# Women's Fear of Crime at Bus Stops: The effects of building uses


Student name and number: Gréta Pethő, S4389700
Bachelor: Spatial Planning and Design
Supervisor: Christian Lamker
Date: 30th June, 2023

# Abstract

The fact that women's accessibility to public transport is constrained by their fear of crime is widely established in academic literature. Yet, transport planning still inadequately addresses women's mobility needs. Even though scholars argue that mixed land use eases fear of crime, the findings on ground-floor building uses are less consistent. These building uses can have positive impacts when they promote natural surveillance. Yet, they can also attract crime, which can induce fear in individuals. Thus, understanding the effects of ground floor building uses could enrich the knowledge of women's fear of crime and mobility needs and aid the transition to more sustainable transport planning. This comparative research in Groningen, The Netherlands context, explores whether ground-floor building uses influence women's fear of crime at bus stops during waiting times by assessing the social and physical environment surrounding the bus stops and surveying female bus users. Although there seems to be no direct relationship between building uses and women's fear of crime, placing bus stops on streets with a vast density of bars and restaurants is discouraged, indirectly lowering the fear of crime through stimulating social incivilities.

# 1 Contents

# 1. Introduction

## 1.1. Background

Despite women being more frequent public transport users than men, women's mobility needs are still inadequately addressed by transport planning (Loukaitou-Sideris et al., 2009; Chowdhury and van Wee, 2020). However, academic literature (Loukaitou-Sideris et al., 2009; Chowdhury and van Wee, 2020) increasingly calls for the recognition of gender differences in mobility needs and patterns, some (Hidayati, Tan and Yamu, 2020) even suggest that acknowledgement of these differences is essential in achieving sustainable urban transport. If sustainable public transportation projects fail to incorporate women's mobility needs into their plans, their sustainable transportation facilities might remain inaccessible to women (Hidayati, Tan and Yamu, 2020).

The abovementioned studies identified safety perception and fear of crime (FoC) as crucial determinants in gendered mobility since, for one, women fear more throughout their journey and in public spaces, which, for two, leads to adaptive or even avoidance behaviours. Women might modify their mode choices, the route they take, only travel at certain times of the day, or only with a company due to their concerns about their safety (Chowdhury and van Wee, 2020). Furthermore, they might avoid places that they fear altogether.

Abenoza et al. (2018) suggest that waiting times are an especially vulnerable part of the journey, and experiences during these times can deter the overall travel experience. Thus, the environment women spend their time in to wait for public transport has a huge impact, especially as many women feel anxious during this part of the journey (Chowdhury and van Wee, 2020). Ceccato et al. (2022) state that the social and physical environment surrounding the transit environment are both relevant. For example, environments characterized by poor maintenance, insufficient lighting, low visibility or the presence of drunk people increase FoC and attract more crime (Loukaitou-Sideris et al., 2009). Whereas the presence of other people, transparent bus shelters and mixed land use positively impacted safety feelings (Abenoza et al., 2018). Similarly, Gehl (2010) argues that mixed-use buildings are highly important in creating safe environments. He argues that the ground floors of buildings are especially relevant, as passersby mainly interact with this part of the building.

Although bus stops located in a mixed land use area can be beneficial for decreasing FoC because this land use draws a constant flow of passersby to the area throughout the day (Abenoza et al., 2018), Cozens and Love (2015) suggest that the positive correlation between crime, FoC and mixed land use is not that simple. The duration of activities and the type of activities that businesses offer are also relevant. Correspondingly Liggett, Loukaitou-Sideris and Iseki (2001) found that more crime happens near some establishments like restaurants and bars.

Abenoza et al. (2018) highlight the importance of enriching knowledge on FoC at bus stops with other cultural contexts. Since there is a lack of research on women's FoC at bus stops in the Dutch context, this study compares two bus stops, Zuiderdiep and Sint Jansbrug, in Groningen, Netherlands.

## 1.2 Research Problem

This research aims to contribute to the knowledge of gendered mobility and aid the transition to more sustainable public transportation by exploring the effect of building uses on women's FoC at bus stops in a Dutch context. For this aim, the following main research question is posed:

1. How do buildings around the bus stop influence women's fear of crime during waiting times?

Then, the following sub-questions intent to complement the main question:

**1.1** What aspects of the social environment impact women's fear of crime during waiting times?

**1.2** What is social environment like around ground floor building uses?

**1.3** What aspects of the physical environment impact women's fear of crime during waiting times?

**1.4** How is the physical environment like around the ground floor building uses?

# 2. Theoretical Framework

Crime and Fear of Crime

Almanaza et al. (2022, pp.2) describe FoC as the "emotional response of dread or anxiety to crime or symbols of crime that a person associates with crime". From this description, it seems logical to assume that FoC correlates with crime rates and Gerell (2018) and Abenoza et al. (2018) also stated in their paper that crime levels influence FoC. Yet, after conducting their research, Abenoza et al. (2018) found no significant correlation between crime rates and perceived safety at bus stops. In alignment with this finding, Lorenc et al. (2012) state that even though crime is relevant in influencing FoC, other factors, like interpersonal relationships and the physical and social environment, are more impactful.

The environment provides individuals with cues that they decode, interpret and incorporate into their perceptions of the environment (Cozens and Love, 2015), which relates to the second part of the above-given description of FoC, to the symbols people associate with crime. In addition, individual characteristics like age, gender and, or ethnicity can also impact how people perceive the environment, hence their FoC too (Ceccato et al., 2022). In connection to gender, women have an increased FoC compared to men (Loukaitou-Sideris et al., 2009).

In transit environments, Ceccato et al. (2022) identified several main aspects that are influential on the FoC, such as the transport stops' characteristics and facilities, the immediate environment of the stop, the stops location within the city, and the environment people spend their time in while getting to the stop. Next to these, Loukaitou-Sideris et al. (2009) suggest that all parts of the journey (i.e. getting to the stop, waiting at the stops, and onboard) are criminogenic and can evoke anxiety in women, with the most sensitive part being the waiting environment according to Abenoza et al. (2018).

Maintenance and Incivilities

The Broken Windows Theory of Wilson and Kelling (1982) proposes that crime and urban decay can be induced by small physical elements that signal disorder because they create the perception that the environment is neglected, which prompts criminal offences. These physical elements are referred to as physical incivilities (Hur and Nasar, 2014; Lorenc et al., 2012;) and include graffiti, litter, abandoned cars, broken features, dilapidated buildings, vacant buildings, and poor lighting. When researching the relationship between physical incivilities, perceived environment, and fear of crime through audits and surveys, Hur and Nasar (2014) found that improvement in the actual environment leads to improvement in the perceived environment, which then betters FoC. Yet, they note that perceived and actual conditions and signs of the disorder are not the same, meaning that perceived disorder and fear of crime can still be significantly impacted by incivilities when actual crime rates and risks are not. Similarly, in transit environments, Loukaitou-Sideris et al. (2009) also noted that poor physical conditions increase FoC in women. Therefore, they suggest that improvement in physical conditions, or in other words good maintenance, helps ease FoC.

Besides physical incivilities, Lorenc et al. (2012) mention social forms of incivilities, that also signal the deterioration of the neighbourhood, such as people selling or using drugs or public intoxication. Further, Bastomski and Smith (2016) argue that women are more prone to notice and react to incivilities than men. Almanza, Romero-Mendoza and Gómez (2022, pp 4.) studied women's insecurity in public spaces and suggested that even "low-intensity behaviours" like shouting, rudeness, or walking too closely can be anxiety-inducing for women. These behaviours have also been linked to negative safety perceptions in transit environments (Ceccato et al., 2022). Ceccato et al. (2022) included groups of young people causing trouble or inappropriate use of mobile phones in low-level behaviours.

Natural Surveillance, Visibility and Lighting

Natural surveillance refers to the supervision other people on the streets or in close by buildings provide (Cozens and Love, 2015). These people can be seen as guardians since they could interfere in case a crime occurs. Accordingly, studies (Abezona et al., 2018; Ceccato et al., 2022; Loukaitou-Sideris et al., 2009) note the importance of good surveillance opportunities for lowering FoC in transit environments. Abezona et al. (2018) even found that it is one of the most impactful factors in strengthening good safety perceptions at bus stops during waiting times. On the contrary, low surveillance opportunities often increase FoC (Loukaitou-Sideris et al., 2009). Surveillance opportunities can be affected by environmental factors like window placement or street design (Cozens and Love, 2015).

Closely related to surveillance is visibility. This term refers to the possibility for an individual to see and locate other people or situations around themselves (Ceccato et al., 2022). Poor visibility enhances people's fear of crime, while good visibility decreases it (Loukaitou-Sideris et al., 2009). Just like with surveillance, the physical environment can impact visibility conditions. Transparent bus shelters are better in terms of visibility than opaque shelters (Loukaitou-Sideris et al., 2009).

In general, good lighting positively affects safety perceptions (Loukaitou-Sideris et al., 2009). Lighting is defined as good when both the bus shelter and the adjacent streets are well-lit. However, the fishbowl effect, a lighting condition where the bus shelter is more lit than the streets around it, can enhance FoC ((Ceccato et al., 2022; Loukaitou-Sideris et al., 2009). Under this lighting condition, passengers feel overexposed to their surroundings, which reduces their safety perceptions. Thus, fishbowl effect should be avoided.

Time

The time of the day also impacts FoC, as it creates varying conditions at and around the transit environment by affecting natural surveillance or visibility (Abenoza et al., 2018; Ceccato et al., 2022). The number of passengers or passersby at the transit stop differs between peak hours, off-peak hours, weekdays, weekends, day- and night-time. Findings (Ceccato et al., 2022; Chowdhury and van Wee, 2020) often highlight night-time as a more feared time of the day.

Land-use & Building-use

According to Liggett, Loukaitou-Sideris, and Iseki, (2001) in reducing the occurrence of crime, ensuring good visibility from building uses in the vicinity of the bus stop is important, as they can be a source of natural surveillance. Similarly, Abenoza et al. (2018) found that safety perceptions at night can be positively influenced by mixed-land use because, in comparison to only commercial or residential land use, it generates a sufficient amount of pedestrians and activities. Related to the link between natural surveillance and mixed-land use, Mehta (2007) found that commercial seating, defined as seating offered by businesses, prompts people to linger on streets, contributing to street liveliness. Another positive influence of building uses on safety feelings at night is that they provide a light source (Gehl, 2010).

On the other hand, Ceccato et al. (2020) and Gerell (2018, p. 356.) note that there are building uses, termed as 'risky places', that attract crime in their vicinity. Examples of risky places are bars, restaurants, stores, and shopping malls (Ceccato et al., 2020). Similarly, Liggett, Loukaitou-Sideris, and Iseki, (2001, p.21.) found that the presence of 'undesirable establishments', like bars, adult movie theatres, or liquor stores in the close surrounding of a bus stop increased crime rates around the bus stop. However, this was mainly true for less serious crimes, for example, drug dealing and public drinking. Moreover, Roberts and Gornostaeva (2007) found that in the United Kingdom, alcohol consumption and the nighttime economy come with negative externalities like littering, noise and decreased safety. Similarly to this finding, Ceccato et al. (2020) suggest that women feel less safe around stations near nightclubs Accordingly, Liggett, Loukaitou-Sideris, and Iseki (2001) advise locating bus stops away from alcohol-selling establishments.

On the other hand, Gerell (2018) argues that facilities do not have a criminogenic value intrinsically. One

argument for this is that primary transport nodes are affected differently by risky places than peripheral nodes. Also, different locations within the city are likely variously impacted. Additionally, it is probable that risk factors for crime interact with each other and have a joint effect (Gerell, 2018). In other words, individual risk factors might not affect crime significantly but only in certain combinations with other risk factors.

## 2.1. Conceptual Model

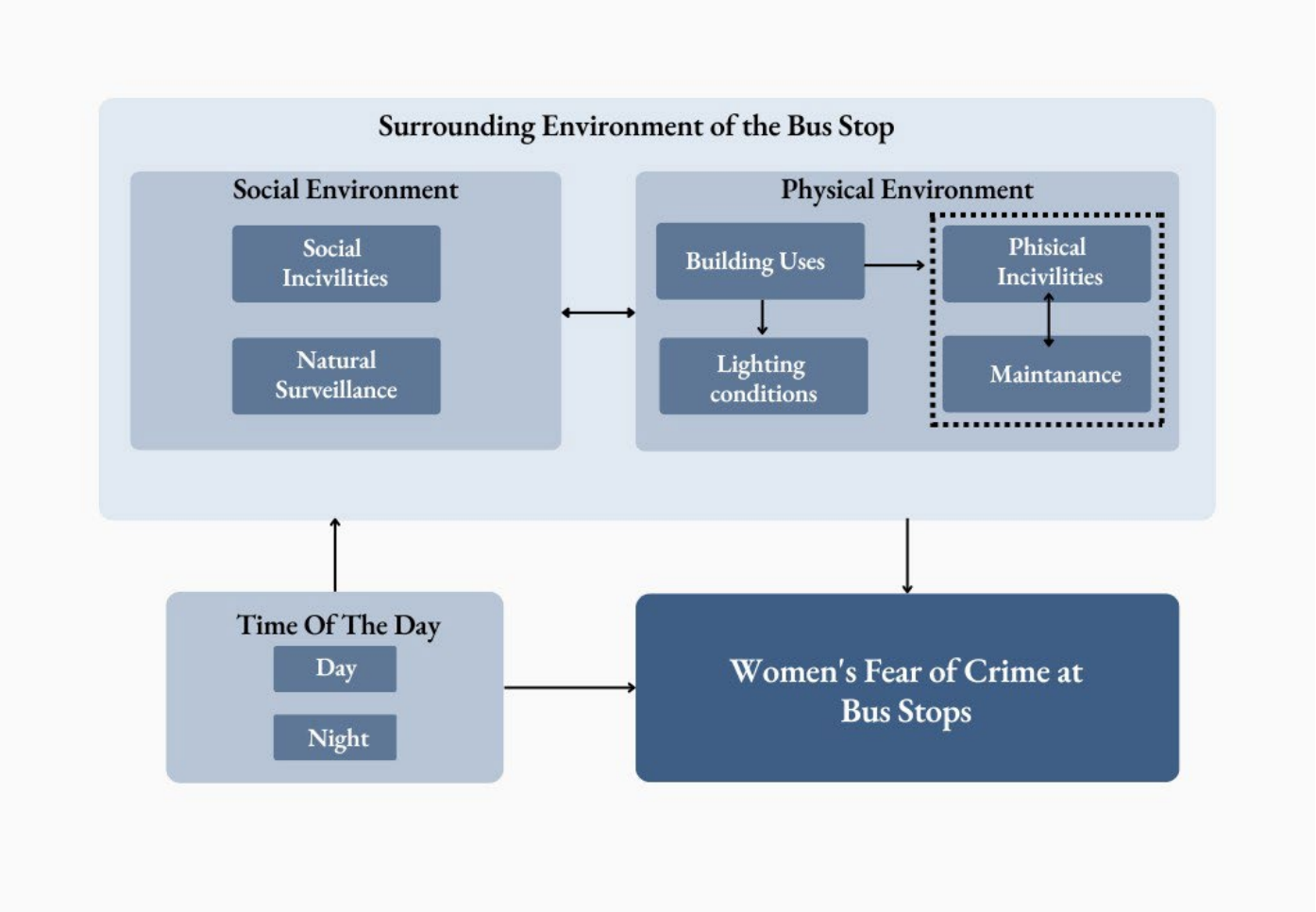


**Figure 1.** *Conceptual Model*

Based on the theoretical framework, the conceptual model (see Figure 1) illustrates how women's fear of crime is influenced by the time of the day, the surrounding environment of the bus stops and the interrelations between these elements and their subparts. The effect (positive or negative) of these relations have on the FoC of women is context-dependent.

Within the physical environment, physical incivilities closely correlate with maintenance, as the level of maintenance corresponds with the level of physical incivilities. In addition, building uses can impact physical incivilities depending on the activity the building use provides. Further, building uses can also be a source of light at night. Additionally, they can impact the social environment by affecting both surveillance and social incivilities. Lastly, the time of the day creates varying lighting and social conditions and also influences the activity times of businesses.

## 2.2. Expectations

We expect that the relevant aspects for women within the social or physical environment will be similar between the locations. However, we expect that at the Zuiderdiep, there will be more social and physical incivilities but also more natural surveillance due to the higher number of commercial uses in the area. Overall, due to the higher number of social and physical incivilities, women's FoC will be higher at the Zuiderdiep than at the Sint Jansbrug.

# 3. Research Design & Methods

This study triangulates between 3 methods; field audits, non-participant observations and surveys. The field audits are employed to objectively asses the physical environment, focusing on the level of maintenance (Hur and Nasar, 2014) around the bus stops and aim to answer sub-question 1.4. Then, non-participant observations aim to gain an objective overview of the social environment and intent to answer sub-question 1.2. Then, the surveys aim to capture women's perceptions regarding the social and physical environment and their sense of safety (Hur and Nasar, 2014) at bus stops, which aim to answer sub-questions 1.1 and 1.3.

All of these were done comparatively; by contrasting outcomes between Zuiderdiep and Sint Jansbrug to gain insights into whether building uses can be explanatory variables in causing the differences. The following paragraphs will provide a more in-depth description of the sites and the application of these methods.

The following paragraphs will introduce the sites and give a more in-depth description of the data collection and analysis for each method. Lastly, it will conclude with the ethical considerations.

## 3.1 Site selection a description

The study sites were selected based on the principles of the most similar system design, meaning that most characteristics of the sites were similar, except for one, which is expected to cause the difference in outcomes. Thus, both bus stops had transparent shelters, benches and lighting. (see Image 1 and Image 2).

***Image 1.*** *Bus stop characteristics at the Zuiderdiep location*

*Image 2.* Bus stop characteristics at the Sint Jansbrug location

Secondly, both have similar waiting times, on average 15 minutes during the day and 30 minutes after six pm and at the weekends (Qbuzz , n.d.). Moreover, the Zuiderdiep and the Sint Jansbrug stops are the two closest bus stops to the main square of Groningen (see Map 1), and both of them are major nodes within Groningen's bus stop network, with main lines going through them (see Image 3).


***Map 1.*** Locations of the bus stops within Groningen


***Image 3*** Locations and importance of Zuiderdiep and Sint Jansbrug node ( source Sebas van den Brink, 2022 in https://www.qbuzz.nl/english)

Furthermore, both bus stops are located in a mixed land-use area (see Map 2 and 3.)

However, the sites differ in the amount of possible undesirable establishments surrounding the bus stops. At the Sint Jansbrug, building uses consists of a school, a theatre, a gym, and commercial uses (see Map 3). Additionally, there are around six possible undesirable establishments, including restaurants and bars. In contrast, at the Zuiderdiep, building uses consist of several types of commercial uses like bars, cafés, barbershops, clothing stores or supermarkets (see Map 2). There are at least 12 possible undesirable establishments, including restaurants and bars.

Lastly, the boundaries of the area were established based on the viewshed of women with an average height of 1,60, which is 300 meters (Gargiulo et al., 2020). Thus, the study sites included the street section that measures 300 meters from both directions of the bus stops.


***Map 2.*** *Building uses around the Zuiderdiep bus stop*


***Map 3.*** *Building uses around the Sint Jansbrug bus stop*

## 3.2 Data collection

The audits and observations were conducted in the last week of May 2023. To account for the temporal dimension of safety perceptions and to get fuller coverage, sessions were done on Tuesday, Thursday and Saturday. In addition, data were collected during morning peak-, midday off-peak-, afternoon peak hours, and at ten pm each of these days. The fixed physical objects were assessed only once, while litter was recorded each session since it is a moveable object. Table 1 summarizes all the elements and their description included in this study.

The non-participant observations were done from the bus stop and lasted 15 minutes each time. The reason for this was to monitor the environment from the spot where women would wait for the bus, while the 15-minute duration was based on average bus frequencies. The observations focused on natural surveillance and social incivilities. The social incivilities consisted of drunk behaviour, noisy behaviour, and groups of male teenagers and adults. The latter was documented only when it was coupled with another type of incivility. However, then this other incivility was recorded separately as well.

For the survey, participants were recruited by purposive sampling because it enabled the recruitment of individuals with direct experience with the researched bus stops and their surroundings. Thus, the selection criteria were women (perceived gender) who waited at the selected bus stops.

The survey consisted of closed, Likert-scale type questions, except for two, that were multiple choice. The first question targeted the time of day participants use the bus stops to ensure that results correspond with experience. Then, women were asked about their safety perception depending on the time of day. The following questions explored, firstly, to what extent each incivility impacts safety feelings in general. Secondly, they investigated women's perception of the severity of the incivilities around the bus stop. The theoretical framework served as a base for selecting the specific incivilities, namely litter, graffiti, drunk behaviour, sell/use of drugs, noisy behaviour, and groups of males, to include in the survey.

Additionally, there were questions on the impact of natural surveillance, lighting and commercial seating on safety feelings. The above-mentioned site-specific questions aimed at investigating women's subjective perception of the social and physical environment around the bus stops. Lighting had two follow-up questions to explore whether there is a fishbowl effect at the sites. Lastly, all the elements the previous questions had asked about were listed, and women could choose which ones relate to building uses in their opinion. The full survey can be found in Appendix 1.

## 3.3 Data Analysis

For the analysis of the audits, definitions and measurements of physical incivilities were adapted from Hur and Nasar (2014) and assessed similarly. However, variables were simplified for the purpose of this study and sites. Additionally, since litter got marked during each auditing session, the measurements were summed and divided to obtain one average for the day and one for the night. Table 1 summarizes the elements and measurements. In connection to lighting, we reviewed whether the adjacent streets and the bus stops are both lit. Further, since the audits and observations only grasp an objective overview of the environment, the analysis is complemented by comparing the outcomes between sites and the survey results.

| Elements | Description | Measurements |
|---|---|---|
| vacant houses | signs that the building is uninhabited | exact number |
| dilapidated features | broken features, peeling paint | exact number |

| | | |
|---|---|---|
| graffti | none 0) to lot ( 5 or more and any bigger ones) (3) | ordinal scale 0-3 |
| litter | none (0) to lot | ordinal scale 0-3<br>summed and divided by 9 for the 'day'<br>summed and divided by 3 for the 'night' |

***Table 1.*** *Descriptions and measurements of physical incivilities (adapted from Hur and Nasar (2014))*

The survey resulted in a sample size of N=21 at Zuiderdiep and N=24 at St. Jansbrug. However, two respondents were dropped from the St. Jansbrug sample because none of the site-specific questions got responses from them. Hence, the sample size decreased to N=22. The analysis of the answers consisted of descriptive statistics and the Mann-Whitney U-test. Descriptive statistics were used to calculate the means for each Likert-scale question to determine the category to which each element belongs. For the categories and codes, refer to Appendix 2 and for the two-tailed significance Appendix 3.

Furthermore, the overall mean safety levels were calculated for the bus stops in 3 steps. If participants indicated that they use the bus both during the day and at night, the means of night safety and day safety were averaged. If they chose 'during the day' and 'I don't use this bus stop at night' too, the mean of 'day' safety was used. The same procedure applied to the 'at night' answers, respectively. Lastly, these three means were averaged to attain the overall mean safety levels per bus stop.

The Mann-Whintey U-test was used after the requirements of the parametric independent samples t-test were not met. This nonparametric test was utilized to examine if mean safety levels at the Zuiderdiep stop are significantly lower than at the St. Jansbrug. Furthermore, SPSS gives a two-tailed significance but one-tailed is need since we lower mean of safety perceptions at the Zuiderdiep. Hence, the result was divided by 2.

Additionally, a follow-up question on natural surveillance was left out from analysis, as an interviewer error was made. Interpretation of responses would have been biased.

## 3.4 Ethical Considerations

As safety is a sensitive topic, the researcher tried to ensure that women feel at ease during surveying. This meant that surveying took place only during the day since women's fear is higher at night. Additionally, the researcher only approached women when there were other passengers at the bus stop and other passers-by since women feel less safe when only one other person is waiting. Additionally, the researcher emphasized that participation is voluntary, and any questions can be left blank.

Further, participants were informed about their anonymity, confidentiality, and data protection. In the survey, none of the questions required personal information. Further, the data is used only for the purpose of the research and will be deleted at the end of 2023. Until then, it is stored in an encrypted, two-factor authenticated drive.

# 4. Results and Analysis

## 4.1 Zuiderdiep

Physical Environment

Despite two vacant stores, the area had no dilapidated exterior. However, measurements for graffiti resulted in a 3, meaning there were a lot. Regarding litter, the average value of the day recordings resulted in a small amount (0.64), while at night, the outcome was almost none (0.3). The litter was mainly scattered around on the sidewalks and trash cans. In all cases, the morning hours had the highest amount of litter, and the area got cleaner after. Furthermore, restaurant employees were observed cleaning their terraces. Overall, it can be said that the Zuiderdiep was well-maintained during the study period, apart from some litter and graffiti. Concerning lighting conditions, both the bus stop and the sidewalks were well-lit. The building uses that remained open provided additional lighting sources. Additionally, commercial seats were occupied throughout the entire day.

General safety perceptions regarding graffiti resulted in a mean value of -0.29, indicating a *neutral perception. In contrast,* litter resulted in the *somewhat unsafe (-0.76)* category. In the site-specific questions, women rated graffiti as *not a problem* (-0.05), whereas litter was seen as *somewhat of a problem* (-0.67). Based on the audits and survey responses, litter might affect FoC at the Zuiderdiep, while graffiti is likely negligible.

Both lighting and commercial seating were rated as *somewhat safe on average*. For the follow-up questions on lighting, responses fall into the *well* category for both 'seeing others' and 'others can see you'. Thus, coupled with the audits, there is likely no fishbowl effect, and the lighting can be described as good. Therefore, lighting may decrease FoC at night at the Zuiderdiep.

Social environment

Concerning natural surveillance, people were present around the bus stop day and night. During the day, more people were at the site than at night since more establishments were open and offered more activities. At night, it was mainly restaurants and bars that remained open. However, the terraces of most of these places were occupied by people throughout the day. Additionally, always more than two people were waiting at the bus stop.

The amount and type of social incivilities documented varied between day and night. In total, six incivilities were recorded during the day; two noisy behaviour, two public drinking and three groups of males hanging out. At night, the total amount was 12; four drunk behaviour, five groups of males and eight noisy behaviour. However, only five of all incivilities had a direct link to building uses, to bars and to the supermarket.

General safety perceptions regarding social incivilities resulted in *a somewhat unsafe* category for all. The presence of drunk people was rated the highest negative mean value of -1.52, bordering *somewhat unsafe* and *very unsafe* categories, followed by the sell or use of drugs (-1.35), noisy behaviour (-1.05) and groups of male teenagers or adults (-0.95). In the site-specific questions, all social incivilities rated, on average, as *somewhat of a problem*, and this category had the highest share of responses in all cases. Drunk people had the highest negative value (-1.19). All the other mean values were above -0.8. Overall, based on these responses and the observations, it is likely that social incivilities increase women's FoC at the site, especially at night when it seems to be more prevalent. In contrast, natural surveillance was rated *somewhat safe* (0.90). Therefore, it possibly eases women's FoC.

## 4.2 Saint Jansbrug

Physical Environment

At the Sain Jansbrug, there was one vacant building and three dilapidated exteriors. Regarding litter, the average value of the during-day recordings resulted in 0.67, meaning there was a small amount. However, at night the

amount was almost none (0.33). In most cases, the litter was near residential buildings or scattered around the sidewalk. In all instances, mornings had the highest amount of litter, but the area got cleaner after, except around a few residential buildings. Moreover, the measurements of graffiti resulted in a lot (3). However, the site was generally well-maintained, except near a few residential buildings.
Regarding lighting conditions, the street was well-lit around the bus stop and sidewalks. The building uses that remained open at night contributed to lighting conditions on the sidewalk, while the sidewalk was slightly darker around residential buildings. People often occupied the commercial seating.

General safety perceptions regarding graffiti resulted in the *neutral category*. In contrast, litter was perceived as *somewhat unsafe (-0.77)*. In the site-specific questions, women rated graffiti as *not a problem* (-0.32) and litter *as somewhat of a problem* (-0.64). Based on the survey and audit outcomes, litter might affect FoC at the Sint Jansbrug, while graffiti probably has no effect.

In contrast, the effects of commercial seating were rated on average as *somewhat safe*, while the lighting was just on the borderline of *somewhat safe* and *neutral*. In the follow-up questions on lighting, responses fall into the well category for both 'seeing others' and 'others can see you'. Even though the fishbowl effect is unlikely at the site, no conclusive statements can be made on the impacts of lighting at this site since safety perceptions of lighting were ambiguous.

Social environment

Regarding natural surveillance, there was a constant flow of people around the bus stop day and night. During the day, the school provided the most surveillance directly, while at night, the theatre. Although people used the terraces of cafés, bars, and restaurants throughout the day, most were not visible from the stopThe amount and type of social incivilities recorded varied between day and night. During the day, four incivilities were observed; two noisy behaviour, a group of teenage boys hanging out and public drinking. While at night, this amount was one; males hanging out in a group. Two incivilities were connected to the school and one to a pizza place.

In general, women perceived social incivilities as *somewhat unsafe*. The sell/use of drugs was rated the lowest (-1.59), followed by drunk behaviour (-1.45), noisy behaviour (-1.14) and a group of male teenagers or adults (-1.09). For the site-specific questions, the mean values concerning these incivilities resulted around the middle value between *somewhat of a problem* and *not a problem*, with minor differences in mean values. Noisy behaviour and drunk behaviour were somewhat more problematic, while sel/use of drugs was more on the no problem side, and groups of males were just in the middle. Contrastingly, natural surveillance was perceived *as somewhat safe* (0,77).

Even though the perceptions of social incivilities indicated that if it is a big problem, it increases women's fear of crime, the audits did not document many social incivilities. Moreover, women had only a moderate concern. Therefore, it is likely that social incivilities had no substantial impact on women's FoC at this bus stop. In contrast, that natural surveillance likely positively impacts safety perceptions at Saint Jansbrug.

## 4.3 Comparison

The one-tailed Mann-Whitney U test showed that women's fear of crime was significantly ($p=0.019<0,05$) higher at the Zuiderdiep than at the St. Jansbrug, with a mean of 0.93 average safety at the Zuiderdiep location and of 1.41 at the St. Jansbrug. In addition, the St. Jansburg location had higher mean values for both the day- and the night safety perceptions. During the day, women felt very safe (1.76) and neutral (0.43) at night, while at Zuiderdiep, the mean value (1,48) for the day safety was in between *somewhat safe* and *very safe*, and in the neutral category at night (-0.05). These results show that women felt less safe at night than during the day at both bus stops.

Regarding the relationship between building uses and the listed elements, the four most frequently chosen elements were the same at both bus stops; two-thirds or more women selected *drunk people*, *other people being around, groups of male teenagers/adults* and *noisy people*. These frequencies were fairly identical between locations ( see

Figure 3).

The physical environment around both bus stops was generally well-maintained, with slightly more physical incivilities recorded at the Saint Jansbrug location. In both cases, litter might have a somewhat negative impact on FoC, whereas graffiti seems negligible. Interestingly, morning hours had the most litter at both sites, which might have been caused by previous night activities, as the night-time economy can cause littering (Roberts and Gornostaeva, 2007). Since, after the mornings, the areas got cleaner, this assumption seems plausible. Regarding lighting both sites had good lighting with no fishbowl effect. However, responses at the Sint Jansbrug were slightly ambiguous.

At both bus stops, women perceived commercial seating positively. Since Mehta (2017) found that commercial seating contributes to lingering activities, women may see terraces as a source of natural surveillance, which could explain why women rated them positively. Yet, commercial seating had a higher value at the Zuiderdiep compared to the Saint Jansbrug. One explanation for this outcome could be that there are more hospitality establishments, hence more commercial seating, at the Zuiderdiep. Further, more of these are directly visible from the bus stop. And as noted from the literature (,Ceccato et al., 2022; Loukaitou-Sideris et al., 2009), it is not only natural surveillance that is important for good safety perceptions but also good visibility.

In contrast, larger differences were observed at the sites and deducted from the surveys concerning the social environment. At St. Jansbrug, the largest share of responses for all social incivilities fell into the 'not a problem' category. In comparison, at the Zuiderdiep, this was true for the 'somewhat of a problem' category, indicating that women at the Zuiderdiep perceived their surrounding environment somewhat worse (see Figure 2). These findings correspond with observation results that showed that social incivilities were more prevalent at the Zuiderdiep, predominantly at night. All this might partly explain why average safety perceptions were lower at night at the Zuiderdiep stop. Natural surveillance also corresponded with previous studies, as women indicated it makes them feel somewhat safe. There were more people at the Zuiderdiep, which might be because there are more commercial ground floor uses there, drawing more people to the area.

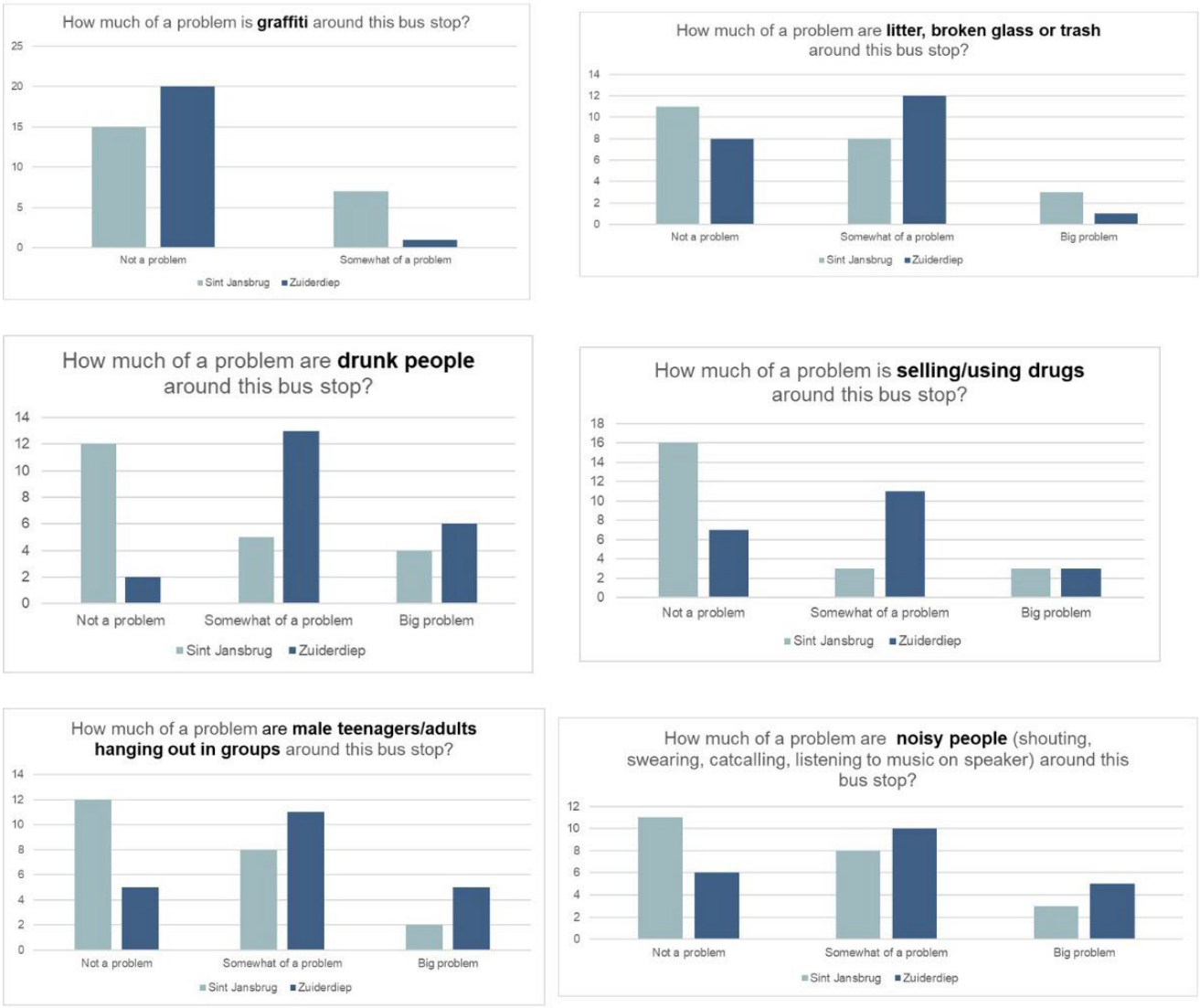


***Figure 2.*** *Differences in the composition of responses regarding incivilities between the Sint Jansbrug and the Zuiderdiep bus stops*

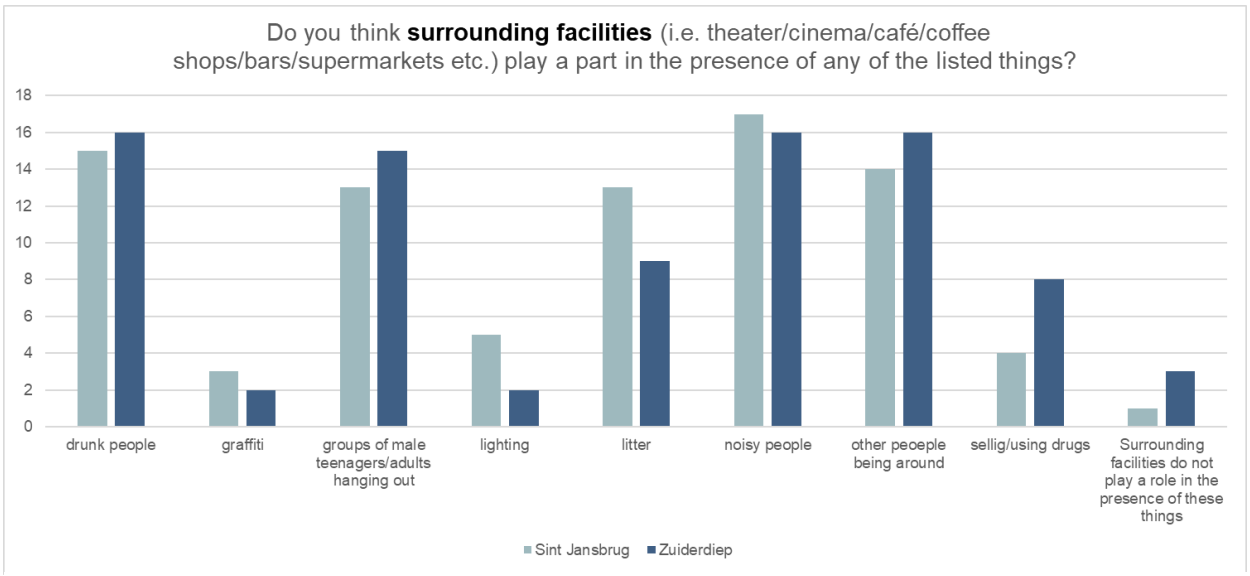


***Figure 3.*** *Women's perception on the relationship between building uses and surveyed elements*

# 5 Conclusion

Overall, this study aimed to answer the question *How do groundfloor uses of buildings influence women's fear of crime at bus stops during waiting times?*

The physical environments around both stops were well-maintained, with physical incivilities having little to no effect on women's FoC at either site. Since general safety perceptions of both sites were generally good, this finding confirms that well-maintained areas may help ease women's FoC. In connection to lighting, the sites had no fishbowl effect, but lighting only at the Zuiderdiep seemed to have a positive influence. Overall, building uses did not seem to substantially impact the physical environment based on the audits and survey results.

On the other hand, also corresponding with previous studies, women had a negative perception of social incivilities. Further, social incivilities had the highest negative values at both stops. Findings of both the non-participant observations and the survey indicated that it is more of a problem at the Zuiderdiep than at the St. Jansbrug, especially at night. These findings were the most prominent differences between the two stops. Therefore, these results might explain the outcome of the Mann-Whitney U-test, which showed that average safety perceptions at the Zuiderdiep are significantly lower. Additionally, the social environment was mostly related to building uses by women at both bus stops. On the other hand, a direct relationship between building uses and the social or physical environment was only observed in a few instances.

Then, taking the research design into account, the main contextual difference between the sites, was the number of undesirable establishments, especially the alcohol-selling ones like restaurants and bars. Since, Liggett, Loukaitou-Sideris, Iseki (2001) found a correlation between lower severity crimes like a public nuisance and these establishments, and we also found more social incivilities here, undesirable establishments might be a possible explanation for this. However, there were restaurants and bars at the Sint Jansbrug, but a negligible amount of incivilities were found. This seems to reconfirm Geller (2018)'s suggestion, that building uses are not intrinsically criminogenic rather specific combination of risk factors has to be in place. However, since there were a large number of restaurants and bars at the Zuiderdiep, they might act as a combination of risk factors and have a joint effect on the social environment.

Then, to answer our research question, ground floor building uses are likely to have no direct influence on women's FoC but they might have an indirect effect by impacting mainly the social environment, natural surveillance and social incivilities. Therefore, they might have both positive and negative indirect impacts, but these cannot be separated from other factors that influence women's FoC. Still, it might be beneficial to not place bus stops on street with a very high number of restaurants and bars.

However, the study has several limitations, meaning that the findings of this research are not generalizable. Firstly, the sampling method and the sample size did not provide a representative sample. Therefore, the outcomes of the study should be interpreted with caution. In future studies, a bigger sample size should be aimed at or a different methodological approach, such as focus groups and interviews, to better capture women's perceptions. Additionally, the results of the audits and observations are context-dependent; restricted to the sites and the time where and when the research was conducted and subject to the researcher's judgment without interrater reliability. Further, the study's findings are limited to the spring period and to the two researched bus stops. Additionally, in the survey, catcalling was included in the noisy behaviour. Even though it is a verbal form of harassment, it would have been better to have a separate category for it. This might affect the survey outcomes. For all these reasons, it would be valuable to repeat this study in other contexts and a more representative sample.

Further, acknowledging the complexity of the notion of fear of crime, the author agrees with the literature ( Lorenc et al., 2012; Loukaitou-Sideris et al., 2009) that design interventions in themselves are inadequate in tackling crime and the fear of it, as the issue is deeply rooted in a wider sociocultural context. Still, every effort should be made to ease women's fear of crime in public spaces and their mobility needs and to find more comprehensive solutions, especially when countries aim to transition to more sustainable urban transportation.

Tackling fear of crime could improve women's access to sustainable public transportation, increase their well-being, and could potentially narrow gender differences. These could contribute to more sustainable urban

regions.

# 6 References


Abenoza, R. F., Soria-Lara, J. A., Coomans, M., Cats, O., & Van Arem, B. (2018). Individual, Travel, and Bus Stop Characteristics Influencing Travelers' Safety Perceptions. Transportation Research Record: Journal of the Transportation Research Board, 2672(8), 19–28. doi:10.1177/0361198118758677.

Almanza Avendaño, A. M., Romero-Mendoza, M., & Gómez San Luis, A. H. (2022). From harassment to disappearance: Young women's feelings of insecurity in public spaces. PLOS ONE, 17(9), 4-29. doi:10.1371/journal.pone.0272933.

Bastomski, S., & Smith, P. (2016). Gender, Fear, and Public Places: How Negative Encounters with Strangers Harm Women. Sex Roles, 76(1-2), 73–88. doi:10.1007/s11199-016-0654-6.

Ceccato, V., Gaudelet, N., & Graf, G. (2022). Crime and safety in Transit Environments: A systematic review of the English and the French literature, 1970–2020. Public Transport, 14(1), 105–153. doi:10.1007/s12469-021-00265-1.

Chowdhury, S., & van Wee, B. (2020). Examining women's perception of safety during waiting times at public transport terminals. Transport Policy, 94, 102–108. doi:10.1016/j.tranpol.2020.05.009.

Cozens, P., & Love, T. (2015). A Review and Current Status of Crime Prevention through Environmental Design (CPTED). Journal of Planning Literature, 30(4), 393–412. doi:10.1177/0885412215595440.

Gargiulo, I., Garcia, X., Benages-Albert, M., Martinez, J., Pfeffer, K., & Vall-Casas, P. (2020). Women's safety perception assessment in an urban stream corridor: Developing a safety map based on qualitative GIS. Landscape and Urban Planning, 198, 103779. doi:10.1016/j.landurbplan.2020.103779.

Gehl, J. (2010). Cities for people. Washington, D.C.: Island Press. Accessed June 29, 2023, from: https://search-ebscohost-com.proxy-ub.rug.nl/login.aspx?direct=true&db=nlebk&AN=348250&site=ehost-live&scope=site

Gerell, M. (2018). Bus Stops and Violence, Are Risky Places Really Risky? European Journal on Criminal Policy and Research, 24(4), 351–371. doi:10.1007/s10610-018-9382-5.

Hidayati, I., Tan, W., & Yamu, C. (2020). How gender differences and perceptions of safety shape urban mobility in Southeast Asia. Transportation Research Part F: Traffic Psychology and Behaviour, 73, 155–173. doi:10.1016/j.trf.2020.06.014.

Hur, M., & Nasar, J. L. (2014). Physical upkeep, perceived upkeep, fear of crime and neighborhood satisfaction. Journal of Environmental Psychology, 38, 186–194. doi:10.1016/j.jenvp.2014.02.001.

Liggett, R., Loukaitou-Sideris, A., & Iseki, H. (2001). Bus Stop–Environment Connection: Do Characteristics of the Built Environment Correlate with Bus Stop Crime? Transportation Research Record: Journal of the Transportation Research Board, 1760(1), 20–27. doi:10.3141/1760-03.

Lorenc, T., Clayton, S., Neary, D., Whitehead, M., Petticrew, M., Thomson, H., Cummins, S., Sowden, A., & Renton, A. (2012). Crime, fear of crime, environment, and mental health and wellbeing: Mapping review of theories and causal pathways. Health & Place, 18(4), 757–765. doi:10.1016/j.healthplace.2012.04.001.

Loukaitou-Sideris, A., Bornstein, A., Fink, C., Samuels, L., & Gerami, S. (2009). How to ease women's fear of transportation environments: Case studies and best practices. Social Research in Transport (SORT) Clearinghouse.

Mehta, V. (2007). Lively Streets. Journal of Planning Education and Research, 27(2), 165–187. doi:10.1177/0739456x07307947.

Qbuzz (n.d.). Groningen Sint Jansbrug bus stop. Accessed June 29, 2023, from

https://www.qbuzz.nl/gd/halte/groningen-sint-jansbrug

Qbuzz (n.d.). Groningen Zuiderdiep bus stop. . Accessed June 29, 2023, from https://www.qbuzz.nl/gd/halte/groningen-zuiderdiep

Roberts, M. and Gornostaeva, G. (2007) 'The night-time economy and sustainable town centres: dilemmas for local government', International Journal of Sustainable Development and Planning, 2(2), pp. 1-19. ISSN 1743-7601. Accessed June 29, 2023, from: http://journals.witpress.com/pages/paperinfo.asp?PaperID=274&jID=17&vn=2&in=2

Wilson, J. Q., & Kelling, G. L. (1982). Broken Windows. The Atlantic Monthly, 249, 29-38.

# 7 Appendices

## 7.1 Appendix 1.

Bachelor's Thesis - Building Uses and Women's Safety Perceptions at Bus Stops

Ethical consideration, intro:

Dear participant,

Thank you for contributing to my research with your input. I am Gréta Pethő, a Spatial Planning & Design student at the University of Groningen.

I am researching the relationship between women's feelings of safety at bus stops during waiting times and the surrounding environment. The surrounding environment includes other people's behaviour and building uses( for example: cafés, schools, restaurants, cinema etc.) and some other physical elements like litter.

Completing this survey will take around **5-7 minutes**. Participation is entirely volunatary, none of the questions are obligatory to answer, and withdrawal from participation is possible at any point. No personal information are collected, therefore the questionniare is completely anonymus. Additionally, the data provided will only be used for the purpose of this research, with only the researcher and her supervisor having access to data. Data encyriptionis ensure through the use of SurveyMonkey. After completing my studies, the data will be deleted.

If you have any questions or concerns please contact:

g.petho@student.rug.nl

Thank your for your time and input!

Introduction questions – Please tick the box that applies to you

When do you usually use this bus stop?

- During the day

- At night
- Both during the day and at night

How safe do you feel waiting for the bus at this bus stop during the day?

- Very unsafe
- Somewhat unsafe
- Somewhat safe
- Very safe

How safe do you feel waiting for the bus at this bus stop at night?

- Very unsafe
- Somewhat unsafe
- Somewhat safe
- Very safe

Individual perceived incivilities – Please tick the box that applies to you the most, only one answer possible

**Graffiti**

How safe do you feel at bus stops that are located on streets where graffiti is a big problem?

- Very unsafe
- Somewhat unsafe
- Nor unsafe, nor safe
- Somewhat safe
- Very safe

How much of a problem is graffiti around this bus stop?

- Big problem
- Somewhat of a problem
- Not a problem

Litter

How safe do you feel at bus stops that are located on streets where litter, broken glass or trash are big problem?

- Very unsafe
- Somewhat unsafe
- Nor unsafe, nor safe
- Somewhat safe
- Very safe

How much of a problem is litter, broken glass or trash around this bus stop?

- Big problem
- Somewhat of a problem

- Not a problem

Public Drinking

How safe do you feel at bus stops that are located on streets where the presence of drunk people is a big problem?

- Very unsafe
- Somewhat unsafe
- Nor unsafe, nor safe
- Somewhat safe
- Very safe

How much of a problem are drunk people around this bus stop?

- Big problem
- Somewhat of a problem
- Not a problem

Selling/ Using Drugs

How safe do you feel at bus stops that are located on streets where people selling/using drugs is a big problem?

- Very unsafe
- Somewhat unsafe
- Nor unsafe, nor safe
- Somewhat safe
- Very safe

How much of a problem is selling/using drugs around this bus stop?

- Big problem
- Somewhat of a problem
- Not a problem

Groups of male teenagers/adults

How safe would you feel at bus stops that are located on streets where male teenagers/adults hanging out in groups is a big problem?

- Very unsafe
- Somewhat unsafe
- Nor unsafe, nor safe
- Somewhat safe
- Very safe

How much of a problem are groups of male teenagers/adults around this bus stop?

- Big problem
- Somewhat of a problem
- Not a problem

### Noisy behaviour

How safe would you feel at bus stops where the presence of noisy people (shouting, swearing, catcalling, listening to music on speaker) is a big problem?

- Very unsafe
- Somewhat unsafe
- Nor unsafe, nor safe
- Somewhat safe
- Very safe

How much of a problem are noisy people around this bus stop?

- Big problem
- Somewhat of a problem
- Not a problem

### Lighting/Visibility

How safe does the lighting around this bus stop make you feel?

- Very unsafe
- Somewhat unsafe
- Nor unsafe, nor safe
- Somewhat safe
- Very safe

How well can you see others from this bus stop at night?

- Not well
- Well
- Very well

How well can others see you waiting at this bus stop at night?

- Not well
- Well
- Very well

### Natural Surveillance

How safe does the presence of other people (people walking by, cycling, sitting etc.) around this bus stop make you feel?

- Very unsafe
- Somewhat unsafe
- Nor unsafe, nor safe
- Somewhat safe
- Very safe

How much do you agree with the following sentence: *There is enough people around this bus stop.*

- Strongly disagree
- Disagree
- Nor disagree, nor agree
- AgreeStrongly agree

Commercial seating

How safe does the presence of terraces of cafes/restaurants/bars around this bus stop make you feel?

- Very unsafe
- Somewhat unsafe
- Nor unsafe, nor safe
- Somewhat safe
- Very safe

Do you think surrounding facilities (i.e. theater/cinema/café/coffee shops/bars/supermarkets etc.) play a part in the precence of any of the listed things? *Choose the ones that you think are related, more choices are possible*

- Graffiti
- Litter
- Drunk people
- Selling/Using drugs
- Noisy people
- Lighting
- Other people being around
- Surrounding facilities do not play a role in the presence of these things

Additional comments:

## 7.2 Appendix 2. Codes and Categories

| | |
|---|---|
| Not a problem | 0 |
| Somewhat of a problem | -1 |
| Big problem | -2 |
| | |
| How well can you see others from this bus stop at night? | |
| Not well | 0 |

| | |
|---|---|
| Well | 1 |
| Very well | 2 |

How much do you agree with the following sentence: 'There are enough people around this bus stop.' ?

| | |
|---|---|
| Disagree | -1 |
| Agree | 1 |
| Neutral | 0 |

| | |
|---|---|
| Very safe | 2 |
| Somewhat safe | 1 |
| nor safe, nor unsafe | 0 |
| somewhat unsafe | -1 |
| very unsafe | -2 |

## 7.3 Appendix 3. Two-tailed significance of Mann- Whitney U test

**Test Statistics[a]**

| | Value |
|---|---|
| Mann-Whitney U | 147 |
| Wilcoxon W | 378 |
| Z | -2,1 |
| Asymp. Sig. (2-tailed) | ,036 |

a. Grouping Variable: Bus_stop