



# Mobile communication, social presence, and perceived security on public transport

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## Abstract

Mobile phones have become a ubiquitous phenomenon on public transport. However, little attention has been given to the effect of mobile communication on perceived security on public transport. This paper develops a model of social presence and perceived security in order to understand the widespread use of mobile phones on public transport as well as its effects. The first part of the model suggests a mediating role of social presence to understand how perceived security motivates mobile communication. The respective hypotheses are tested with a representative survey ( $N = 2,267$ ), and the results support the mediating role of social presence. The second part of the model assumes that social presence is not only a motive to use mobile communication but also helps to improve perceived security. Based on a 2-week mobile experience sampling with 86 participants and 1,264 measurement points, the effect of mobile communication and social presence obtained, as well as individual and situational factors on perceived security were tested. The respective hypotheses were partially supported but also suggest that other coping strategies might be of relevance to fully understand the relationship between mobile communication and situational perceived security. Besides the academic insights, these results suggest that public transport operators should consider expanding mobile phone coverage in their vehicles and stations to improve perceived security and make their services more attractive.

## Keywords

mobile communication, perceived security, public transport, social presence, uses and gratifications

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Mobile communication, in the form of phone calls and texting, is essential for our work, leisure, and family life (Deng et al., 2018). This becomes especially apparent on public transport. Mobile phones are omnipresent on buses, on trains, and in stations. A recent study from Norway showed that about 80% of travelers carry a smartphone or other mobile device on public transport (Julsrud & Denstadli, 2017). When asked about the purpose of mobile phone use, people refer foremost to sociability, entertainment, and availability (Grellhesl & Punyanunt-Carter, 2012). Only a few researchers have considered the effects of mobile communication on personal security (Aoki & Downes, 2003; Dimmick, Sikand, & Patterson, 1994), and surprisingly, little attention has been given to these effects in the context of public transport. This is of relevance, since several studies have shown the lack of perceived security on buses and trains (Delbosc & Currie, 2012; Stradling, Carreno, Rye, & Noble, 2007) and revealed that up to 40% of passengers have feelings of insecurity (Currie, Delbosc, & Mahmoud, 2010). Despite these findings and the ubiquitous use of mobile media on buses and trains, there is neither a theoretical model nor an empirical work known to us that specifically addresses mobile communication in relation to perceived security on public transport. We propose to close this research gap based on social presence theory (Short, Williams, & Christie, 1976), with the following rationale: Social presence theory refers to the idea that computer-mediated communication can lead to an increased feeling of not being alone. Since being alone is a crucial factor for passengers in feeling insecure (Delbosc & Currie, 2012; Lynch & Atkins, 1988), it can be assumed that social presence mediates the relationship of mobile communication and security perception on public transport. We analyzed this theoretically derived assumption within the framework of the uses and gratifications approach. Hereby, the distinction between gratification sought (GS) and gratification obtained (GO) enabled us not only to investigate what people are seeking from mobile communication but also what they actually get from its use (Palmgreen & Rayburn, 1982). Gratifications sought can be regarded as general beliefs and attitudes toward a specific behavior, while the obtained gratification is closely linked to specific situations of use. Hence, the distinction between GS and GO should not only be made by nuances in question wording but requires two distinct empirical designs. Therefore, this article combines two studies. Study 1 focused on GS and was designed as a representative survey ( $N = 2,267$ ) asking about motives for the use of mobile communication on public transport. Study 2 focused on GO and was designed as a mobile experience sampling that prompted the questionnaire while the study participants ( $N = 86$ ) used public transport during a 2-week period ( $N = 1,264$  observations). In combination, they allowed us to test the proposed model of social presence and perceived security in the context of public transport.

## Perceived security on public transport

Information about crime rates on public transport is primarily available for Western countries and large transportation authorities (e.g., from metropolitan areas). While some cities such as London report a decline in objective security, the public transport system in Berlin has become more secure in recent years (BVG, 2018; Transport for London, 2018). However, even a good objective security level is no guarantee for passengers to

actually feel secure. Factors that cause insecurity include darkness at stations and stops, full vehicles, poor visibility, threatening persons, and the feeling of being alone (Cozens, Neale, Whitaker, & Hillier, 2003; Currie et al., 2010; Delbosc & Currie, 2012; Lynch & Atkins, 1988). Hence, perceived security is not only influenced by the possibility of a crime, as represented by crime statistics, but also by several subjective factors, which can distort the estimation of risks and the actual security level (Jungermann & Slovic, 1993). In other words, people may feel insecure and be afraid of crimes even though they are not very likely.

### **Mobile phone use and perceived security**

The latest research on motivations for mobile phone use has focused on gratifications such as sociability, joy, pleasure, entertainment, availability, instrumentality, and the possession of a status symbol. Other gratifications, such as reassurance, are only occasionally addressed (Grellhesl & Punyanunt-Carter, 2012; Wei, 2008). Reassurance was first identified by Dimmick et al. (1994) in the context of landline phones and refers to the “reassurance of the well-being of relatives and friends at a distance and the ability to obtain help in an emergency” (Dimmick et al., 1994, pp. 658–659). Later studies extended the research field to cell phones and mobile communication, and therefore focused on the latter aspect of reassurance: the possibility of mobile phone use in the case of (perceived) emergencies (Devitt & Roker, 2009; Gonzales, 2014; Leung & Wei, 2000). For example, Aoki and Downes (2003) identified a usage type in their studies, labeled as “security/safety conscious,” which includes users who feel more secure when they have a smartphone nearby. According to the authors, psychological security is an initial motivation to obtain a cell phone. Related to this, J. E. Katz (1997) also discussed that security and the fear of crime are major reasons for acquiring mobile phones. More recent research, after the widespread use of the smartphone began, confirmed these findings. For instance, Cumiskey and Brewster (2012) found that women perceive their mobile phone as a weapon of self-defense and regard it as more effective than carrying pepper spray. In sum, the ability to contact other persons or emergency numbers seems to be an important gratification of mobile phones. However, these studies do not provide or test a theoretical explanation in which psychological mechanisms link mobile phone use and perceived security.

### **The social presence theory**

The concept of social presence was introduced by Short et al. (1976) and can generally be defined as “the sense of being with another” (Biocca, Harms, & Burgoon, 2003, p. 456) induced by mediated communication. Early studies argued that social presence is a characteristic of the medium itself, and communication channels have different capabilities to convey the feeling of not being alone (Short et al., 1976). However, this technologically determined understanding of social presence shifted in later studies, since researchers found that the perception of social presence differs from user to user, and furthermore, people evaluate the same medium differently in various situations (Walther, 1992). Accordingly, social presence theory not only refers to the objectively measurable

qualities and technical possibilities but primarily to the subjectively experienced characteristics of a medium (Lowenthal, 2010).

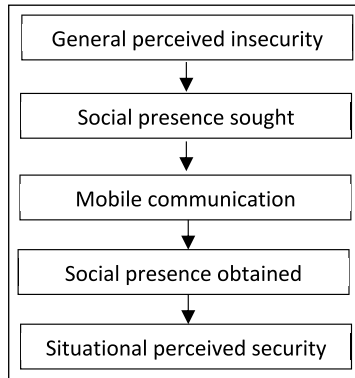
Biocca et al. (2003) argued that social presence consists of three parts: (a) copresence, which refers to the communicators feeling as if they are in the same location and appear to share an environment; (b) psychological involvement refers to mutual empathy and understanding, which can be described as the degree to which the mediated conversation partners perceive themselves to respond to the emotional states of one another; and (c) behavioral engagement, which means the degree to which the observers believe their actions are connected and may provide assistance. According to these three dimensions, we define social presence as a multidimensional construct that consists of copresence, psychological involvement, and behavioral engagement (Biocca et al., 2003).

Empirical research has examined both the factors influencing social presence and the effects of perceived social presence in several contexts (Oh, Bailenson, & Welch, 2018). Ultimately, these findings have in common that social presence can have effects on people's behavior and feelings that are similar to those of the real presence of other people. Since being alone is a crucial factor for feeling insecure on public transport, we assume that passengers are trying to connect with known people via mobile communication to overcome aloneness (Cumiskey, 2011) and cope with insecurity. Hence, social presence is proposed as a linking pin between mobile communication and security perception.

## **The model of social presence and perceived security**

Based on the literature on social presence theory, we argue that experiencing social presence is an additional yet unstudied aspect of the use of mobile communication on public transport to improve the feeling of personal security. One of the most prominent approaches to investigating the motives for the use of media and communication technologies is the uses and gratifications approach (UGA) (Blumler & Katz, 1974). The UGA examines why and how people use various media and communication forms and emphasizes the active role of people who use media to satisfy certain needs in different life situations (Rubin, 2009). According to this, the UGA focuses on the individual needs of media users, which are "the combined product of psychological dispositions, sociological factors, and environmental conditions" (E. Katz, Haas, & Gurevitch, 1973, p. 27). The UGA was originally introduced to analyze TV and radio use, but recent studies have also applied the approach to smartphone use and mobile communication (Chan, 2015; Klenk, Reifegerste, & Renatus, 2017; Wei, Huang, & Zheng, 2017).

Along with the popularity of the UGA, the approach has been the focus of various criticisms. It has been argued that most studies do not distinguish explicitly between media-related needs and the actual fulfillment of these desires, so that often only the motives for media use are investigated (Bae, 2018). In this context, Palmgreen and Rayburn (1982) proposed the model of the gratification sought (GS) and gratification obtained (GO) process. Since a GS must not necessarily be obtained (Palmgreen, Wenner, & Rayburn, 1980), both measures have to be distinguished conceptually and empirically. According to E. Katz et al. (1973), we understand GS as the expectations formed in advance of media use and, thus, as more dependent on general thoughts and feelings, while GO, in contrast, describes the gratifications obtained from a certain media use and



**Figure 1.** Model of social presence and perceived security.

refers to a very specific situation. Accordingly, we distinguish between social presence sought and social presence obtained, as well as between general perceived security and situational perceived security. Based on these considerations, we introduce the *model of social presence and perceived security* to study the use of mobile communication on public transport. Figure 1 illustrates the suggested process from general perceived insecurity, to social presence sought, use of mobile communication, social presence obtained, and ultimately, to situational perceived security.

This model enables us to examine not only the effects of perceived security on social presence as a motive for the use of mobile communication on public transport, but also whether mobile communication and social presence actually work as a coping strategy and help to improve situational experienced security.

## Research question and hypotheses

Given the ubiquitous use of mobile communication on public transport, the widespread feeling of insecurity among passengers, and the potential mediating role of social presence for security perception on public transport, we address the following research question: What is the relationship between mobile-communication-induced social presence and perceived security on public transport? Based on the proposed model of social presence and perceived security, we can hereby distinguish between general perceived insecurity and social presence sought in a first instance, and social presence obtained and situational perceived security in a second instance.

### *General perceived security, social presence sought, and mobile communication*

Based on the literature on mobile communication, social presence, and security perception, we propose that passengers who feel insecure on public transport seek social presence to improve their feeling of security, and as a result, they use their smartphones more often for mobile communication.

**H1:** Social presence sought mediates the relationship between general perceived insecurity and the frequency of mobile communication.

Furthermore, we assume that social presence sought depends on the individual factors of the passengers. More specifically, we assume differences in social presence sought regarding the gender of passengers. Studies on uses and gratifications in the context of mobile communication found that there were gender differences regarding specific gratifications (Grellhesl & Punyanunt-Carter, 2012) and that women identified more with social gratifications, including help in emergencies, while men tended to use their phones for entertainment or business reasons (Totten, Lipscomb, Cook, & Lesch, 2005).

**H2:** Women seek more frequently for social presence than men.

It has been found that there is a considerable difference in the frequency of use of mobile media on public transport with regard to the age of passengers. Accordingly, passengers in the age group between 15 and 29 spend up to 60% of their time on buses and trains using electronic media, while passengers older than 55 only spend about 20% of their time on mobile media (Best & Engel, 2016). Therefore, we assume that younger people seek more often for social presence via smartphones than older adult public transport users.

**H3:** Younger passengers seek more often for social presence than older adult public transport users.

Since we expect people with a low level of interpersonal trust (Viklund, 2003) and those who have experienced victimization (Singer et al., 2018) on public transport to feel less secure, and therefore to be more dependent on coping strategies, we also hypothesize that these passengers seek more often for social presence.

**H4:** Victimization experience is positively related to social presence sought.

**H5:** Interpersonal trust is negatively related to social presence sought.

### *Mobile communication, social presence obtained, and situational perceived security*

Based on the argumentation of Palmgreen and Rayburn (1979), the causal attribution of a specific behavior (e.g., mobile communication) to a gratification sought (e.g., improvement of security) is key to understanding repeated or routine behavior. Hence, for the development of a routine use of mobile communication as a coping strategy on public transport, it is of particular relevance whether the passengers have the subjective feeling that mobile communication contributes to an improvement of perceived security. Since H1 proposed that passengers seek for social presence when they feel insecure, we ultimately assume that they have a feeling of improved situational perceived security due to mobile communication.

**H6:** Social presence obtained is positively related to the improvement of situational perceived security due to mobile communication.

Based on the previous rationale, the perceived (subjective) effect is more important than the objective effect to understand the use of mobile communication. Nevertheless, it is also of interest whether mobile communication improves passengers' feelings of security. We suppose that passengers who use mobile communication and experience a higher degree of social presence feel more secure in a specific situation. Again, we assume a mediation process. Due to filters in the questionnaire and the resulting data structure, the mediation model cannot be tested by regression analysis and interaction effects. Therefore, the assumed mediation model is subdivided into three hypotheses and needs to be tested with different statistical tests.

**H7:** Mobile communication is positively related to social presence obtained.

**H8:** Social presence obtained is positively related to situational perceived security.

**H9:** Mobile communication is positively related to situational perceived security.

Furthermore, situational factors can lead to very different security perceptions (Delbosc & Currie, 2012). Therefore, we also expect situational factors to affect our dependent variable. Based on previous research, it can be assumed that people feel less secure in darkness than during the day (Lynch & Atkins, 1988).

**H10:** Passengers feel more secure during daylight hours than during dark hours.

In addition, we assume that passengers feel less secure on local public transport than in long-distance traffic. First, this is because long-distance transport shows a relative homogeneity of its user groups, while regional and urban transport is characterized by the heterogeneity of urban people, which may be the actual cause of the perceived insecurity (LaGrange, Ferraro, & Supancic, 1992). Second, considerably more personnel are deployed at main stations than at smaller and less frequented stops. Since security staff is a crucial reason for passengers to feel more secure (Cozens et al., 2003), this may lead to a higher level of perceived security on long-distance than on short-distance public transport.

**H11:** Passengers feel more secure on long-distance than on short-distance public transport.

Since people feel less secure when overview and means of escape are limited (Appleton, 1996), we assume that people feel more secure in nonunderground than in underground vehicles and stations.

**H12:** Passengers feel more secure in nonunderground vehicles and stations than in underground trains and stations.

Based on findings from research on security perception on public transport (Delbosc & Currie, 2012; Hamilton & Jenkins, 2000), we assume similar differences for gender and age as in H2 and H3.

**H13:** Women have lower levels of situational perceived security than men.

**H14:** Age is negatively related to situational perceived security.

In analogy to Hypotheses 4 and 5, we also expect victimization experience and interpersonal trust to influence situational perceived security.

**H15:** Victimization experience is negatively related to situational perceived security.

**H16:** Interpersonal trust is positively related to situational perceived security.

## Research design

According to Palmgreen et al. (1980) and E. Katz et al. (1973), gratifications sought and obtained must be distinguished not only conceptually but also empirically. Based on this assumption and our proposed model of social presence and perceived security, we conducted two separate studies. The first study focused on the relation between general perceived insecurity, social presence sought, and the use of mobile communication. The second study focused on the relation between the use of mobile communication, social presence obtained, and situational perceived security.

## Study I: Social presence sought

### *Procedure and participants*

The first study examined the effects of general perceived insecurity on social presence sought and the mediating effect of social presence sought on mobile communication. To test the respective hypotheses, we employed a national survey in Germany. Participant sampling (quota: Age  $\times$  Gender  $\times$  Federal State) and reminders were administered by a professional research company (Institut für angewandte Sozialwissenschaft GmbH [infas]) from April 10 to April 24, 2018. Adolescents and adults ( $N = 2,267$ ) between the ages of 16 and 87 ( $M = 48.5$ ,  $SD = 16.6$ ) were included in the study. Both users and nonusers of public transport were interviewed. For the present study, only regular public transport users and respondents who frequently used their smartphones for mobile communication were considered. Therefore, the final sample for the analysis consisted of 1,291 participants. Table A1 in the Appendix shows the demographic quota and the composition of the final sample.

### *Measures*

*General perceived insecurity.* Participants were asked to evaluate their general perceived security on public transport on a 5-point scale (1 = *not secure at all*, 5 = *very secure*).



For analysis, we reversed the coding of this variable to obtain perceived insecurity (1 = *very secure*, 5 = *not secure at all*).

**Social presence sought.** To assess social presence sought, participants were asked to respond to three statements regarding their perception of copresence, psychological involvement, and behavioral engagement when using their smartphones for mobile communication. The items were based on the Social Presence Scale from Biocca and Harms's (2003) study and adapted to the present research topic. The items were directly related to security in order to analyze to what extent social presence is used as a gratification and coping strategy in insecure situations. Due to limited survey space, only one item per subscale was integrated. The adapted scale was validated in a pretest within a student sample ( $n = 156$ ,  $\alpha = .77$ ). Subsequently, items were revised, which led to a significantly improved internal consistency in the actual study ( $\alpha = .89$ ). The translated versions of all items and their descriptive statistics are reported in Table A2 in the Appendix.

**Frequency of mobile communication on public transport.** Respondents were asked to estimate how often they use their smartphones for mobile communication on public transport. The frequency was measured on a 5-point scale (1 = *never*, 5 = *very often*).

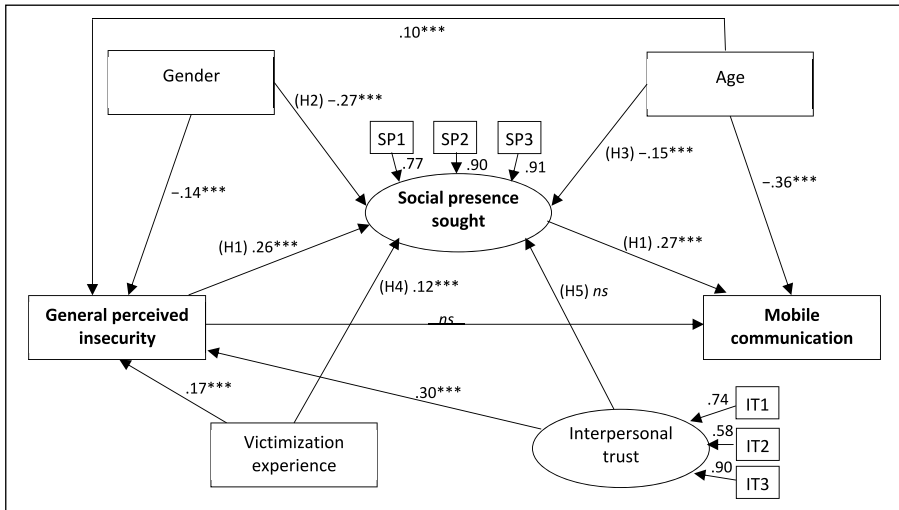
**Victimization experience.** This variable contained information about whether a participant had already been the victim of a crime on public transport. Bodily attacks, thefts, and harassment against respondents were considered. For analysis, we coded a dummy variable (0 = *no victimization experienced*, 1 = *experienced victimization*).

**Interpersonal trust.** For measuring interpersonal trust, the German short scale KUSIV3 (Beierlein, Kemper, Kovaleva, & Rammstedt, 2012) was used. The scale consists of three items. Cronbach's alpha was reasonable ( $\alpha = .77$ ).

## Results

As expected, smartphone use was a frequent behavior while using public transport. Of the respondents, 76% stated that they use their smartphones on public transport at least occasionally ( $M = 3.25$ ,  $SD = 1.57$ ), and 87% of these respondents use their smartphones for mobile communication ( $M = 3.42$ ,  $SD = 0.99$ ). The results also revealed that respondents appeared to feel relatively secure ( $M = 2.38$ ,  $SD = 0.94$ ). The mean value of perceived insecurity was distinctly under the midpoint of the 5-point scale.

To test our hypotheses regarding social presence sought, we conducted structural equation modeling (SEM) using the computing environment R and the package lavaan (Rosseel, 2012). The correlations between the constructs are reported in Table A3. We checked the assumptions for SEM (i.e., linearity, multivariate normality, random residuals) and found that the multivariate nonnormality was slightly violated. Therefore, we used maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic. Although the chi-squared test, 241.21 (34),  $p < .001$ , was significant, the overall goodness-of-fit indices (RMSEA = .07, CFI = .96, TLI = .93, SRMR = .06) were well within recommended values (Kline, 2015).



**Figure 2.** Structural equation model to test the mediating role of social presence sought.

The final model and standardized coefficients are shown in Figure 2 and further statistics are reported in Table A4. As assumed in H1, social presence sought mediated the relationship between general perceived insecurity and the frequency of mobile communication. While we did not find a direct effect of general perceived insecurity, the results showed that general perceived insecurity was a significant contributor to social presence sought ( $\beta = .26, p < .001$ ), and social presence sought was a predictor of the frequency of use of mobile communication on public transport ( $\beta = .27, p < .001$ ). Furthermore, results indicated that women ( $\beta = -.27, p < .001$ ) and younger passengers ( $\beta = -.15, p < .001$ ) seek for social presence significantly more often than men and older respondents, which supported H2 and H3. Also, victimization experience ( $\beta = .12, p < .001$ ) had a significant relation to social presence sought, which is in line with H4. Interpersonal trust and social presence sought were not related. Thus, H5 was not supported.

Besides testing the hypotheses, the model controlled for the effects of gender, age, interpersonal trust, and victimization on general perceived insecurity and the frequency of mobile communication. Both demographic variables, gender ( $\beta = -.14, p < .001$ ) and age ( $\beta = .10, p < .001$ ), as well as victimization experience ( $\beta = .17, p < .001$ ) and interpersonal trust ( $\beta = -.30, p < .001$ ), were significantly associated with the general perception of insecurity. Furthermore, age was negatively related to the frequency of mobile communication ( $\beta = -.36, p < .001$ ). The inclusion of these effects was informed by and confirmed general findings from security research (Delbosc & Currie, 2012) and mobile phone use research (Best & Engel, 2016). However, we refrained from justifying, testing, and discussing separate hypotheses for these effects in order to focus on social presence sought and its mediating role in the model.

The final model accounted for 20.3% of the variance in social presence sought, 14.2% in general perceived insecurity, and 22.8% in the frequency of mobile communication. A

post hoc power analysis based on the chi-squared test and the degrees of freedom in the final model indicated that we had adequate power to detect the hypothesized effects (effect size = .10, alpha = .05, power = 1.00).

## Discussion

The findings of our first study showed that social presence sought mediated the relationship between general perceived insecurity and mobile communication on public transport (H1). Therefore, the feeling of social presence can be regarded as a gratification sought (Palmgreen & Rayburn, 1982) for the use of mobile communication on public transport and gives aid to understanding why people use mobile communication as a coping strategy. Furthermore, the results showed that social presence sought not only depends on general security perception but also on other factors such as age, gender, interpersonal trust, and victimization experience. According to our findings, female passengers seek for social presence more often in order to reduce insecurity. This was in line with our hypothesis (H2) and the results of previous research that showed that women use mobile communication more often for social reasons than do men (Totten et al., 2005). Another explanation for this could be the finding that women feel more insecure in general, which was in line with existing research (Hamilton & Jenkins, 2000), and may lead to an increased need for coping strategies. The results also showed that younger passengers seek more often for social presence to reduce insecurity than older travelers, which therefore confirmed Hypothesis 3. This is of special interest, since our study revealed that older people feel less secure, which is also commonplace in earlier security research (Greve, 1998). So why do those with less insecurity (younger people) seek for social presence more often? An explanatory approach for this could be the higher general frequency of smartphone usage of younger people (Best & Engel, 2016) and the concept of the digital divide (Scheerder, van Deursen, & van Dijk, 2017), which suggests that digital natives (those who grew up in the digital age) are more familiar with technology than digital immigrants (those who had to adapt to the digital age). Other studies have shown that older adults view mobile phone use as disruptive to communication quality, which ultimately leads to limited feelings of copresence (Kadylak et al., 2018). Accordingly, it can be assumed that younger users are more likely to use mobile communication as a coping strategy, since they have a more ritualized use of mobile devices, and older passengers had to develop other coping strategies for dealing with insecurity.

The results also confirmed that victimization experience (H4) was related to social presence sought. Passengers who had already been the victims of crime on public transport seek for social presence more often. According to previous research (Singer et al., 2018), it may be assumed that passengers with victimization experience tend to estimate the risk of becoming a victim of crime again as more likely, feel less secure, and ultimately are more dependent on coping strategies. The direct negative effect of interpersonal trust on social presence sought (H5) was not supported. However, the indirect effect ( $\beta = .08$ ) indicated that this relationship seems to be fully mediated by general perceived insecurity, which is in line with the general tenets of H5.

## Study 2: Social presence obtained

### *Procedure and participants*

To assess social presence obtained, we applied the mobile experience sampling method (MESM). The major advantage of this method is that participants can provide immediate responses about the very specific situations and emotional states that are difficult to assess in a post hoc interview or survey (Barrett & Barrett, 2001). Therefore, we developed a smartphone application that detected changes in geolocalization and prompted a request about whether the participants were traveling on public transport or by other means of transport (e.g., bike or car). When participants confirmed that they were using public transport, the actual questionnaire was started. The threshold for significant location changes was assessed in a pretest and set to 320 meters. After participants answered a questionnaire, the app changed to standby mode for the next 120 minutes. A daily limit was set to four prompts. On average, each of the 86 participants filled out our questionnaire with open-ended and closed questions 15 times during the 2-week field period. This resulted in 1,264 relevant measures. Additionally, the participants also completed the same questionnaire as in Study 1.

The sample consisted of 86 regular public transport users. Participants were recruited by a combined quota sample (age, gender, use of public transport) in two major cities in Germany, and received a small incentive. They were aged 18–63 years ( $M = 33.14$ ,  $SD = 11.83$ ), and 47% were female. We only considered for analysis those observations in which respondents were traveling alone. The presence of a colleague, friend, or family member would likely overlay the effects of mediated social presence.

### *Measures*

*Social presence obtained.* In the MESM, the same dimensions were used to measure social presence as in the representative survey. However, the wording of the task and the introductory sentence in Study 2 (social presence obtained) referred explicitly to a specific and current situation (see Table A5), while the wording in Study 1 (social presence sought) was more general and unspecific. Again, the internal consistency of the scale was good ( $\alpha = .89$ ).

*Mobile communication.* This variable contained information about whether mobile communication was used during the respective ride (0 = *no*, 1 = *yes*).

*Improvement of situational perceived security (ISPS).* To measure the causal attribution of a behavior (mobile phone use) to a specific outcome (perceived improvement of security), we asked the respondents to rate the statement “Using my smartphone made me feel more secure” on a 5-point scale (1 = *highly disagree*, 5 = *highly agree*).

*Situational perceived security.* Besides this causal attribution, we also assessed participants’ situational perceived security on a 7-point scale (1 = *not secure at all*, 7 = *very secure*).

*Daylight.* The time of day was automatically captured by the smartphone. Based on sunrise and sunset during the survey period, we dichotomized the variable as a measure of daylight during public transport use (0 = *dark*: from 6 p.m. to 8 a.m.; 1 = *bright*: from 8 a.m. to 6 p.m.).

*Short versus long distance.* This variable referred to the use of short- or long-distance public transport (0 = *long-distance traffic*, 1 = *short-distance traffic*). Short distance included the use of underground trains, trams, buses, and regional trains, while long distance included long-distance trains (Intercity-Express [ICE], Intercity [IC], Eurocity [EC]) and intercity buses.

*Use of underground trains.* Respondents were asked which vehicles they were using or going to use during the respective journey. This variable contained information about whether underground trains were used (0 = *nonunderground vehicles*, 1 = *underground trains*).

*Individual variables.* The same individual variables (age, gender, victimization, and interpersonal trust) as in Study 1 were surveyed.

### Data analysis

In order to assess our hypotheses, we developed three multilevel models and regressed predictors on two different outcome variables: (a) improvement of situational perceived security (ISPS) due to mobile communication with other persons (H6 regarding the causal attribution), and (b) situational perceived security (H7 to H16 regarding perceived security and additional influencing variables). For ISPS, we included only respondents who used their mobile phones to communicate with other persons in the respective situations and therefore experienced social presence to various degrees. For situational perceived security, we calculated a model with the same restriction and a model that considered all respondents, including those who did not use mobile communication. Multilevel modeling was chosen as the analytic approach to account for the data structure, including individual and situational factors. We used R and the package nlme (Pinheiro, Bates, DebRoy, Sarkar, & Team, 2018) to perform the analyses. Situational variables were entered as fixed effects on Level 1 and participant variables on Level 2. Intercepts were modeled as varying randomly across participants to take the nested structure of the data into account. In both cases, random intercept models had a better model fit than random slope models.

We conducted group-mean centering for all continuous predictors on Level 1 and grand-mean centering for all continuous independent variables on Level 2. Since people used mobile communication less frequently than expected, we only had small sample sizes available for our analysis. Post hoc sensitivity analyses revealed that we had reasonable power to detect the effect sizes of social presence of  $> .18$  in Multilevel Model (MLM) 1 and  $> .39$  in MLM 2, and the effects of mobile communication of  $> .24$  in MLM 3. Therefore, we were not able to detect smaller effects, and nonsignificant findings need to be interpreted with caution.

## Results

In 82.2% of all observations, the respondents traveled alone. In 56.1% of these situations, the respondents stated that they had used their smartphones, and in 16.8% of the cases it was reported that they used their smartphones to interact with other persons (i.e., texting or talking). On average, participants felt more secure than in Study 1 ( $M = 6.54$ ,  $SD = 1.05$ ).

To assess the causal attribution of security improvement due to mobile communication (H6), we conducted a multilevel model with 175 observations nested in 58 individuals (see Table 1, MLM 1). Only observations in which respondents used mobile communication were considered. In this model, social presence obtained was a highly significant predictor of ISPS ( $b = .21$ ,  $p < .01$ ), which was in line with H6. We also controlled for situational (daylight, short vs. long distance, underground) and individual factors (gender, age, victimization experience, interpersonal trust), and only found that interpersonal trust significantly related to ISPS ( $b = -.24$ ,  $p < .05$ ).

For testing the direct effects of mobile communication on social presence obtained (H7), we found the mean of social presence ( $M = 3.16$ ,  $SD = 1.19$ ) to be significantly greater than the midpoint of the 5-point scale,  $t(174) = 2.01$ ,  $p < .05$ , which indicated that the respondents agreed that they perceived social presence due to mobile communication. This finding supported the relationship between mobile communication and social presence obtained.

To assess the effect of social presence obtained on situational perceived security (H8), we regressed a second multilevel model (see Table 1, MLM 2) with the same subsample as in MLM 1. In this model, there was no relationship between social presence obtained and situational perceived security, which was not in line with H8. This finding indicates that the perceived level of social presence had no effect on situational perceived security. We again controlled for situational and individual variables. Regarding situational factors, daylight ( $b = .41$ ,  $p < .05$ ) and the use of underground public transport ( $b = -.62$ ,  $p < .01$ ) were highly significant predictors of situational perceived security, while the use of long- versus short-distance public transport had no effect. Individual factors such as age, gender, victimization experience, and interpersonal trust had no significant relation to situational perceived security.

To assess the direct effects of mobile communication, situational factors, and individual factors on situational perceived security, we conducted a third multilevel model (see Table 1, MLM 3) with all 1,039 observations nested in 85 participants. Intraclass correlation (ICC) results of the null model showed that 23.5% variance is accounted for by the effects of respondents, demonstrating the necessity of multilevel modeling. Regarding H9, we found no significant direct effects of mobile communication on situational perceived security. In summarizing the results for the assumed mediation of mobile communication on perceived security via social presence obtained, we have an indicator that mobile communication leads to social presence obtained (H7), while neither the second part of the mediation (i.e., social presence obtained on situational perceived security; H8) nor the direct effect of mobile communication (H9) can be supported.

We also checked for the assumed effects of situational factors on situational perceived security. Hereby, it is found that daylight was positively related to situational perceived

**Table 1.** Multilevel estimates for situational perceived security.

Variable	MLM 1	MLM 2	MLM 3
Dependent variable	ISPS <sup>1</sup>	Situational perceived security	
Intercept	3.95 (.23)*** 3	6.41 (.37)***	6.58 (.17)***
<i>Level 1</i>			
Social presence obtained (H6 and H8)	.21 (.07)**	.11 (.14)	
Mobile communication (H9)			-.01 (.08)
Daylight (1 = bright; H10)	-.03 (.09)	.41 (.16)*	.29 (.06)***
Long versus short distance (1 = short; H11)	-.23 (.16)	.03 (.32)	-.16 (.13)
Underground (1 = underground; H12)	-.19 (.13)	-.60 (.23)**	-.31 (.09)***
<i>Level 2</i>			
Gender (1 = male; H13)	-.09 (.18)	.22 (.22)	.14 (.12)
Age (H14)	-.01 (.01)	.02 (.01)	.00 (.01)
Victimization experience (H15)	.05 (.19)	-.29 (.22)	-.25 (.13)
Interpersonal trust (H16)	-.24 (.12)*	.02 (.14)	.13 (.07)
<i>Model statistics</i>			
AIC	326.46	523.45	2888.70
BIC	361.27	558.26	2943.11
Log likelihood	-152.23	-250.72	-1433.35
Observations	175	175	1039
Respondents	58	58	85

Note. Unstandardized coefficients. Standard error in parentheses.

<sup>1</sup>Improvement of situational perceived security attributed to mobile communication.

\*\*\* $p < .001$ . \*\* $p < .01$ . \* $p < .05$ .

security ( $b = .29, p < .001$ ), which supported H10. Additionally, there was no statistically significant effect of the use of long- versus short-distance public transport on situational perceived security. Therefore, H11 was not supported. The use of underground trains had a negative effect on situational perceived security ( $b = -.31, p < .001$ ), which was in line with H12.

Regarding the individual factors, the effects had the expected signs for gender, victimization experience, and interpersonal trust, but none of these were statistically significant. Additionally, age was not related to situational perceived security. Therefore, Hypotheses 13 (gender), 14 (age), 15 (victimization), and 16 (interpersonal trust) were not supported. Furthermore, both AIC and BIC decreased with the addition of situational variables to the model. This indicated that Level 1 predictors explained the additional variance in situational perceived security. Additional details for the three multilevel models are reported in Tables A6, A7, and A8 in the Appendix.

## Discussion

Based on the mobile experience sampling, we found that mobile communication induces social presence and that participants causally attribute security improvement to mobile

communication (MLM 1). This causal attribution proposed in H6 seems to occur quite universally, since none of the other variables had a significant effect except for interpersonal trust. However, this positive effect of mobile communication seems to be limited to a subjective causal attribution, since no significant effects were found for situational perceived security. An explanation for the absent effect of social presence (MLM 2) and mobile communication (MLM 3) on situational perceived security could lie in alternative coping strategies (Reid, Roberts, & Hilliard, 1998). These alternative coping strategies may be unrelated to smartphones or include other gratifications produced by smartphone use. For instance, studies have shown the relevance of escapism as a strategy of avoidance for coping and highlighted the role of mobile phone use as a means of escape from unpleasant situations (Panova & Lleras, 2016). Hence, alternative but unobserved mediators might have covered a possible effect of mobile communication on situational perceived security.

The result that passengers who traveled in the dark or used underground trains felt significantly less secure may be explained by the prospect refuge theory (Appleton, 1996), which assumes that people feel more secure in places that they can survey well (prospect). Passengers therefore feel particularly insecure during dark hours and in underground trains and stations with no daylight, as their visibility is limited. In conclusion, our findings show that people attribute a positive effect to mobile communication, even though it may not have a significant effect on their situational perceived security. However, the small sample size of Study 2 resulted in weak statistical power. Therefore, the results must be considered as explorative. Nevertheless, the study demonstrates the application of an innovative research design for future studies in this domain.

## General discussion and conclusion

The model of social presence and perceived security introduces social presence theory and the uses and gratifications approach as linking pins between mobile communication and perceived security. Based on this theoretical model, the two studies provide unprecedented insight into mobile communication and perceived security on public transport by differentiating between social presence sought and obtained as mediating variables. The first study, based on a representative survey, revealed that passengers with lower perceived security more frequently seek social presence via mobile communication. Furthermore, social presence sought proved to be the mediating variable between general perceived insecurity and mobile communication. The findings from the second study are based on a 2-week period of *in situ* surveys (mobile experience sampling) and partly support the positive relationship between mobile communication, social presence obtained, and the improvement of situational perceived security. Respondents tended to agree that they obtained social presence via mobile communication, and social presence contributed to passengers' feeling of improved security (causal attribution of a positive effect to mobile communication). At the same time, we found no evidence for an effect of mobile communication or social presence on situational perceived security. This indicates that passengers might also use other strategies to cope with perceived insecurity (see Discussion section of Study 2). Hence, future research should consider additional



gratifications of smartphone use as well as other coping strategies regarding security perception on public transport.

The adaption of the model of GS and GO (Palmgreen & Rayburn, 1982) has proved to be fruitful, since the expectations and the actual experiences of travelers seem to be distinct. In this context, our proposed model of social presence sought and social presence obtained provides the framework for future studies to assess gratifications from mobile communication on public transport, perceived security, and other contexts. With regard to the interpretation of social presence sought and the general perception of security, it should be noted that both concepts refer to more general attitudes and feelings than social presence obtained and situational perceived security, but nevertheless are not static. Palmgreen and Rayburn (1979) argue that the fulfillment of gratifications initially sought leads to satisfaction and reinforces the intention to continue using a medium (Bae, 2018). This suggests that motivations and gratifications sought are adapted to the gratifications actually obtained. In this respect, the finding of a positive relation between social presence obtained and perceived improvement of situational security due to mobile communication (causal attribution) gains additional relevance. The finding indicates that those applying this coping strategy perceive a positive effect, and hence will be more likely to seek this gratification in the future.

The results of the two studies not only serve the social science community but can also provide public transport operators with suggestions and guidance regarding the handling of security perception issues. The expansion of the digital infrastructure and a resulting improvement of possibilities for mobile communication can be a cost-effective solution to reduce feelings of insecurity. Furthermore, providing the social presence of the operators themselves via mobile communication may be a good strategy. A possible implementation could be the use of the operators' smartphone applications for sending individualized text messages to passengers during subjectively insecure situations (e.g., at night or during major events). In this regard, studies have already shown that social presence is positively related to positive effects in the business-to-consumer context (Dash & Saji, 2008). Therefore, it can be assumed that fulfilling passengers' gratifications sought regarding social presence may lead to higher levels of trust and satisfaction regarding public transport operators, which ultimately may affect personal feelings of security. This is of special relevance, since security is a major factor influencing travel behavior (Backer-Grøndahl, Fyhri, Ulleberg, & Amundsen, 2009).

## **Limitations and future research**

We applied MESM as a method to collect data about situational perceived security. Even though this method is generally assumed to provide more valid insight into situationally changing outcomes, we cannot rule out that our findings are potentially confounded by this method. Since the questionnaire was prompted on the smartphone, this may have led to a change in the use of mobile communication.


Future research should include additional motives and gratifications that may explain the relationship between the use of mobile communication and perceived security on public transport. Among others, this should include escapism and para-social presence

that may be induced by media content used on mobile devices. It is likely that these aspects will become more important given new technical possibilities such as augmented and virtual reality applications and will also provide new opportunities for security campaigns of public transport operators.

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## Appendix

**Table A1.** Study I: Demographic composition.

	Quota	Overall sample		Final sample	
	%	<i>n</i>	%	<i>n</i>	%
<b>Gender</b>					
Male	48.0	1,079	47.6	638	49.4
Female	52.0	1,188	52.4	653	50.6

(Continued)

**Table A1.** (Continued)

	Quota	Overall sample		Final sample	
	%	<i>n</i>	%	<i>n</i>	%
<b>Age</b>					
16–19	4.0	92	4.1	87	6.7
20–29	14.0	290	12.8	247	19.1
30–49	34.0	782	34.5	532	41.2
50–64	24.0	551	24.3	267	20.7
65+	24.0	552	24.3	158	12.2
<b>Federal state</b>					
Bavaria	15.5	345	15.2	210	16.3
Baden-Württemberg	13.1	301	13.3	178	13.8
Rhineland-Palatinate	5.0	112	4.9	64	5.0
Saarland	1.2	28	1.2	13	1.0
Hesse	7.5	173	7.6	94	7.3
North Rhine-Westphalia	21.9	500	22.1	283	21.9
Thuringia	2.7	64	2.8	34	2.6
Saxony	5.0	112	4.9	62	4.8
Brandenburg	3.1	80	3.1	43	3.3
Berlin	4.1	92	4.1	44	3.4
Saxony-Anhalt	2.8	62	2.7	36	2.8
Mecklenburg-Vorpommern	2.0	44	1.9	20	1.5
Bremen	0.8	18	0.8	12	0.9
Hamburg	2.1	47	2.1	33	2.6
Schleswig-Holstein	3.5	81	3.6	40	3.1
Lower Saxony	9.7	218	9.6	125	9.7
<b>Victimization experience in PT</b>					
Yes		647	28.5	433	33.5
No		1,620	71.5	858	66.5
<b>Total</b>		<b>2,267</b>		<b>1,291</b>	

Note. Quota sampling is based on the 2011 EU census in Germany. PT = public transport.

**Table A2.** Study I: Constructs.

Construct/Item	<i>M</i>	<i>SD</i>	Std. load.	$\alpha$	CR	AVE
<b>General perceived insecurity</b>	2.38	0.94				
<b>Social presence sought</b>	2.46	1.22		.89	0.90	0.74
<i>I interact with other people via my smartphone on public transport. . .</i>						
<i>. . .so I don't feel like I'm traveling alone.</i> (Copresence)	2.49	1.36	0.76			

(Continued)

**Table A2.** (Continued)

Construct/Item	M	SD	Std. load.	$\alpha$	CR	AVE
. . .because I feel that the people I talk to could help me if something unpleasant happened to me. (Psychological involvement)	2.36	1.31	0.91			
. . .so I can show other passengers that I'm not all alone. (Behavioral engagement)	2.53	1.38	0.91			
<b>Frequency of mobile communication on PT</b>	3.42	0.99				
<b>Interpersonal trust</b>	3.19	0.85		.77	0.78	0.55
I am convinced that most people have good intentions.	3.34	1.00	0.74			
Nowadays you can no longer rely on anyone.	3.08	1.12	0.58			
In general, you can trust people.	3.16	0.96	0.87			

Note. Final sample:  $n = 1,291$ ;  $M$  = arithmetic mean;  $SD$  = standard deviation; Std. load. = standardized loading;  $\alpha$  = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted; PT = public transport.

**Table A3.** Study I: Correlations between constructs.

Scale	1	2	3	4	5
1. General perceived insecurity	-				
2. Social presence sought	.31***	-			
3. Mobile communication	.03	.31***	-		
4. Victimization experience	.17***	.15***	.10***	-	
5. Interpersonal trust	-.31***	-.20***	-.10***	-.11***	-

Note. Final sample:  $n = 1,291$ .  
\*\*\* $p < .001$ . \*\* $p < .01$ . \* $p < .05$ .

**Table A4.** Study I: Detailed results of regressions in the SEM model.

Path	$b$	SE	$p$	LCI	UCI	$\beta$
Insecurity $\rightarrow$ Social presence (H1)	.29	.04	< .001	0.22	0.36	.26
Social presence $\rightarrow$ Mobile communication (H1)	.26	.03	< .001	0.20	0.31	.27
Insecurity $\rightarrow$ Mobile communication (H1)	-.05	.03	.085	-0.10	0.01	-.04
Gender $\rightarrow$ Insecurity (H2)	-.25	.05	< .001	-0.35	-0.16	-.14
Age $\rightarrow$ Insecurity (H3)	.01	.00	< .001	0.00	0.01	.10
Victimization $\rightarrow$ Insecurity (H4)	.33	.05	< .001	0.23	0.43	.17
Trust $\rightarrow$ Insecurity (H5)	-.38	.04	< .001	-0.46	-0.30	-.30
Gender $\rightarrow$ Social presence	-.56	.06	< .001	-0.67	-0.45	-.27
Age $\rightarrow$ Social presence	-.01	.00	< .001	-0.01	-0.01	-.15
Victimization $\rightarrow$ Social presence	.27	.06	< .001	0.16	0.39	.12
Trust $\rightarrow$ Social presence	-.05	.04	.279	-0.14	0.04	-.03
Age $\rightarrow$ Mobile communication	-.02	.00	< .001	-0.03	-0.02	-.36

Note.  $b$  = unstandardized coefficient; SE = standard error;  $p$  =  $p$  value; LCI = lower 95% confidence interval; UCI = upper 95% confidence interval;  $\beta$  = standardized coefficient.

**Table A5.** Study 2: Constructs.

Construct/Item	M	SD	$\alpha$
<b>Social presence obtained</b> ( $n = 175$ )	3.16	1.21	.89
<i>By interacting with other people via my smartphone. . .</i>			
<i>. . . I have the feeling that I am not traveling alone.</i>	3.32	1.26	
(Copresence)			
<i>. . . I have the feeling that people I talk to could help if something unpleasant happens to me.</i>	3.06	1.40	
(Psychological involvement)			
<i>. . . I can show other passengers that I'm not all alone.</i>	3.10	1.33	
(Behavioral engagement)			
<b>Improvement of situational perceived security</b> ( $n = 175$ )	3.62	0.77	
<b>Situational perceived security</b> ( $n = 1,039$ )	6.54	1.05	
<b>Interpersonal trust</b> ( $n = 85$ )	3.48	0.81	.75
<i>I am convinced that most people have good intentions.</i>	3.52	0.88	
<i>Nowadays you can no longer rely on anyone.</i>	3.63	1.09	
<i>In general, you can trust people.</i>	3.30	1.00	

Note.  $M$  = arithmetic mean;  $SD$  = standard deviation;  $\alpha$  = Cronbach's alpha.

**Table A6.** Study 2: Estimates for Multilevel Model 1.

Variable	$b$	$SE$	$p$	LCI	UCI	$\beta$
Intercept	3.948	.23	< .001	3.50	4.40	.05
<i>Level 1</i>						
Social presence obtained (H6)	.21	.07	.002	0.08	0.34	.14
Daylight (1 = bright; H10)	-.03	.09	.715	-0.20	0.13	-.02
Long versus short distance (1 = short; H11)	-.23	.16	.168	-0.54	0.09	-.07
Underground (1 = underground; H12)	-.19	.13	.149	-0.45	0.06	-.10
<i>Level 2</i>						
Gender (1 = male; H13)	-.09	.18	.633	-0.45	0.27	-.06
Age (H14)	-.01	.01	.600	-0.02	0.01	-.06
Victimization experience (H15)	.05	.19	.802	-0.32	0.05	.03
Interpersonal trust (H16)	-.24	.12	.047	-0.47	-0.01	-.24

Note. Dependent variable = improvement of situational perceived security attributed to mobile communication;  $b$  = unstandardized coefficient;  $SE$  = standard error;  $p$  =  $p$  value; LCI = lower 95% confidence interval; UCI = upper 95% confidence interval;  $\beta$  = standardized coefficient.



**Table A7.** Study 2: Estimates for Multilevel Model 2.

Variable	<i>b</i>	<i>SE</i>	<i>p</i>	LCI	UCI	$\beta$
Intercept	6.41	.37	< .001	5.70	7.12	.06
<i>Level 1</i>						
Social presence obtained (H8)	.11	.14	.451	-0.16	0.37	.05
Daylight (1 = bright; H10)	.41	.16	.015	0.09	0.72	.17
Long versus short distance (1 = short; H11)	.03	.32	.925	-0.59	-0.16	.01
Underground (1 = underground; H12)	-.60	.23	.010	-1.04	-0.16	-.21
<i>Level 2</i>						
Gender (1 = male; H13)	.22	.22	.321	-0.21	0.64	.09
Age (H14)	.02	.01	.160	-0.01	0.04	.13
Victimization experience (H15)	-.29	.22	.193	-0.73	0.14	-.12
Interpersonal trust (H16)	.02	.14	.888	-0.25	0.29	.01

Note. Dependent variable = situational perceived security; *b* = unstandardized coefficient; *SE* = standard error; *p* = *p* value; LCI = lower 95% confidence interval; UCI = upper 95% confidence interval;  $\beta$  = standardized coefficient.