

# Safety and privacy perceptions in public spaces: An empirical study on user requirements for city mobility

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**Abstract.** Mobility represents an essential prerequisite for the participation in social lives in urban environments. However, seamless mobility and traveling is based on dwellers' perception of a high personal safety at different urban locations. Safety can be supported by adequate surveillance technologies (e.g., cameras, but any surveillance undermines individual wishes for protection of privacy. In this empirical study, we explore users' perceptions on safety and privacy. Using an online survey, 99 users were requested to indicate their acceptance of different types of technologies that increase safety, differentiating perceived benefits and barriers. Also, we explored acceptance differences towards surveillance technologies during day- and nighttime at various locations (private and public). Finally, we determined the trade-off between the wish for increasing safety and the wish for privacy.

**Keywords:** privacy, safety, mobility, user diversity, technology acceptance, tradeoff between privacy and security

## 1. Introduction

One of the major challenges of modern societies is to meet the complex demands of urbanization processes and to maintain livable, sustainable, and resilient cities. Up to 2030, more people will live in cities than in other regions and this development is forecasted to increase further. In line with these fundamental urbanization processes, consecutive challenges arise. Beyond climate change-related and environmental issues, nowadays' major keystones of urban planning are the broadly accepted implementation of technical infrastructures and (smart) mobility concepts [1]. Mobility represents an essential prerequisite for the participation in social and economic life. Mobility services must meet a wide range of travellers' needs, including easy accessibility, high comfort regarding safety and security, sustainability, and affordability. Mobility options must be flexible and intermodal, especially when considering different traveller profiles in both professional and private travel contexts [2][3]. Facing the demographic change, urban mobility is essential for all dwellers, but specifically for seniors and persons living alone, in order to participate actively, autonomously, and independently in social living [4].

## 2. Security and Privacy – Prerequisites of Urban Mobility

For free and unrestricted mobility in urban areas, people need to feel safe. Crime threat in cities is a time-consuming challenge [5][6]. The consequences of crime for urban safety and individual risk perception are well described and repre-

sent a serious barrier for many travellers [7]. While it is undisputed that safety and crime prevention are major goals for mobility and urban development, the realization of safety is controversially evaluated [8][9]. Technically, surveillance technologies are at hand and might be helpful to increase urban safety [10][11]. However, at least two arguments militate in favor of not exclusively relying on predominantly technology-centered planning of infrastructural mobility concepts. One argument relates to the contradictory nature of the wish for increasing safety by adequate technologies, on the one hand, and the understandable wish for protecting dwellers' and travellers privacy, on the other [12], which can only be understood if the trade-off between both basic motives is empirically addressed. Second, travellers' profiles are increasingly diverse, and age [13] and gender [14] of travellers might specifically impact the perceived tradeoff between safety and privacy in urban environments.

So far, only sparse knowledge is available about the specific acceptance patterns of dwellers towards the benefits and barriers of surveillance technologies that are assumed to increase safety perceptions. The goal of the present study is, thus, to understand the key drivers of surveillance technologies in urban environments, taking security and privacy as prominent factors into account.

### **3. Exploratory Study: Acceptance of Surveillance Technology**

Data was collected in an online survey conducted in Germany. Completing the questionnaire took about 20 minutes. Questionnaire items were taken from a focus group study carried out prior to this study. In total, 99 participants (16 - 75 years) filled in the survey. Mean age was 37.8 (SD=15.5), with 58.6% females and 41.4% males. Participants volunteered to take part and were not gratified for their efforts.

The questionnaire was arranged in five sections. The *first part* addressed demographic characteristics of the participants. In the *second part*, we asked for the individual perception of crime threat at different places by day and by night. For clarity reasons, locations were arranged into four categories (*private* (e.g., garden), *semi-private* (e.g., own street), *semi-public* (e.g., shopping mall), and *public* (e.g., train station) locations). The question "To what extent do you feel threatened by crime during the day?" had to be evaluated for more than 20 different public and private locations (see Fig. 1). Threat perceptions had to be rated on a six-point Likert scale (1=not at all; 6 strong threat perception). In addition, looking for possible differences of threat during day- and nighttime, participants had to evaluate on a five-point scale (-2=much lower threat; -1=lower threat; 0=no difference; 1=higher threat; and 2=much higher threat) if they would feel a different crime threat at the same locations by night. The *third part* assessed the perceived security provided by technologies and other measures. Thus, different technologies (e.g., camera surveillance, ambient lighting, microphones) but also social measures (e.g., police presence, guard dog) had to be rated on a six-point Likert scale (1=strongly disagree; 6=strongly agree). The *fourth part* of the questionnaire asked about the acceptance of crime surveillance technologies at different locations, as well as the perceived benefits and barriers of crime surveillance (6-point Likert scale, 1=strongly disagree; 6=strongly agree). Benefits of crime surveillance were examined in seven items which referred to security aspects, e.g., prevention of crime, sense of security, the felt deterrent effect for potential criminals. Barriers referred to eight items relating to privacy aspects, e.g., protection of civil rights and personal freedom, storage of recorded data, inference of being under general suspicion. The *fifth and last part* focused on the trade-off between looking for security,

on the one, and protecting individual privacy, on the other hand. Participants had to consider whether privacy or security is more important to them at different locations on a 10-point scale (1=increase of security; 10=protection of privacy).

## 4. Results

Data was analyzed descriptively and, with respect to the effects of gender and age, by (M)ANOVA procedures (significance level at 5%).

### 4.1. Perceived crime threat

**Daytime:** The perceived crime threat by day can generally be seen as rather low (see Fig.1; grey bars show the perceived crime threat by day (left axis); black line by night (right axis)). The majority of private locations is perceived as only lightly threatened, e.g., *own garden* (M=1.3; SD=0.6) or *own home* (M=1.4; SD=0.8). Semi-private locations are noticed as lightly threatened, e.g., *own street* (M=1.8; SD=1) or *hotel* (M=1.8; SD=0.9). Semi-public locations are observed as slightly threatened, e.g., *market* (M=2.4; SD=1.2) and *public transport* (M=2.6; SD=1.3). Public locations are perceived as more threatened, e.g., *parks* (M=2.8; SD=1.3), *train station* (M=3; SD=1.4) or *underground car park* (M=3.3; SD=1.6).

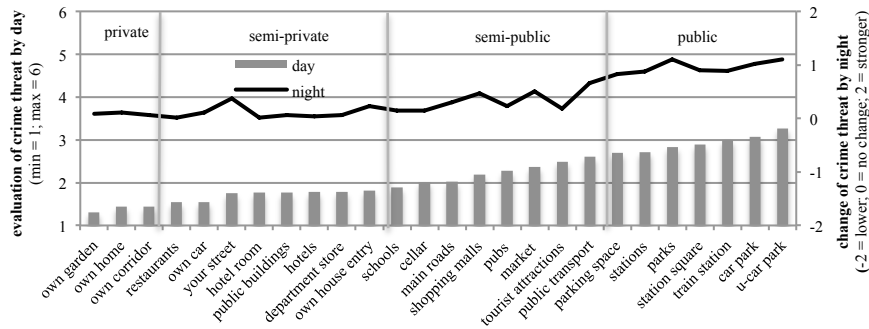


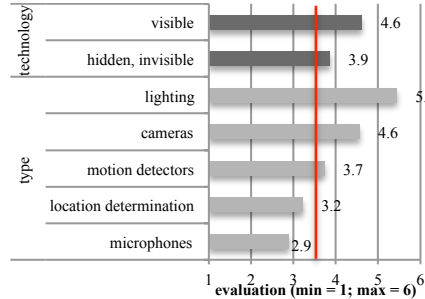
Figure 1: Perceived crime threat by day and by night (min=1, max=6)

**Night time:** The perceived threat at night did not vary strongly across the different locations. Private and semi-private locations are not perceived differently by day or by night, except for the *own street* (M=0.3; SD=0.8). Concerning semi-public locations a higher perceived crime threat was found, e.g., for *market* (M= 0.5; SD=0.8) or *public transport* (M=0.6; SD=0.8) by night. Regarding public locations, nearly all locations are perceived as more threatened by night, e.g., *train station* (M=0.9; SD=0.9) as well as *parks* (M=1.1; SD=0.8).

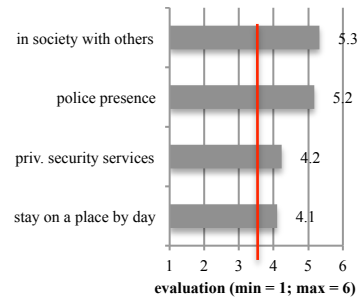
### 4.2. Acceptance of crime surveillance

Generally, surveillance technologies that are *visible* (M=4.6; SD=1.5) are more accepted than *invisible* (M=3.9;SD=1.8) technologies (see Fig. 2). Increase in *ambient lighting* (M=5.4; SD=0.8) is most wanted, followed by *cameras* (M=4.6; SD=1.4). *Motion detectors* (M=3.7; SD=1.7) and *localization technologies* (M=3.2;SD=1.6) are considered neutral, whereas *microphones* are rather rejected (M=2.9; SD=1.5).

Other security measures (see Fig. 3), e.g., *to be in society with others* (M=5.3; SD=0.8), *more police presence* (M=5.2; SD=0.98), *private security services* (M=4.2; SD=1.6), or *staying only on a place during the day* (M=4.1; SD=1.5) received also high acceptance scores.

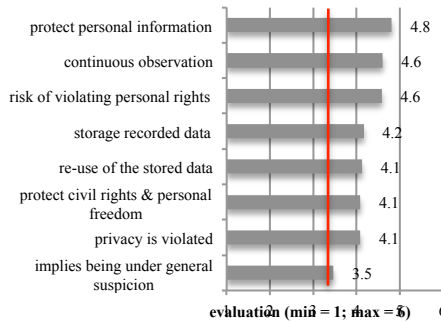


**Figure 2: Acceptance of surveillance technologies**

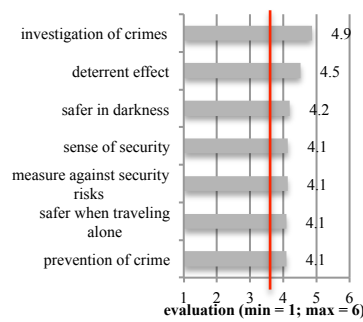


**Figure 3: Other measures enhancing perceived crime threat**

**Perceived benefits** of crime surveillance are rated similarly positive (see Fig. 4). *Investigation of crime* (M=4.9;SD=1.5) is perceived as the most important benefit. Regarding perceived barriers (see Fig. 5), *protection of sensitive personal information* (M=4.8; SD=1.6) is the most important aspect. *Inference of being under general suspicion* (M=3.5; SD=1.6), an assumed barrier, is quite accepted though.

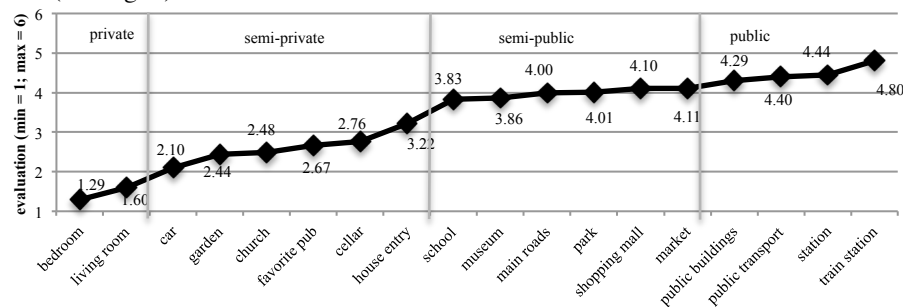


**Figure 4: Benefits of surveillance**



**Figure 5: Barriers of surveillance**

The acceptance of crime surveillance technologies depends on the type of locations (see Fig. 6).



**Figure 6: Crime surveillance acceptance**

Surveillance of private locations is not accepted, e.g., the *bedroom* (M=1.3; SD=0.7), and also rejected at semi-private locations, e.g., at *church* (M=2.5; SD=1.6). Crime surveillance at semi-public locations, in contrast, is quite accepted, e.g., at a *museum* (M=3.4; SD=1.7) as well as in *schools* (M=3.8; SD=1.7). At pub-

lic locations, crime surveillance is most accepted, e.g., at *train stations* (M=4.8; SD=1.4).

### 4.3. Security versus privacy

Finally, the trade-off between looking for security and protecting one's own privacy is reported (see Fig. 7). Outcomes can be summarized quite simply. Whenever private locations, e.g., *living room* (M=9; SD=1.9), or semi-private locations, e.g., *church* (M=7; SD=3), are addressed, privacy is preferred over security. On the other hand, security is preferred over privacy at public locations, e.g., *train station* (M= 2.6; SD=2.3) and at semi-public locations, e.g., *shopping mall* (M=4.1; SD=2.7).

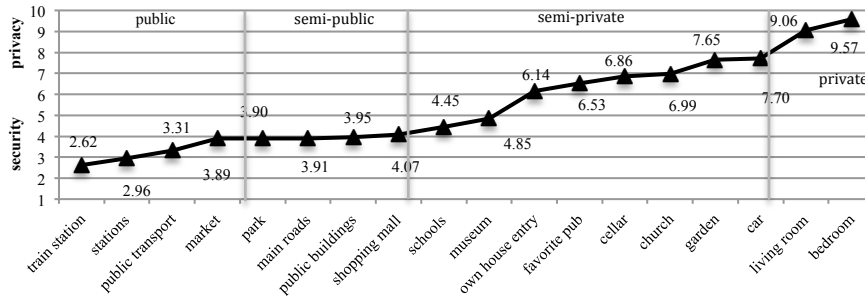


Figure 7: Security vs. Privacy

### 4.4 User diversity

As user diversity might be crucial for security perception and acceptance of surveillance technologies, we analyzed effects of age and gender on acceptance patterns. During **daytime**, women feel more threatened by crime than men ( $F(1,26)=2; p<.02$ ), e.g., *car park* ( $M_{\text{male}}=2.6; M_{\text{female}}=3.5; F(1,26)=5.1; p<.03$ ). Also, older persons feel a higher crime threat than younger ( $F(2,52)=1.8; p<.007$ ), e.g., *parking space* ( $M_{\text{young}}=2.5; M_{\text{middle}}=2.3; M_{\text{old}}=3.2; p<.03$ ). Perceived crime during **nighttime** was not impacted by user diversity, hinting at an age-insensitive perception of crime threat. Nearly every type of surveillance technology but also the other measures enhancing perceived security are more accepted by women than men, e.g., *cameras* ( $M_{\text{male}}=4.0; M_{\text{female}}=4.8; p<0.05$ ), while there was no effect of age in this regard. Perceived benefits of crime surveillance are more important to women, e.g., *feel of security*: ( $M_{\text{male}}=3.6; M_{\text{female}}=4.5; p<0.01$ ). Perception of barriers, in contrast, was more important to men, e.g., *protect personal information* ( $M_{\text{male}}=4.9; M_{\text{female}}=4.3; p<0.01$ ). In addition, trade-off-perceptions between privacy and security are also gendered: while privacy is more important to men, security is much more important to women ( $F(1,18)=2.3; p<.006$ ).

## 5. Conclusion

This study revealed insights into acceptance patterns regarding the use of crime surveillance technologies in urban environments. In order to understand the specific needs of a diverse traveller population, we examined the tolerance towards such

technologies at various public and private urban locations. Results show a differentiated picture. In private locations, the perceived crime threat was quite low, in contrast to public spaces. Surveillance technologies are accepted in those locations in which crime threat is present. Users then prefer safety over privacy. User diversity is a crucial factor in this context: Women attach a higher importance to safety in general, in contrast to men, while men prefer the protection of their privacy. Overall, the predominantly technology-centered planning of infrastructural mobility concepts, without integrating citizens into the decision-making processes, seems not sufficient to cover human attitudes and regarding safety and privacy concerns in the context of urban mobility.

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