the other three campuses. The scores on activity support are comparable to the overall mean. The observers noticed less physical and social disorder compared to the overall mean scores on these variables. The results of the surveys show that students experienced less fear of crime on this campus compared to the other three campuses. For all three dimensions, the lowest scores were found. Staff members’ experiences with fear of crime on Campus 4 are comparable with the overall mean scores for the three dimensions.

In light of these findings, it may be assumed that students’ lower levels of fear of crime on campus are associated with a higher presence of access control, territoriality and maintenance in the campus neighbourhood. A higher presence of the aforementioned CPTED principles could also be related to staff members’ average scores on risk perception, feelings of anxiety and avoidance behaviour. Subsequently, also low levels of disorder may have contributed to lower levels of fear of crime among students.

8.3.5. All campuses

Firstly, the results show that the campuses where students indicated a lower risk perception, less frequent feelings of anxiety and less frequent avoidance behaviour (Campus 3 and 4) have in common that they are characterized by a higher presence of territoriality, maintenance and access control. Surveillance was less observed in the neighbourhood of these two campuses. When these results are compared to the campuses on which students had higher levels of fear of crime, we found a lower presence of maintenance on Campus 2, while Campus 1 is
Relationship between CPTED and fear of crime

characterized by the lowest scores on territoriality and access control. Both campuses are also characterized by a higher presence of surveillance.

Secondly, the results indicate that Campuses 3 and 4 students are characterized by a lower presence of both physical and social disorder. On Campuses 1 and 2, higher levels of physical disorder were observed while a higher presence of social disorder was noticed in the neighbourhood of Campus 2. On this campus, students indicated to frequently avoid certain places. On Campus 1, they experienced most feelings of anxiety and perceived the risk of becoming a victim as highest.

Thirdly, staff members’ scores on the three dimensions of fear of crime are mainly similar to the overall mean scores for these variables. This implies that, concerning staff members’ fear of crime, only preliminary findings can be reported. On Campus 1, staff members indicated to experience least frequent feelings of anxiety and avoidance behaviour, while they estimated the risk of becoming a victim on this campus as the highest. These lower levels of anxiety and avoidance behaviour may be related to a higher presence of maintenance and surveillance in the neighbourhood of the campus. Staff members indicated to have the lowest risk perception on Campus 2, which is characterized by lower levels of maintenance. Additionally, staff members indicated to show most frequent avoidance behaviour on Campus 3, a campus that is mainly characterized by a high presence of territoriality and access control. On Campus 1, where they experienced less frequent avoidance behaviour, the lowest levels of territoriality and access control were observed.

Concerning the relationship between disorder and staff members’ fear of crime, again only preliminary findings can be reported. The highest presence of physical disorder was observed in the neighbourhood of Campus 1, the campus where staff members estimated the risk of becoming a victim as the highest. However, the lowest scores on risk perception were found for Campus 2, which is characterized by the same levels of physical disorder. On this campus, the highest presence of social disorder was found, while staff members’ level of feelings of anxiety and avoidance behaviour are similar to the overall mean scores for these variables. In the neighbourhoods of Campus 3 and 4 lower levels of physical and social disorder were found. On these campuses, staff members indicated average levels of fear of crime, except for avoidance behaviour, which was more frequently experienced on Campus 3.
8.4. **Conclusion and discussion**

This study had the aim to provide more insight in the relationship between CPTED and fear of crime. By using a multi-method approach, combining surveys and SSO, associations between the environmental characteristics of four campus neighbourhoods and fear of crime among university’s students and staff members were examined. Based on the findings, it can be concluded that lower levels of students’ fear of crime may be related to a higher presence of CPTED principles territoriality, access control and maintenance. Additionally, a greater presence of surveillance could be associated with higher levels of fear of crime among students on and in the neighbourhood of the campus. Students indicated to experience more fear of crime on campuses with higher levels of social and physical disorder. The presence of physical disorder may have been more related to students’ risk perception, while visible signs of social disorder may influence students’ avoidance behaviour to a greater extent. Regarding staff members’ fear of crime, it can be concluded that their feelings of anxiety and avoidance behaviour may be associated with the presence of CPTED principle maintenance. Additionally, a higher presence of territoriality and access control may have been related to lower levels of staff members’ avoidance behaviour. Contrary to students’ fear of crime, staff members’ experiences with fear of crime are less related with the presence of physical and social disorder in the neighbourhood of the campus.

In light of the above, we can conclude that similar CPTED principles are related to students’ and staff members’ fear of crime on campus. Lower levels of fear of crime among students were observed on campuses that are characterized by a higher presence of territoriality, access control and maintenance. Also staff members experienced less feelings of anxiety and avoidance behaviour on campuses with a higher presence of maintenance measures. Additionally, they indicated the risk of becoming a victim lower on campuses with a higher presence of territoriality and access control. Concerning the influence of disorder, different conclusions can be drawn for students and staff members. While students experienced less fear of crime on campuses characterized by a lower presence of physical and social disorder, it was difficult to relate staff members’ fear of crime to these variables. In summary, our study showed that CPTED principles territoriality, access control and maintenance were mostly associated with students’ and staff members’ fear of crime on campus. Subsequently, it was
found that the presence of physical and social disorder was more related with students’ fear of crime in comparison to staff members’ fear of crime on campus.

Interventions in the physical environment have shown promising results in reducing crime and fear of crime in different settings such as residential neighbourhoods and commercial areas (Casteel et al., 2004; Cozens et al., 2005). Only few studies have assessed the relation between built environment and fear of crime in an educational context (Fisher & May, 2009; Petherick, 2000; Sas et al., 2021). This study sought to fill this gap by examining the relationship between CPTED and fear of crime in a campus setting. Our findings provide further evidence for the effectiveness of the CPTED approach in promoting security through reducing fear of crime. Additionally, this study offered more insights in which CPTED measures are most effective in a campus neighbourhood. While most European universities are open-access environments where people move between and among buildings and outdoor spaces (Rasmussen & Johnson, 2008), traditional security measures (such as badge checks or fences) are often not desirable or feasible. A more feasible approach to improve campus security could be the implementation of various physical security measures, aligning with the principles of CPTED (Maier & DePrince, 2020; Robinson, 1999). The proactive nature of the CPTED approach could be better suited to college environments compared to more reactive and coercive approaches.

Regarding the assessment of the presence of CPTED, we included five CPTED principles in our checklists of which the items do not consistently refer to the same latent concept as they mainly indicate the presence or absence of physical characteristics that are not always related to each other (e.g., the presence of lighting and the presence of CCTV). This may be different for the phenomena that are based on perceptions, such as social disorder. One social phenomenon (e.g., drunk people) is often accompanied by the presence of other social phenomena (e.g., people fighting). Future research in different crime and demographic settings is needed to examine how the presence of CPTED can be measured in a more reliable way to evolve towards the development of a more solid measurement instrument.

Although this study offered a valuable contribution to the existing literature on CPTED and fear of crime in general and the relationship between these concepts in a campus setting more specifically, there are some limitations to bear in mind when interpreting these findings. The
first potential constraint is that the data were collected at three different points of time. While the surveys were distributed in the spring and summer of 2019, the observations were carried out at the end of 2020. This implies that it is possible that changes could have been made to the built environment or that the presence of disorder has increased or decreased in the period between the three data collections. To overcome this limitation, in-situ observations were combined with observations via GSV. All GSV images were captured after May 2017 and a large majority of images was captured in 2019. Moreover, we asked respondents about their experiences with fear of crime in the past 12 months. However, collecting the data simultaneously is recommended for future research in order to limit this potential bias.

Subsequently, in this study we did not include other factors that could have influenced respondents’ fear of crime, such as previous victimization (e.g., Karakus et al., 2010; Marzbali et al., 2012) or demographic factors (e.g., Fox et al., 2009; Tulloch, 2000). Moreover, as all data were collected through self-reports, socially desirable answers could be given by the respondents. We aimed to overcome this limitation by informing the respondents that we guaranteed the anonymity of their responses, but this is definitely a limitation that has to be taken into account. Additionally, we did also not include factors that could have influenced the presence of CPTED measures at the time the observations were carried out. In this light, it is important to mention that the observations took place during the COVID-19 pandemic, which was accompanied by restrictions implemented by the government\(^\text{11}\). We assume that these restrictions had obviously an impact on the results of the observations, especially regarding the presence of disorder and activity support.

Finally, it remains unclear whether our findings are generalizable to other university campuses or other neighbourhood settings. Future research in different contexts would increase the validity and generalizability of our findings and provide more insights in the relationship between CPTED and fear of crime in various settings. Despite these limitations, the study

\[^{11}\text{At the time of the observations, the following measures against COVID-19, that are relevant for this study, applied: (1) at the University of Antwerp, only 20% of students were allowed to be physically present in the auditoriums, all other students had to follow classes online from home, (2) telework was highly recommended for staff members, several days a week, (3) all bars had to be closed at 11 p.m., (4) non-organized gatherings outside were limited to a maximum of four people, except for family members who lived under the same roof, (5) there was a limitation of a maximum of three close contacts per month for everyone, (6) extra efforts in the field of enforcement had to ensure that the above measures were applied everywhere.}\]
provides support for the CPTED theory and its relationship with people’s fear of crime. A first insight was obtained in the type of CPTED measures that are most effective in campus environments. Our findings offer useful insights for higher educational institutions that have the aim to create a secure environment for their students and staff members. Based on this study, a focus on evidence-based implementations of CPTED measures and disorder limiting measures is recommended.
8.5. References


Cozens, P., & Sun, M. Y. (2019). Exploring crime prevention through environmental design (CPTED) and students’ fear of crime at an Australian university campus using prospect and refuge theory. Property management.


### 8.6. Appendix

**Table 8.4.** Overview of items that were included in the CPTED checklist and their factor loadings ($N=25$).

<table>
<thead>
<tr>
<th>Scale construct (type of scale)</th>
<th>Items</th>
<th>Factor loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveillance (4-point scale (0 to &gt;4))&lt;sup&gt;*&lt;/sup&gt;</td>
<td>There is formal surveillance at the observation point (e.g., police patrol, security guards, community guards, ...)</td>
<td>.41</td>
</tr>
<tr>
<td></td>
<td>There is natural control at the observation point (e.g., pedestrians, shop owners, car drivers, ...)</td>
<td>.52</td>
</tr>
<tr>
<td></td>
<td>There is lighting at the observation point</td>
<td>.42</td>
</tr>
<tr>
<td></td>
<td>There are CCTV cameras at the observation point</td>
<td>.79</td>
</tr>
<tr>
<td></td>
<td>There are signs that indicate the presence of CCTV cameras at the observation point</td>
<td>.79</td>
</tr>
<tr>
<td>Access control (4-point scale (0 to &gt;4))&lt;sup&gt;*&lt;/sup&gt;</td>
<td>There are clearly visible entrances and exits at the observation point</td>
<td>.88</td>
</tr>
<tr>
<td></td>
<td>There are signs that indicate the presence of entrances and exits at the observation point</td>
<td>.88</td>
</tr>
<tr>
<td>Territoriality (4-point scale (0 to &gt;4))&lt;sup&gt;*&lt;/sup&gt;</td>
<td>There are physical barriers (e.g., fences, shrubs, ...) at the observation point that distinguish between the campus and public space</td>
<td>.78</td>
</tr>
<tr>
<td></td>
<td>There are signs that indicate the presence of the university at the observation point</td>
<td>.84</td>
</tr>
<tr>
<td></td>
<td>There are signs that indicate the presence of private properties at the observation point</td>
<td>.59</td>
</tr>
<tr>
<td>Maintenance (4-point scale (very bad to very good))</td>
<td>The condition of the buildings at the observation point is...</td>
<td>.52</td>
</tr>
<tr>
<td></td>
<td>The condition of the road surface at the observation point is...</td>
<td>.67</td>
</tr>
<tr>
<td></td>
<td>The condition of the sidewalks at the observation point is...</td>
<td>.65</td>
</tr>
<tr>
<td></td>
<td>The maintenance of the greenery (e.g., plants, grass, ...) at the observation point is...</td>
<td>.57</td>
</tr>
<tr>
<td>Activity support (4-point scale (0 to &gt;4))&lt;sup&gt;*&lt;/sup&gt;</td>
<td>There is a cultural activity going on (e.g., performance, festival, ...) at the observation point</td>
<td>.67</td>
</tr>
<tr>
<td></td>
<td>There is a playground at the observation point</td>
<td>.73</td>
</tr>
<tr>
<td></td>
<td>There is a park/lake at the observation point</td>
<td>.76</td>
</tr>
<tr>
<td>Physical disorder (4-point scale (0 to &gt;4))&lt;sup&gt;*&lt;/sup&gt;</td>
<td>There are car wrecks at the observation point</td>
<td>.84</td>
</tr>
<tr>
<td></td>
<td>There are bicycle wrecks at the observation point</td>
<td>.79</td>
</tr>
<tr>
<td></td>
<td>There are broken windows/doors at the observation point</td>
<td>.58</td>
</tr>
<tr>
<td></td>
<td>There are visibly vacant buildings at the observation point</td>
<td>.49</td>
</tr>
<tr>
<td>Social disorder (4-point scale (0 to &gt;4))&lt;sup&gt;*&lt;/sup&gt;</td>
<td>There are vagrants, homeless people or beggars at the observation point</td>
<td>.99</td>
</tr>
<tr>
<td></td>
<td>There are drunk people at the observation point</td>
<td>.99</td>
</tr>
<tr>
<td></td>
<td>There are people that are using drugs (e.g., weed, hash, ...) at the observation point</td>
<td>.81</td>
</tr>
<tr>
<td></td>
<td>There are people fighting at the observation point</td>
<td>.99</td>
</tr>
</tbody>
</table>

*Note. 4-point scale with 1 (= 0), 2 (= 1-2), 3 (= 3-4) or 4 (>4).
Discussion and conclusion

Previous studies found that the campus is prone to various types of crime (Jennings et al., 2007; Schokkenbroek et al., 2020), that approximately one-quarter of students report feeling insecure on campus (Maier & DePrince, 2020; Sani et al., 2020) and that security perceptions play an important role in the school choice process of students (British Council, 2012; De Jager & Bezuidenhout, 2014) and in the level of job satisfaction among employees (Ayim Gyekye, 2005; Nielsen et al., 2011). Although authors agree that an integral focus on the technological, organizational and human security domains is needed in order to create a secure environment, HEI’s often overlook the human factor in campus security. In order to obtain more insight in the human domain of security culture, this dissertation consisted of three main parts: (1) a conceptual part, (2) a methodological part and (3) an empirical part. All three parts contributed to the key aim of the dissertation: unravelling the human factors of campus security. In order to do so, four sub-aims were formulated: (i) the development of a comprehensive conceptual model of security culture, (ii) the investigation of how security culture can be measured, (iii) exploring which factors constitute security awareness on campus and how they can be strengthened and (iv) exploring the extent to what environmental cues of the campus are related to fear of crime and how these feelings of fear can be reduced. Throughout seven separate studies, answers were formulated on each of the above research aims.

In this concluding part, the findings of the dissertation will be discussed pertaining these four sub-aims. Subsequently, some practical recommendations are formulated for HEI’s who have the aim to invest in the human factor of campus security and create a secure environment for their students and staff members. Finally, an overview is provided of the limitations of the studies that were carried out, linked to some theoretical implications and suggestions for future research.
9.1. Responding to the four research aims

9.1.1. Development of a comprehensive conceptual model of security culture

To examine the human factors of campus security, it was indispensable to first obtain a clear insight in physical security in general. Although some authors already proposed a definition of security culture (Reniers et al., 2011; Winter, 2007), they mainly focused on one type of organization or security domain. A more holistic model for physical security culture was presented in Chapter 2, based on acquired knowledge in the related domain of safety. Due to the main similarities between safety and security, much can be learned from safety sciences which is characterized by a longer research tradition compared to security. Based on an extensive literature review, the TEAM-model of Vierendeels et al. (2018), which presents a conceptual model for safety culture, was further examined and adapted to the security domain. The presented TEAM-model for security culture offers an integral overview of all security related aspects within an organization and brings together the technological, organizational and human domains in a coherent way.

Our findings showed that the three security domains are strongly intertwined, which implies that organizations should focus on all three domains to strengthen their security culture. This also means that attention should not only be paid to observable security domains (e.g., technology, procedures, behaviour), but also to security aspects that are not visible but offer an important contribution to the security culture, such as people’s attitudes or management’s commitment to security. Additionally, different from safety culture, the impact of security threats (e.g., vandalism, theft) and external factors (e.g., technological development, national culture) should also be considered when analysing or improving an organization’s security culture. Finally, we provided a first insight in how an organization’s security culture can be measured. It is suggested that a diagnosis of all sub-domains is needed in order to provide recommendations for improvement. Furthermore, the organization will benefit from involving all organizational members. This whole process should be seen as a continuous and everlasting cycle of evaluation and improvement. The methodological part of this dissertation (Chapters 3 and 4) focused further on this measurement process.
9.1.2. The investigation of how security culture can be measured

An extensive review of literature showed that only a few authors made an attempt to develop a measurement tool and tested its reliability and validity in practice (e.g., Martins et al., 2007; Schlienger & Teufel, 2003). Chapter 3 aimed to identify and analyse these tools in order to provide recommendations for the development of a standardized measurement instrument. In order to do so, a systematic review of already existing tools that measure security culture was carried out. Six tools were found eligible and were compared to each other regarding their general characteristics and methodological approach. Based on the results of the systematic review, we had to reaffirm that information security has a predominant position in security research. Taking into account the specific focus of these instruments, the results showed that all tools emphasized on the organizational and human aspects of an organization’s security culture. Half of tools also focused on the assessment of the technological domain. More differences were found regarding the methodological approach. The majority of tools used a single method approach, mainly focused on the distribution of surveys. Although this quantitative approach could provide useful insights in the strengths of the organizational and technological domain, it limits the measurement of the human domain, for instance because there is often a dissimilarity between people’s self-reported behaviour in a survey and their actual behaviour. To overcome this potential limitation, two tools included a combination of quantitative and qualitative methods such as the use of document analysis, observations and surveys. Additionally, it was found that the involvement of the entire organization in this measurement process is indispensable (Chia et al., 2002; Martins et al., 2007). On one hand, it is argued that a cultural change should always be supported by the top of the organization (Alnatheer et al., 2012). On the other hand, it is assumed that a stronger support for cultural change is more likely to be achieved when all organizational members are involved (Kraemer et al., 2009).

In Chapter 4, we investigated one methodological approach more thoroughly, namely systematic social observations (SSO). Although numerous studies have been carried out to examine the relationship between individuals’ demographic characteristics (e.g., Fox et al., 2009; May et al., 2010), socio-structural features (e.g., Brunton-Smith & Sturgis, 2011; Vauclair & Bratanova, 2017) or social processes (e.g., Hardyns et al., 2018; Scarborough et al., 2010) and fear of crime, it was one of the sub-aims of this dissertation to examine the relationship
between physical cues in the environment and students’ and staff members’ feelings of security. Over the years, SSO have become a commonly used and effective methodological approach in ethnographic research to examine neighbourhood characteristics (Hinkle & Yang, 2014). Although this observation technique provides many advantages compared to more traditional methods, such as census data or surveys, some disadvantages are linked to observations on site (e.g., transportation costs, extensive time investment, potential dangers in specific areas). In order to overcome these drawbacks, the reliability and validity of in-situ observations, observations via original photographs and observations by means of GSV images were evaluated. Our results showed that observations via photographs and GSV imagery served as reliable and cost-effective tools for gathering information about the presence of physical cues in the environment. It was, however, found that by means of in-situ observations, more disorder and CPTED measures were observed compared to the virtual methods. Observations via original photographs and GSV images seemed to miss an equal amount of aspects or reality due to the specific characteristics of these methods. Based on our findings, challenges and avenues for future research were provided to keep evolving towards a more valid and reliable measurement approach for the physical environment.

9.1.3. Exploring which factors constitute security awareness on campus and how they can be strengthened

The first two chapters of the empirical part of this dissertation aimed to unravel the factors that constitute students’ and staff members’ security awareness and examine how this level of security awareness could be improved. The first empirical study (Chapter 5) focused on staff members’ security awareness and the effectiveness of training sessions on their awareness level. Based on the Knowledge Attitude Behaviour (KAB) model of Baranowski et al. (2003), the relationship between staff members’ security knowledge, attitudes towards security and self-reported behaviour regarding security was examined. A significant relationship was found between security knowledge and attitudes towards security. The results showed no significant relationship between staff members’ attitude and self-reported security behaviour. This complex attitude-behaviour relationship is not new as it has been studied multiple times in previous research (Baranowski et al., 2003; Conner et al., 2002; Newbould & Furnell, 2009). Explanations were found in potential mediators such as the combination of a positive attitude about the expected behaviour, subjective norm towards the behaviour and the perception of
behavioural control, as proposed by the theory of planned behaviour of Ajzen (1991). Also potential moderators, such as the contextual condition in which employees work (Guagnano et al., 1995) or the direct experiences with security (Regan & Fazio, 1977) may impact this attitude-behaviour consistency. Although no direct relationship was observed between staff members’ attitudes and behaviour, we found that more security knowledge and a better attitude towards security related to better self-reported security behaviour. In other words, staff members with greater knowledge about the security procedures of the university and a more positive attitude towards security indicated to behave in a more secure way on campus. Taking into account socio-demographic characteristics, employees who are older, who are working at the university for a longer time and who spend more time on campus reported to know more about the university’s security procedures. Older employees also indicated to behave in a more secure way.

In order to examine the effectiveness of training sessions on staff members’ knowledge, attitudes and behaviour, awareness trainings were organized on campus. A comparison between the results of a pre-test and post-test survey among the participants showed a significant increase in staff members’ security knowledge and attitudes towards security. A smaller and non-significant improvement in people’s self-reported security behaviour was observed. Although we found an overall positive impact of the training on staff members’ security awareness, the results also showed that increased attention is needed for the behavioural awareness dimension. A combination of awareness trainings, which mainly affect participants’ knowledge and attitudes, and more practical initiatives aimed at influencing participants’ behaviour, such as interactive demos or workshops, are therefore recommended.

An alternative approach for improving people’s behaviour was found in the use of nudges (Chapter 6), which already proved to be successful in other research domains. A quasi-experiment was carried out at the university to reduce the opportunities for bicycle theft by carrying out two nudging interventions. Stickers and posters that contained a clear social norm were implemented in a selection of bicycle parking facilities in the neighbourhood of one university campus in order to improve cyclists’ locking practices by making them more aware of the potential risks and informing them about the expected preventive behaviour. Our findings showed that the nudges served as an effective crime prevention measure. At the end
of the experiment, significant more cyclists locked their bicycle in a secure way at the treatment sites compared to the control sites. Although the nudges aimed to impact people’s reflective or conscious decision process, a large majority of cyclists indicated that they had noticed the interventions, but that they changed their behaviour not under the influence of the nudges or any other factors. Additionally, although 85% of cyclists indicated to be aware of the nudges, still 20% of them locked their bike in a poor way at the end of the experiment. Taking these findings into account, the nudges may have rather affected cyclists’ automatic or unconscious decision process. This led to the conclusion that an increase in people’s awareness does not always lead to a change in behaviour. Referring to the findings of the previous empirical study (Chapter 5), an explanation may be found in the relationship between cyclists’ attitudes and behaviour and potential moderators and mediators that could affect this complex connection.

**9.1.4. Exploring the extent to what environmental cues of the campus are related to fear of crime and how these feelings of fear can be reduced**

In addition to unravelling people’s security awareness, it was a sub-aim of this dissertation to empirically examine which factors contribute to fear of crime on campus. Our empirical study in Chapter 7 responded to this aim and focused on the impact of contextual factors on students’ fear of crime. By carrying out a large-scale survey among all students of the University of Antwerp, the relationship between students’ fear of crime and the perceived presence of physical and social disorder was examined. Our findings showed that a higher perception of physical disorder in combination with a higher risk perception and higher levels of anxiety led to more avoidance behaviour on campus. In other words, students who perceived more physical disorder, such as litter or visible signs of vandalism, indicated to show more avoidance behaviour on campus. Another relationship was found between perceived social disorder and feelings of anxiety, indicating that students’ feelings of anxiety increase when they notice more social disorder, such as drunk people or people fighting, on campus. Considering gender differences, our study confirmed the findings from previous studies (Hollander, 2001; Pain, 2001) as female students indicated to show more avoidance behaviour compared to their male counterparts. While these behavioural patterns often arise from a higher risk perception and more feelings of anxiety, no significant relationships were found between gender and these two fear of crime concepts. Although both male and female
students indicated similar scores on risk perception and feelings of anxiety, this resulted more frequently in a change in behaviour among female students compared to male students. Based on these findings, we concluded that ‘fixing the broken window’, or preventing and reducing both social and physical disorder, should be an integral part of HEI’s security policies in order to reduce fear of crime among students.

The empirical study in Chapter 8 further examined the relationship between contextual factors and fear of crime. By applying a multi-method approach, the relationship between Crime Prevention Through Environmental Design (CPTED) and disorder and campus residents’ fear of crime was explored. Data collected via SSO (as described in Chapter 4) was merged with data originating from the two large-scale surveys carried out among students and staff members (see also Chapters 5 and 7). This way, our study aimed to assess the presence of CPTED measures and disorder within four campus neighbourhoods and examine the relationship with students’ and staff members’ fear of crime on and in the neighbourhood of these campuses. Our findings showed that similar factors contribute to students’ and staff members’ fear of crime. Both students and staff members indicated to show lower levels of fear of crime on campuses characterized with a higher presence of access control (e.g., detection systems), maintenance (e.g., condition of the buildings) and territoriality (e.g., hedges, fences). Concerning the relationship between fear of crime and the presence of disorder, we could draw different conclusions. While students experienced less fear of crime on campuses characterized by a lower presence of physical and social disorder, a less straightforward relationship was found between staff members’ fear of crime and disorder. Nevertheless, our results provided further evidence for the effectiveness of the CPTED approach in creating a secure environment through the reduction of fear of crime. The implementation of physical features in the built environment of the campus may serve as a more feasible security approach compared to more sophisticated technological measures. Finally, similar to the conclusions and recommendations that were drawn based on the findings of Chapter 7, preventing and tackling disorder is recommended in order to decrease students’ fear of crime.
9.2. Recommendations

The specific characteristics of the campus and the campus neighbourhood make it a major challenge for HEI’s to create an environment where students and staff members feel secure to participate in various activities. The conceptual, methodological and empirical studies in this dissertation offered valuable insights in how HEI’s can approach campus security. For most HEI’s, it is one of the biggest challenges to find the right balance. In the following paragraphs, we will provide some recommendations that may help HEI’s to find the right balance. More specifically, we will focus on three topics:

1. Finding a balance between the technological, organizational and human security domains;

2. Finding a balance between students’ and staff members’ security knowledge, attitudes and behaviour;

3. Finding a balance between the open campus design and students’ and staff members’ feelings of security.

9.2.1. Finding a balance between the technological, organizational and human security domains

With the technological, organizational and human security domains, we refer to the organization’s security culture as proposed by the TEAM-model in Chapter 2. Throughout this dissertation, the importance of a strong security culture was emphasized, indicating that HEI’s should focus simultaneously and proportionally on all three domains. In order to develop an efficient security culture in practice, we argued that this process always starts with a diagnosis of security culture, followed by the formulation of recommendations and the implementation of improvement strategies. Based on our findings, some recommendations regarding those three essential phases in the development of security culture can be formulated.

9.2.1.1. Diagnosis of security culture

The diagnosis of security culture starts with an identification of the HEI’s goals in the field of security. Decisions have to be made about which security aspects will be measured, how this
will be measured and what has to be done whether adjustments are needed (Reniers et al., 2011). To figure out what has to be measured, HEI’s have to determine the dimensions and sub-dimensions of their security culture. More specifically, the technological, organizational and human security domains have to be filled in with concrete aspects that are relevant for the HEI. Subsequently, these dimensions and sub-dimensions need to be translated into measurable performance indicators to be able to objectively assess them. In order to determine how these security aspects can be measured, our findings from Chapters 2 and 3 of this dissertation showed that a multi-method approach is recommended. More qualitative methods are suitable for the measurement of the observable technological (e.g., CCTV, detection systems), organizational (e.g., written security procedures) and human (e.g., students’ and staff members’ behaviour) security domains. Measurement techniques such as interviews, focus groups, document analyses or observations may provide more insight in the effectiveness of these security aspects. To evaluate the non-observable organizational (e.g., trust in the organization, perceptions on management commitment towards security) and human (e.g., students’ and staff members’ attitudes towards security) domains, a more quantitative approach is needed, such as the use of questionnaires.

Applying a multi-method approach makes the measurement process more time-intensive, but ensures a more detailed and realistic outcome that can be translated into substantiated recommendations. Moreover, the combination of multiple measuring tools does not have to imply that HEI’s have to invent new tools as they can often rely on instruments that are already in use in other domains. For instance, think of surveys that are carried out in order to obtain more insight in the well-being of staff members and students, or questionnaires that assess students’ opinion regarding the content of course units. The same software programs and distribution methods may be used to carry out a survey about students’ attitudes towards security or staff members’ trust in the organization. Additionally, valuable information can be obtained from incident reports. As HEI’s already follow up the reports of occupational incidents, similar reporting methods and evaluation techniques may be used for security incidents. Furthermore, most HEI’s have a yearly tradition of carrying out an evacuation drill in case of a fire alarm. While the observation of how this exercise is performed provides valuable information on students’ and staff members’ safety knowledge and behaviour,
similar exercises may be organized regarding security incidents, such as a bomb alert or active shooter threat.

9.2.1.2. **Formulation of recommendations**

Based on the diagnosis of the security culture, recommendations for improvement can be formulated. In Chapter 3 of this dissertation, we found that only two of six existing measuring tools for security culture focused on the formulation of recommendations in their approach. Carrying out a diagnosis of HEI’s security culture without putting the outcomes in practice, should be considered as a missed opportunity. It is recommended that the measurement process leads to well-formulated security strategies that aim to strengthen HEI’s technological, organizational and human domains. Based on the diagnosis, some weaknesses and strengths of the organization’s security approach are discovered, which can be translated to short-term and long-term goals.

Additionally, the importance of benchmarking was emphasized by some measuring tools we discussed in Chapter 3 (AlHogail & Mirza, 2015; Martins et al., 2007). By comparing one’s own security strategy with other HEI’s, the own level of campus security can be determined more accurately. Additionally, HEI’s can learn from the knowledge and experiences of peers and share best practices which may result in more informed decisions about campus security. For instance, the Association of University Chief Security Officers (AUCSO, 2016) provides a forum to exchange knowledge and best practices relating to campus security within the sector. This association for security professionals working at HEI’s in the United Kingdom, Europe and across the globe organizes annual meetings and provides an online forum on which information can be shared.

9.2.1.3. **Implementation of improvement strategies**

Building on the previous phase, the implementation of improvement strategies is needed in order to develop a strong security culture. When introducing new security measures, it is recommended that the entire organization is involved. This implies that not only staff members and students need to be prepared and informed about changes in security approaches, but that also other people, such as contractors, visitors or neighbouring residents should be involved in this process. Additionally, our findings showed that a pioneering role
should be attributed to the organization’s management (Alnatheer, 2012; International Atomic Energy Agency, 2017). Showing commitment and involvement regarding security issues may lead to more support and more positive attitudes towards security among other organizational members. Moreover, expected security behaviours will be more accepted as the way things are done within the organization when the example is set by the management. Closely related to this, it is indispensable that organizational members have trust in the management concerning security and vice versa. It will be easier to implement new security strategies when the management of HEI’s trust all staff members and students.

Furthermore, when implementing improvement strategies in the field of security, it is important to find a balance between safety and security. While security culture research can be considered as a relatively new field and a topic that is still climbing higher on the business agendas of organizations, the safety domain is characterized by a longer research tradition and a strongly anchored position within organizations’ daily operations. HEI’s have often implemented numerous safety measures, while they are still gradually considering the need to protect themselves against security incidents as important. Although safety and security differ on many areas, they also contain a lot of similarities. This implies that, when implementing security measures, a strong overlap with safety measures is expected. On one hand, measures taken in the field of security may also have a positive effect in the safety domain and vice versa. For instance, awareness trainings aimed to improve participants’ security awareness may also result in more awareness of safety aspects among participants. On the other hand, a contradiction may emerge when applying safety and security measures in practice. For instance, from a security perspective it is indispensable that some buildings (e.g., laboratories) are locked with a badge system. In case of a safety incident, however, it is important that everyone can exit the building as quickly as possible, preferably without losing time by using a badge. In other words, finding the right balance between safety and security requires an adequate alignment between both types of measures in the two domains.

Finally, a regular follow-up of the implemented improvement strategies is needed in order to maintain a strong security culture. Regular evaluations are indispensable in order to obtain knowledge about whether recommendations from previous measurements were actually implemented and the extent to which these security measures effectively improved HEI’s security culture. Previous studies agree that the creation of a strong security culture should
be considered as a long-term and continuous process, which will take many years (Gaunt, 2000; Reniers et al., 2011).

9.2.2. Finding a balance between students’ and staff members’ security knowledge, attitude and behaviour

Throughout this dissertation, we argued that HEI’s often overlook the importance of human factors when investing in physical security. The TEAM-model in Chapter 2 showed that the human aspects are an indispensable part of HEI’s security culture. In order to strengthen this human domain, HEI’s should focus on students’ and staff members’ security awareness, or their security knowledge, attitudes towards security and security behaviour. In Chapters 5 and 6, we empirically examined the effectiveness of security trainings and nudges for increasing security awareness. Based on our findings and best practices from previous research, some recommendations for the improvement of students’ and staff members' security knowledge, attitudes and behaviour are formulated. Additionally, some considerations when implementing a security awareness program are highlighted.

9.2.2.1. Sufficient knowledge as the necessary foundation

In Chapter 5 of this dissertation, we found that staff members who have more security knowledge also indicated to behave in a more secure way. In order to improve security awareness, it is therefore indispensable that students and staff members acquire knowledge about the potential risks on campus and the behaviour they can adopt to prevent criminal incidents. As campus security is often not their main concern when performing activities on campus, it is important that the most efficient, desirable and feasible awareness programs are developed.

Our evaluation of the effectiveness of awareness trainings showed a positive impact on participants’ knowledge about the security procedures and policies. Also in previous research, education is considered as one of the most effective methods to transfer the necessary information (Eminağaoğlu et al., 2009; Furnell & Clarke, 2005; Kim, 2014). In order to develop efficient awareness trainings, the content plays a significant role (King et al., 2001; McCoy & Fowler, 2004). In our trainings, we mainly focused on terrorism and radicalization at the request of the university as they noticed some concerns about these topics among staff
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members. In general, the information that is provided should be based on what participants need to know about security, instead of what is nice to know. Subsequently, the information communicated should always be adjusted to the participants of the training (McCoy & Fowler, 2004). Finding a balance between theoretical explanations and more practical security guidelines is therefore indispensable.

Additionally, it is important that awareness programs do not take up too much time (King et al., 2001). In our study, we organized the security trainings during lunchtime, so that staff members had to invest as little working time possible. This approach led to the desired outcome as the maximum number of registrations per training session was achieved. An alternative format may be the organization of online trainings, which can be followed whenever students or staff members have sufficient time. In addition to training sessions, also other methods such as newsletter articles, email messages, posters, flyers or banners on the intranet may be used to transfer security information to the target group. Regardless of which method is used, it is recommended that the program is time efficient, focuses on what participants must know and provides information that is adjusted to the audience.

9.2.2.2. Positive attitudes as the indispensable link in the awareness chain

Our findings showed that people’s attitudes towards security are an indispensable link between their knowledge and behaviour. Increased attention for students’ and staff members’ attitudes is therefore needed when organizing awareness programs. We argued that some mediating or moderating factors could have an important role in the development of attitudes towards security. For instance, according to Regan and Fazio (1977), individuals who form their attitudes on direct behavioural interaction with the attitude’s object will show significantly greater attitude-behaviour consistency than people whose attitudes are formed by other means. When adapting this assumption on security awareness improvement strategies, more interactive formats may have a greater impact on people’s attitudes.

Our awareness training only included a short moment of interaction at the end of the presentation. Previous research has found that, in order to make trainings sessions more effective, it is useful to include some discussion moments during the training (Albrechtsen & Hovden, 2010). By discussing different security issues, knowledge can be shared among participants which may influence their understanding of the security strategies of the
organization. By learning more about the attitudes of their colleagues, they may change their own motivation in a positive way. Additionally, alternative and more interactive approaches, such as penetration tests, red teaming, simulation attacks or interactive demos could increase participants’ direct interaction with certain security topics, which may also lead to more positive attitudes towards security.

Finally, in order to change people’s attitudes, it is indispensable that security is a natural part of the organizational culture from day one students start to study or staff members start to work at the HEI. On this moment, necessary security procedures need to be communicated to indicate the expected level of security on campus and show the importance given to campus security. Subsequently, regularly and various programs should be organized to maintain attention for security among students and staff members. This way, attitudes towards security can gradually be shaped which ideally leads to more secure behaviour.

9.2.2.3. Secure behaviour as the desired outcome

The security awareness programs and guidelines that were discussed in the previous paragraphs all aim to achieve more secure behaviour among people. Our findings concerning the impact of awareness trainings showed that they did not result in a significant change in participants’ (self-reported) security behaviour. As an alternative approach, we examined the effectiveness of nudging in Chapter 6, which did show a significant behavioural change among cyclists. Also the limited amount of previous experiments with nudges in the field of physical security proved to be successful (Gamman & Willcocks, 2010; Kuiper et al., 2016).

In our study, we implemented system 2 nudges in the format of a sticker and a post to target people’s reflecting and conscious thinking. Both interventions contained a clear social norm which referred to the approved behaviour and the behaviour that is set by other people. Starting from the assumption that people tend to do what is socially approved and what is popular, the inclusion of these social norms resulted in the desired outcome. Including social norms in security awareness programs is therefore a recommended strategy to achieve the desired behavioural outcome. Additionally, as the use of an image showing the behaviour that was expected from the cyclists proved to be successful in our experiment, it is suggested that the expected behaviour should be presented as simple and easy as possible. While we found that the first nudge increased cyclists’ locking behaviour significantly, the combination of both
nudges showed less impact. Taking this into account, it is recommended to focus on one type of nudge or message to direct people’s behaviour. Also in previous research it is argued that a change in people’s behaviour is more difficult when the person is bombarded with a large number of messages (Bada et al., 2019). Moreover, it is important that some ethical concerns are born in mind when implementing nudges (Sunstein, 2015). Awareness is needed for the thin line that separates nudging from the manipulation of choice and a lack of transparency regarding underlying intentions. Finding a balance between individuals’ autonomy and steering people’s behaviour into the ‘right’ direction is therefore indispensable, especially in a higher educational environment where much importance is attached to freedom of choice.

Finally, Guagnano et al. (1995) argued that contextual conditions are important when achieving the desired behaviour among the target population of an awareness program. Not having two bicycle locks may be one of the reasons why some cyclists did not change their behaviour during the nudging experiment. To refer to another example; when encouraging students and staff members to report incidents, it is indispensable that an easy to use and quickly available incident reporting system is implemented. In this light, it is recommended that HEI’s provide sufficient security tools when stimulating people to behave in a more secure way.

9.2.2.4. **Considerations when organizing security awareness programs**

In addition to the specific recommendations that were provided to increase people’s security knowledge, attitudes and behaviour, some general considerations can be formulated when organizing security awareness programs.

First, it is indispensable that all organizational members are involved in the awareness program. As already mentioned before, a strong security culture can only be achieved when everyone is included in the change process. Consequently, all organizational members should be encouraged to participate in security awareness programs. Especially for HEI’s, this may cause a big challenge as the student population changes every four or five years and also within the staff member population there is often a quick turnover in the employment of (foreign) researchers or teaching staff. Reaching specific groups, such as first-year students or foreign doctoral students may be a challenge but is considered as indispensable.
Secondly, it is suggested that security awareness programs focus on topics that still could need some improvement. Obtaining a baseline view or indication of how security aware students and staff members are about certain topics is therefore necessary. Additionally, not only the overall level of security awareness before and after the awareness program should be measured, also the program itself needs evaluation. Based on an overview of the strengths and weaknesses of the program, improvement strategies for more efficient initiatives may be formulated. Similar to the measurement of HEI’s security culture, it is recommended to adopt a multi-method approach when evaluating participants’ awareness and the program’s effectiveness.

Thirdly, it is recommended to repeat awareness programs regularly in order to achieve long-term changes in students’ and staff members’ knowledge, attitudes and behaviours. Although educational methods are considered as one of the most effective and powerful mechanisms to increase people’s awareness, the addition of other initiatives such as posters, flyers, videos, demos or quizzes may be useful to highlight certain security topics that may be forgotten some weeks after a training session. A combination of educational methods with ongoing awareness campaigns is therefore recommended. For instance, the Center for the Protection of National Infrastructure (CPNI), located in the United Kingdom, provides various examples of security awareness campaigns on its website on which inspiration can be drawn (CPNI, 2020).

Finally, HEI’s should find the right balance between providing sufficient information and causing increased fear of crime when implementing awareness programs. Previous research has shown that fear invocations provide an insufficient change in behaviour (Bada et al., 2019). Offering an adequate amount of information in the most appropriate format is therefore needed in order to prevent an increase in fear of crime among students and staff members. Closely related to this, encouraging people to undertake preventive actions should always be accompanied with the implementation of security measures aimed at discouraging perpetrators from commit crimes. A one-sided focus on the responsibilities of potential victims needs to be avoided.
9.2.3. Finding a balance between the open campus design and students’ and staff members’ feelings of security

As HEI’s are by their very nature open-access environments where people move between and among buildings and outdoor spaces, it is one of HEI’s major challenges to create a secure environment for students and staff members while maintaining an open campus. Our empirical studies on the impact of disorder on students’ fear of crime (Chapter 7) and the relationship between CPTED and fear of crime among students and staff members (Chapter 8), showed that the campus design plays an important role in feelings of security among campus’ residents. In this light, we propose the following recommendations.

9.2.3.1. Tackling disorder as a key strategy

Our findings showed that students indicated to experience more fear of crime on campuses where they noticed a higher presence of social and physical disorder. Both the campus and its neighbourhood can be considered as hotspots for crime and disorder. The presence of leisure venues, such as bars, restaurants or shopping venues contribute to the attractiveness of these areas. As higher levels of disorder are expected, tackling social and physical disorder can be considered as an important strategy to create an environment where students and staff members feel more secure.

In order to reduce disorder on campus, HEI’s may focus on tasks such as regularly cleaning the classrooms, providing a quick follow up on reported infrastructural defects or ensuring that there are enough garbage bins on campus. These are, however, activities that are often inherently linked to the normal duties of HEI’s. In addition, an alternative approach may be found in the use of nudges. While we experimented with nudges to create more awareness about bicycle theft, previous studies and field experiments showed that nudges may also be effective in reducing physical and social disorder. For instance, to prevent and reduce loitering, various designs of garbage bins have been developed (Kolodko et al., 2016; Mazar et al., 2013), mirrors were installed in more vandalised neighbourhoods to influence people’s self-awareness (De Kort et al., 2008) and footsteps were placed on the ground to direct people to garbage bins (Keep Britain Tidy, 2013; Webster, 2012; Zero Waste Scotland, 2015). To prevent social disorder, experiments have been carried out to prevent fighting by installing mirrors and red carpets in entertainment areas (CCV, 2015), to reduce public urinating by placing
footsteps on the ground to direct people to public toilets (Celis, 2020), or to limit the presence of drunk people by sending students text messages to encourage them to think about their drinking behaviour (Lesner et al., 2020). Both our experiences with nudges and the aforementioned examples show that this approach may be a successful and cost-effective strategy to reduce physical and social disorder on campus and in its neighbourhood.

Additionally, awareness programs could be efficient in encouraging students and staff members to keep the campus clean and to avoid showing socially undesirable behaviour. This recommendation is supported by previous researchers who emphasize that campaigns can be implemented very easy without being too expensive, especially compared with other technological measures (Jennings et al., 2007; Sani et al., 2020). Similar methods as described in section 9.2.2. may be used to make people more aware of the importance of the absence of disorder. Finally, when preventing and tackling disorder in the neighbourhood of the campus, close cooperation between HEI’s and local authorities is needed. Actors such as the police department, community guards and local entrepreneurs are considered valuable stakeholders when implementing nudges or awareness programs. It is therefore a responsibility of HEI’s to initiate and maintain partnership with local authorities.

9.2.3.2. Hedges and shrubs as crime prevention measures

In addition to the relationship between disorder and fear of crime, our findings showed that also other contextual factors, such as the presence of CPTED measures, play an important role in the feelings of insecurity among students and staff members. More specifically, we found that lower levels of fear among students and staff members were related to a higher presence of CPTED principles maintenance, access control and territoriality. Higher levels of fear were found at campuses characterized by less surveillance measures.

The CPTED principle maintenance starts from the assumption that visible well-maintained and attractive spaces reduce crime and fear of crime. In this light, we refer to the previous section where some guidelines to tackle disorder were provided. To ensure more territoriality on campus, various landscaping elements, such as fencing, hedges or shrubs may be implemented. By making a distinction between the campus and the public environment, a sense of ownership is created which may deter crime and disorder. Clearly indicating the presence of HEI buildings (e.g., by arrows or signs) may also contribute to more territoriality.
The principle access control assumes that crime is more likely in highly accessible areas. To find the right balance between the open campus design and a limited access for people who do not necessarily need to be on campus, some access restrictions may be applied. Off-limit areas of campus property, such as server rooms, laboratories or computer labs, could be equipped with locks or badge control systems to keep intruders out. Implementing reception areas at buildings that should not be accessible for everyone also increases the presence of access control.

The surveillance principle assumes that crime is less likely to occur as deviant behaviour can be noticed and reported more easily. It involves the implementation of mechanical surveillance, such as CCTV, or formal surveillance, such as the presence of security guards, police patrols or community guards. Additionally, the importance of natural surveillance is emphasized. Concerning HEI’s, this form of surveillance may be performed by students and staff members, but also by other people such as residents of the campus neighbourhood, shopkeepers in these areas or even pedestrians walking along the campus. In order to increase natural surveillance, HEI’s should create highly visible areas with little opportunities for potential perpetrators to hide, for instance by keeping shrubs low and avoiding the implementation of high fences. Additionally, previous studies showed that the presence of lighting positively influenced people’s feelings of anxiety (Tseng et al., 2004; Vos et al., 2015) and found a significant decrease in areas that were well lit (van Noije & Wittebrood, 2008). Based on these findings, spaces that are poorly lit should be reduced on campus.

In light of our results, it is suggested that CPTED may be an efficient security measure for HEI’s who aim to maintain an open campus design. CPTED measures are often easily accessible and may be implemented in any area on campus and in its neighbourhood. Moreover, as this type of measures can be applied in the design phase of new buildings or areas in a very natural way, they can be considered as cost-effective.

9.3. Limitations and future research

Although this dissertation offers several valuable contributions to the existing research on campus security and the human factors of security culture, these should be interpreted while keeping some limitations in mind. Although the shortcomings of this research to the field(s)
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of study and to policy have been articulated throughout this dissertation, some points warrant further reflection. A distinction is made between general limitations that apply to the dissertation as a whole and limitations that are inherently linked to the methodological approaches of the empirical studies. In the following paragraphs we will highlight some limitations by linking them to opportunities for future research.

9.3.1. General limitations

As was already discussed in Chapters 2 and 3 of this dissertation, there does not exist a widely accepted definition of physical security culture nor is there a standardized instrument for measuring an organization’s security culture available. We aimed to present a conceptual model of physical security and provided recommendations for the development of a standardized measurement instrument, based on a literature review and systematic review. Among other insights, this extensive search of literature showed that there is clearly a lack of research on physical security culture. Throughout this dissertation, we had to draw inspiration from other research fields, such as safety sciences or information security. Moreover, the limited amount of studies that examined physical security mainly focused on one type of organization, such as nuclear of chemical companies. Although studies originating from these related domains and sectors offered valuable information, it is certainly a limitation that we could not rely on previous research that examined physical security in a more comprehensive way. We aimed to fill this research gap by carrying out four empirical studies on physical security, but we also focused on one specific type of organization. It is therefore recommended for future research to further explore the security domain and carry out empirical research within different types of organizations as not only HEI’s, but also other organizations are increasingly confronted with various types of security threats. Additionally, it would be useful to focus on all three domains of security culture (i.e., technological, organizational and human domains). Considering the specific campus environment and as a way of determining the scope of this dissertation, we focused predominantly on the human domain of physical security. Although we aimed to not separate this from the other domains by regularly referring to technological and organizational aspects, more research is needed on all three domains.
Additionally, we did not only focus on one type of organization, but we also carried out all empirical studies at one HEI (i.e., the University of Antwerp). As this research project was initiated by the university itself, it was clear from the beginning that the four campuses would serve as the main research area. With the support of the University of Antwerp, we were able to distribute two large-scale surveys among the entire student and staff member population, we had the possibility to organize awareness trainings on campus and we could experiment with nudges in the neighbourhood of the campus. Although these research opportunities led to valuable insights in campus security, the specific characteristics of the University of Antwerp should be considered when interpreting the results and applying them to other HEI’s. As we acknowledged this limitation from the start of this research project, we aimed to provide sufficient information about the university itself, its design and the student and staff member population in the empirical studies. Additionally, insights that were obtained from the qualitative in-depth interviews with security managers from other HEI’s in Belgium and The Netherlands were taken into account during the research project. Subsequently, throughout this dissertation we aimed to compare findings from the limited amount of studies on campus security that were carried out in Europe with our empirical results. However, future research on campus security on other HEI’s is needed in order to examine whether our findings can be generalized to other universities in Belgium and abroad.

Another limitation can be attributed to the absence of crime statistics in this dissertation. Although we have repeatedly requested these statistics from the police authorities, we were not able to obtain them. Official statistics would have been useful, for instance, to measure the effectiveness of the nudges based on a comparison of the number of bicycle thefts before and after the interventions. Although reported crimes reflect only a part of all crimes that are committed, it is recommended for future research to take these statistics into account as they could provide valuable information about the effectiveness of security measures or serve as potential mediators in people’s fear of crime on campus.

9.3.2. Methodological limitations

Besides general limitations attributed to the dissertation as a whole, some methodological shortcomings that are linked to the empirical studies have to be mentioned.
First, it should be pointed out that all empirical studies included in this dissertation used cross-sectional designs. For instance, in Chapter 7 we examined the relationship between the presence of disorder and students’ fear of crime based on data obtained from a survey. As this methodological approach can be considered a snapshot in time, this limits the possibility to find a causal link between the included concepts. In other words, it is impossible to declare with certainty whether it is fear of crime that determines the significance of disorder within the neighbourhood or whether it is the perceptions of disorder that shape subsequent levels of fear. A more longitudinal approach would be required in order to examine whether students’ fear of crime changes over time. Especially for HEI’s, which are characterized by a student population that changes every four or five years, obtaining an overview of changes in students’ fear of crime over the years would be useful. Additionally, these fears may also be related to the occurrence of major crime events, such as a terrorist attack, which makes a regularly follow-up very interesting. Closely related to this, it is another limitation that we did not include a number of variables noted to mediate people’s fear of crime. Amongst others, factors such as ethnic diversity (Hooghe & De Vroome, 2016), socio-economic status (McCrea et al., 2005), social networks (Scarborough et al., 2010) or news exposure (Romer et al., 2003) could have played a role in students’ and staff members’ fear of crime. As such, it is recommended to include more of these variables in future research, when examining fear of crime.

Secondly, some other limitations can be attributed to the design of the two large-scale surveys that were carried out among students and staff members. As the respondents could voluntarily choose to fill in the questionnaires, this self-utilizing character can be considered as a potential limitation. Using a non-random selected research sample may have the implication that people who already had a greater interest in campus security were more likely to participate in the study. Additionally, by using this research design, we were not able to control the equal distribution of the demographic characteristics of the participants. Replications with more representative samples are needed to exclude specific effects on the results. Another limitation of the surveys is linked to the included measures, which were not controlled in terms of possible response biases, such as social desirability. This can mainly be considered as a limitation with regard to staff members’ reported level of security awareness. As they had to indicate to what extent they knew the security procedures and policies of the
university, and to what extent they (would) perform a certain behaviour, their answers are highly susceptible to socially desirable behaviour. As such, it is recommended for future research to control for social desirability or other response biases. Also alternative methodological approaches may be used to measure the actual level of security knowledge or behaviour, for instance by awareness quizzes (Khan et al., 2020), interviews (Parsons et al., 2014), group conversations (Albrechtsen & Hovden, 2010) or observations (Rantos et al., 2012).

Thirdly, the two quasi-experiments that were carried out have the limitation in common that the results are only valid for short-term conclusions. In the first experiment with security trainings, the post-test was carried out approximately two weeks after the training was organized. Although the nudging experiment was carried out for 12 weeks, we were not able to observe long-term changes in cyclists’ locking behaviour. Because little research has been carried out on the long-term effect of trainings or nudges, it is recommended for future research to fill in this research gap and repeat evaluations after some time.

Regardless of the limitations that are inevitably linked to every study, this dissertation provided unique and valuable insights in campus security. We are convinced that the conclusions and recommendations of this dissertation could be very helpful for both HEI’s and researchers. We hope that this dissertation is the starting point of an increasing trend in research on physical security in general and campus security in particular. Additionally, we hope that our recommendations may help security managers of HEI’s to strengthen the human security domain by making students and staff members more aware of security and most of all, create a secure campus environment where everyone feels free to study, work and perform other activities.
9.4. References


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McCoy, C., & Fowler, R. T. (2004). "You are the key to security" establishing a successful security awareness program. Proceedings of the 32nd annual ACM SIGUCCS conference on User services,


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## Author contributions

Table 9.1. Overview of the doctoral candidate’s contributions to each study.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Authors</th>
<th>Drs.’ contribution</th>
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<td>Introduction</td>
<td>Marlies Sas</td>
<td>Writing</td>
</tr>
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<td>2</td>
<td>An integrative conceptual framework for physical security culture in organizations</td>
<td>Karolien van Nunen, Marlies Sas, Genserik Reniers, Geert Vierendeels, Koen Ponnet, &amp; Wim Hardyns</td>
<td>Data collection, &amp; writing</td>
</tr>
<tr>
<td>3</td>
<td>Measuring the security culture in organizations: a systematic overview of existing tools</td>
<td>Marlies Sas, Wim Hardyns, Karolien van Nunen, Genserik Reniers, &amp; Koen Ponnet</td>
<td>Research design, data collection, data analysis, chapter conceptualization, &amp; writing</td>
</tr>
<tr>
<td>4</td>
<td>Measuring CPTED and disorder through different systematic social observation methods: in-situ observations, original photographs and Google Street View images</td>
<td>Marlies Sas, Thom Snaphaan, Lieven Pauwels, Koen Ponnet, &amp; Wim Hardyns</td>
<td>Research design, chapter conceptualization, &amp; writing</td>
</tr>
<tr>
<td>5</td>
<td>The impact of training sessions on physical security awareness: Measuring employees’ knowledge, attitudes and self-reported behaviour</td>
<td>Marlies Sas, Genserik Reniers, Koen Ponnet, &amp; Wim Hardyns</td>
<td>Research design, data collection, data analysis, chapter conceptualization, &amp; writing</td>
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<td>6</td>
<td>Nudging as a crime prevention strategy: the use of nudges to improve cyclists’ locking behaviour and reduce the opportunities for bicycle theft</td>
<td>Marlies Sas, Koen Ponnet, Genserik Reniers, &amp; Wim Hardyns</td>
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<td>7</td>
<td>Unravelling college students’ fear of crime: the role of perceived social disorder and physical disorder on campus</td>
<td>Marlies Sas, Wim Hardyns, Genserik Reniers, &amp; Koen Ponnet</td>
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<td>8</td>
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<td>Marlies Sas, Koen Ponnet, &amp; Wim Hardyns</td>
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<tr>
<td>9</td>
<td>Discussion, conclusion and recommendations</td>
<td>Marlies Sas</td>
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Overview of all publications emerging from this research project


