

BUILT ENVIRONMENT, PERCEIVED SAFETY, AND TRANSIT USE

A case study for Utrecht Central Station

Colophon

Title: Built Environment, Perceived Safety, and Transit Use

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Abstract

Train stations are places with an increased risk of crime and nuisance. However, travelers' perceptions of safety from crime can be influenced via the way that train stations are designed. This thesis aimed to identify which built environment characteristics of a train station and its immediate surroundings have the most influence on passengers' perceived safety from crime. In addition, the research aimed to explore whether the perceptions of safety influence the frequency of use of public transport. For this purpose, the following research question has been formulated: "*What built environment characteristics of stations and their immediate surroundings have the most influence on perceived safety from crime and how do the perceptions of safety influence the frequency of use of public transport?*" These issues have been explored through a case study of Utrecht Central Station, by means of a literature review and a survey. The results show that lighting in and around the station and the presence of other users are recognized by travelers as the most influential for perceived safety from crime in general. The amount of access points to the platforms and unmanned buildings around the station show the strongest relationship with the overall grade for perceived safety from crime given for Utrecht Central Station. Both relationships are negative, indicating that the current amount of access points and the unmanned buildings around Utrecht Central Station are perceived by travelers as insufficient. According to this research, the perceptions of safety from crime do not influence the frequency of use of public transport. In practice, a general focus should be on sufficient lighting and on supporting the presence of people inside as well as outside the station.

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1. Background

Safety in public transport is an important issue. According to Ceccato (2013), transit environments are ‘criminogenic settings’, which suggests that the physical and social characteristics of transit environments have the tendency to encourage crime acts. Also, the Dutch Social-Cultural Planning Office refers to train stations as environments with an increased risk of crime and nuisance (Van Noije & Wittebrood, 2008). This can be explained by the fact that train stations produce masses that consist of potential crime victims (Ceccato, 2013). Especially during peak hours, the crowds of people and lack of surveillance can facilitate theft and vandalism (Smith & Cornish, 2006).

Often, there is a gap between actual and perceived safety. The perceptions of safety can be influenced, amongst others, via the way that transit facilities and their internal and external environments are designed (Cozens & Van der Linde, 2015; Ceccato, 2013). According to Ceccato (2014), good transit planning should therefore be aimed at creating transit environments that are perceived as safe and comfortable by everyone. The worldwide approach aimed at limiting crime and nuisance and increasing perceived safety through the design of the physical environment is called Crime Prevention Through Environmental Design (Svob, 2021).

1.1. Societal relevance

Between 2014 and 2016, crime at Dutch train stations had increased. While physical violence decreased during that time by 8%, verbal aggression, theft, nuisance, and vandalism increased by 24%, 28%, 84%, and 18% respectively (Broekhuizen *et al.*, 2017). In this period, 80% of the passengers had a positive perception of safety in the train (Abraham *et al.*, 2016). More recently, the occurrence of incidents has decreased, but the Nederlandse Spoorwegen (NS) noted that the location of the incidents has moved from on the train to at the train stations (NS, 2021). According to the travelers’ needs pyramid from Van Hagen & Sauren (2014), safety is a requirement for passengers to be able to value the qualities higher up in the pyramid and therefore forms the base of the pyramid (Figure 1). By exploring the most important built environment characteristics that influence perceived safety, this research can indicate the characteristics that should be focused on to increase the performance of stations regarding safety and, with that, travelers’ experience.

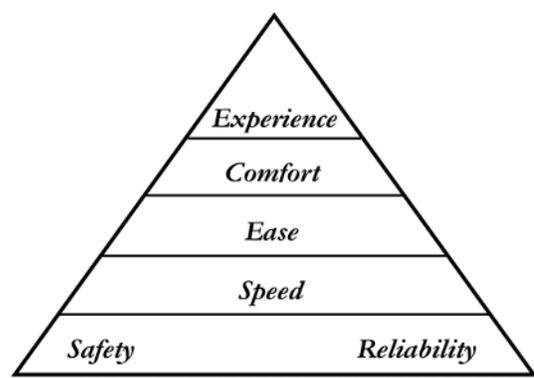


Figure 1: Pyramid of Customers' needs (Source: Van Hagen & Sauren, 2014, reproduced by author)

1.2. Scientific relevance

Hong & Chen (2014) mention that while the relationship between the built environment and safety has been indicated often, more in-depth analyses and case studies should be conducted to show the exact role of the built environment. Besides, Cozens & Van der Linde (2015) note that studies that used the CPTED approach often do not focus much on the surrounding area. This research builds upon this research gap by exploring the influence of physical characteristics of the built environment on perceived safety using a case study, by not only focusing on the train station itself but also on its immediate surroundings.

1.3. Research problem

This research aims to identify which built environment characteristics of a train station and its immediate surroundings have the most influence on passengers' perceived safety from crime. In addition, it aims to explore whether the perceptions of safety influence the frequency of use of public transport. To do so, these two issues are explored for the specific case of Utrecht Central Station.

Following the aim, this research will answer the following central question:

Q.1. *“What built environment characteristics of stations and their immediate surroundings have the most influence on perceived safety from crime and how do the perceptions of safety influence the frequency of use of public transport?”*

To be able to answer the central question, four secondary questions have been formulated:

Q.2.1. *“Which built environment characteristics of a train station and its immediate surroundings contribute to or diminish passengers' perceived safety from crime?”*

Q.2.2. *“What are the general perceptions on safety from crime at Utrecht Central Station and do the perceptions differ based on socio-demographic characteristics?”*

Q.2.3. *“Which built environment characteristics of Utrecht Central Station and its immediate surroundings have the most influence on passengers' perceived safety from crime?”*

Q.2.4. *“What is the relationship between perceived safety from crime and the frequency of use of public transport?”*

1.4. Reading guide

This first chapter has introduced the topic and aim of the research. In the following chapter, the relevant theories and concepts are discussed and in chapter 3 the research design is explained. Chapter 4 shows the results of the data collection and relates the findings to the literature through a discussion of the results. In chapter 5, the conclusions are summarized, the limitations to the research are discussed, and recommendations for further research are provided. Lastly, the references and the appendices can be found.

2. Theoretical framework

In this chapter, the theories and concepts relevant to this research are discussed and the first sub-question is answered. In addition, a conceptual model is presented that summarizes the used concepts and how they relate to each other.

2.1. Perceived safety

Enjoyers of transit environments often perceive the risk of crime, subjective safety, substantially higher than actual crime rates, objective safety, would suggest (Cozens *et al.*, 2003). Subjective or perceived safety is determined by the feeling that a person may be victimized by a crime (Ceccato, 2013). These perceptions often lead to fear and fear of crime can discourage people from traveling by train (Cozens *et al.*, 2003). The mere perception of safety may, therefore, influence travel behavior regardless of its accuracy. Perceptions of safety can be influenced by socio-economic characteristics and individual attitudes (Coppola & Silvestri, 2020; Hong & Chen, 2014). Women generally feel more unsafe from crime in public space than men, and elderly feel more unsafe from crime than young people (Jorgensen *et al.*, 2012; Fattah & Sacco, 2012). But, next to personal characteristics, the design of the built environment can influence perceived safety (Cozens & Van der Linde, 2015). This research focuses on the perceived safety *from crime* since travelers by train generally feel more unsafe from crime than from accidents (Coppola & Silvestri, 2020).

2.2. Built environment

CPTED, Crime Prevention Through Environmental Design, is a worldwide approach aimed at limiting crime and increasing perceived safety through the design of the physical environment (Svob, 2021). The purpose of CPTED is to design and manage a specific area in a way that users feel safe and can be applied at the city- or neighborhood-level, but also for buildings and spaces (Svob, 2021). VOB (Veilig Ontwerp en Beheer) is the Dutch version of CPTED and makes use of four key concepts: visibility, clarity, accessibility, and attractiveness (Svob, 2021). Since these four concepts can all be related to physical characteristics of the built environment, this research makes use of the VOB approach. Which specific characteristics of the built environment, related to these elements, are explored for their influence on perceived safety differs per research and can either be generic for public space or specific for, e.g., parks or transit environments. Using a literature review, a set of built environment (BE) characteristics has been identified related to visibility, clarity, accessibility, and attractiveness. In addition, this research adopts BE characteristics related to a station's immediate surroundings. The BE characteristics identified in the literature are presented in Table 1.

2.2.1. Visibility

An important determinant to visibility is the presence of **open space** (Cozens *et al.*, 2003; Kruger & Landman, 2007; Ceccato, 2014; Blöbaum & Hunecke, 2005; Jorgensen *et al.*, 2012; Loewen *et al.*, 1993; IFV, 2019). The openness of stations and platforms enables passengers to have a clear view around themselves and to be observed by others (Cozens *et al.*, 2003), while certain design elements can provide concealment for offenders (Jorgensen *et al.*, 2012). An often-mentioned characteristic related to concealment is **shelter characteristics** (Cozens *et al.*, 2003; Kruger & Landman, 2007; Ding *et al.*, 2020; Abenoza *et al.*, 2018; Liggett *et al.*, 2001; Loukaitou-sideris *et al.*, 2001). Transparent shelters and waiting rooms enable users to see and be seen and limit the opportunities for the shelter to be used as a hiding place by offenders (Kruger & Landman, 2007). In addition, **lighting** is often mentioned as an important determinant of visibility (Rahaman *et al.*, 2016; Kruger & Landman, 2007; Ding *et al.*, 2020; Loukaitou-sideris *et al.*, 2001, 2006; Blöbaum & Hunecke, 2005; Loewen *et al.*, 1993; IFV, 2019). **Surveillance cameras** were also mentioned as a characteristic that improves perceived safety (Cozens & Van der Linde, 2015, Cozens *et al.*, 2003; Rahaman *et al.*, 2016; Abenoza *et al.*, 2018). However, Kruger & Landman (2007) mentioned that there are many issues to consider regarding the design and adequate operation of the systems for them to have the desired effect. Lastly, much research indicated the importance of **natural surveillance**, which comes mainly from passers-by (Kruger & Landman, 2007; Ding *et al.*, 2020; Abenoza *et al.*, 2018; IFV, 2019). While the occurrence of natural surveillance is not directly a BE characteristic, the presence of people in certain places can be supported by the built environment through the presence of facilities and amenities (Kruger & Landman, 2007).

2.2.2. Clarity

Clarity enables individuals to understand the environment and, with that, gives a sense of control and safety (IFV, 2019). The clear **zoning of areas** inside the station through signboards can clarify the idea and use of restrooms, circulation areas, platforms, and waiting areas, which can alert individuals that certain behaviors are (un)acceptable (Rahaman *et al.*, 2016; Cozens & Van der Linde, 2015). **Marked routes** and wayfinding can improve perceived safety and create flows of people (Kruger & Landman, 2007; Ingvardson *et al.*, 2018). Kruger & Landman (2007) add that bollards and barriers can be used to lead individuals past visible areas. Lastly, the display of trustworthy **real-time information** influences travelers' perceptions of safety (Cozens *et al.*, 2003; Abenoza *et al.*, 2018). According to research by Abenoza *et al.* (2018), travelers feel safer when they know their bus is close.

2.2.3. Accessibility

Accessibility is about making the station easily accessible for intended use while, where necessary, it must be inaccessible for undesired use (IFV, 2019). Therefore, an important characteristic that influences perceived safety is the presence of **sufficient entrance-exit points** (Cozens & Van der Linde, 2015; Rahaman *et al.*, 2016). These entrances can be made less accessible to offenders with the use of **access gates** (Cozens & Van der Linde, 2015; Rahaman *et al.*, 2016; IFV, 2019). According to Rahaman *et al.* (2016) minimizing **access points to platforms** is effective in controlling platform access.

While barriers and fencing can help guide individuals and mark the borders of the station, they can also keep out unwanted users (Cozens & Van der Linde, 2015; Kruger & Landman, 2007). However, entrapment must be avoided. Entrapment constrains an individual's behavior and can evoke fear even if there is no offender around (Blöbaum & Hunecke, 2005). To increase perceived safety, the station must therefore facilitate **refuge** and **escape routes** (Ceccato, 2014; Loewen *et al.*, 1993).

2.2.4. Attractiveness

Many of the BE characteristics related to attractiveness depend on the maintenance of the station area. Environments that are cared for give a sense of orderliness and thus a greater feeling of safety (Cozens & Van der Linde, 2015). Perceptions of safety can, therefore, be influenced by the presence of **graffiti**, **visible vandalism**, and **litter** (Cozens & Van der Linde, 2015; Ding *et al.*, 2020; Liggett *et al.*, 2001; Loukaitou-Sideris, 2006; IFV, 2019). The presence of **benches** and **shelters** can improve the attractiveness of the station (Kruger & Landman, 2007; Ingvardson *et al.*, 2018; Abenzoza *et al.*, 2018). However, these also need to be well maintained, since vandalism could suggest that there is little surveillance (Rahaman *et al.*, 2016). When well-maintained, **greenery** can also improve the attractiveness, and thus the perceived safety at the station (IFV, 2019). Poorly maintained trees and bushes, however, can decrease visibility and provide concealment for offenders (Rahaman *et al.*, 2016; Jorgensen *et al.*, 2012). The presence of shops and other **facilities and amenities** improves the attractiveness of the station, and at the same time generates natural surveillance (Ingvardson *et al.*, 2018; IFV, 2019).

2.2.5. Station's surroundings

Passengers' perceived safety from crime is dependent on multi-scale environmental characteristics (Abenzoza *et al.*, 2018). Several scholars, therefore, advocate the "whole journey approach" (Cozens, 2003; Ding *et al.*, 2020; Kruger & Landman, 2007). This holistic approach considers the journey from starting point to destination (Kruger & Landman, 2007). Walking to and from the stations is considered part of the journey and perceptions of these environments also affect the behavior of travelers (Smith & Cornish, 2006). The access routes of the station should be maintained and protected. Perceptions of safety are therefore also influenced by **lighting** and the presence of **graffiti** and **litter** at access routes and parking spaces (Loukaitou-Sideris, 2001). Several studies also mention the importance of **neighboring land use** (Loukaitou-Sideris, 2001; Abenzoza *et al.*, 2018; Cozens & Van der Linde, 2015). Mixed land use can facilitate natural surveillance by shop owners and residents (Loukaitou-Sideris *et al.*, 2006). However, certain land use indicators, such as liquor stores, pubs, and pawnshops can increase an individuals' fear of crime (Cozens & Van der Linde, 2015; Loukaitou-Sideris *et al.*, 2006; Liggett *et al.*, 2001). In addition, **vacant buildings** or empty areas, such as offices during nighttime, can decrease perceived safety (Kruger & Landman, 2007; Loukaitou-Sideris, 2001). Lastly, Kruger and Landman (2007) also mention the importance of sufficient **pedestrian routing** in proximity to the station.

| BE characteristics | Studies | | | | | | | | | | | | | | | |
|--------------------------------------|-------------------------------|---------------------------|----------------|-------------------------------|-----------------------------|---------------------------|------------|---------------------------------|--------------------------------|-------------------------|------------------------------|-----------------------------|--------------------------|--|-----------------------------|------------------------------------|
| | Abenzoza <i>et al.</i> (2018) | Blobbaum & Hunecke (2005) | Ceccato (2014) | Cozens & Van der Linde (2015) | Cozens <i>et al.</i> (2003) | Ding <i>et al.</i> (2020) | IFV (2019) | Ingvardson <i>et al.</i> (2018) | Jorgensen <i>et al.</i> (2012) | Kruger & Landman (2007) | Liggitt <i>et al.</i> (2001) | Loewen <i>et al.</i> (1993) | Loukaitou-Sideris (2006) | Loukaitou-sideris <i>et al.</i> (2001) | Rahman <i>et al.</i> (2016) | Strandbygaard <i>et al.</i> (2020) |
| Open space/ concealment | | √ | √ | √ | √ | | √ | | √ | √ | | √ | | | | |
| Shelter characteristics | √ | | | | √ | √ | | | | √ | √ | | √ | | | |
| Lighting | | √ | | | | √ | √ | | | √ | | √ | √ | √ | √ | |
| Surveillance cameras/ CCTV | √ | | | √ | √ | | | | | √ | | | | | √ | |
| Informal surveillance | √ | | | | | √ | √ | | | √ | | | | | | |
| Signage | | | | √ | | | | | | | | | | | √ | |
| Marked routes | | | | | | | | √ | | √ | | | | | | |
| Real-time information | √ | | | | √ | | | | | | | | | | | |
| Sufficient entrance/exit points | | | | √ | | | | | | | | | | | √ | |
| Access gates | | | | √ | | | √ | | | | | | | | √ | |
| Access points to platforms | | | | √ | | | | | | √ | | | | | √ | |
| Refuge and escape routes | | √ | √ | | | | | | | | | √ | | | | |
| Graffiti, vandalism, & litter | | | | √ | | √ | √ | | | | √ | | √ | √ | | |
| Presence of benches and shelters | √ | | | | | | | √ | | √ | | | | | | |
| Presence of greenery | | | | | | | √ | | √ | | | | | | √ | |
| Presence of facilities and amenities | | | | | | | √ | √ | | | | | | | | |
| Neighboring land-use | √ | | | √ | | | | | | | | | | √ | | √ |
| Vacant buildings or empty areas | | | | | | | | | | √ | | | √ | | | |
| Pedestrian routing | | | | | | | | | | √ | | | | | | |

Table 1: BE characteristics used in selected studies

2.3. Conceptual framework

This conceptual model (Figure 2) illustrates how the used concepts relate to each other. It is expected that the BE characteristics, related to visibility, clarity, accessibility, attractiveness, and the station’s surroundings, show a relationship with perceived safety from crime, and perceived safety from crime is expected to show a relationship with the frequency of use of public transport. Since socio-demographic characteristics influence perceived safety from crime, this research expects to find a relationship between gender and perceived safety from crime, and age and perceived safety from crime.

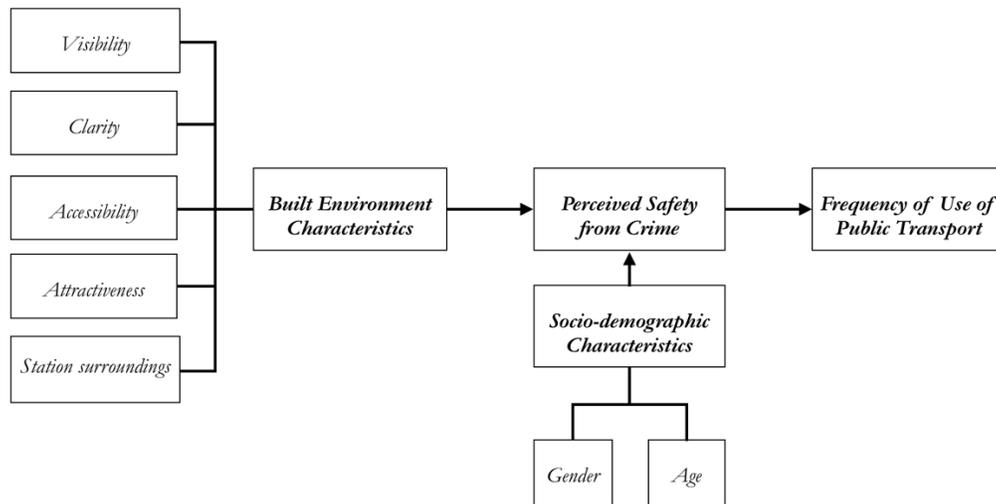


Figure 2: Conceptual model

3. Methodology

This research uses a single case study approach for Utrecht Central Station (UCS). For this case study, mixed methods are used to answer the research questions. A qualitative literature review was used to indicate a set of BE characteristics that influence passengers' perceived safety from crime and forms the basis for the second data collection method: the survey.

3.1. Case study

3.1.1. Case selection

According to the report 'Daders op het spoor' commissioned by the Dutch Ministry of Justice and Security, UCS is amongst the top 5 stations where most violence is committed against NS personnel (Van Wijk et al., 2016). In addition, UCS is amongst the 22 'high-risk stations' that are identified by the NS and police as stations where more incidents take place or there is more aggression than on average (Broekhuizen *et al.*, 2017). However, at the same time, the train station is highly appreciated according to the Travel Experience Monitor of the NS. In 2020, UCS took 18th place in the national list of traveler satisfaction at stations, and even 5th place when only looking at the major stations in the Netherlands (NS, 2020). Also, a survey conducted by travelers' association Rover (2016), concluded that UCS is the 3rd most pleasant station in the Netherlands. These seemingly contrasting figures make UCS an interesting case to explore the influence of BE characteristics on perceived safety from crime.

3.1.2. Case description

The 300m long hall of UCS contains more than 50 shops and take-away restaurants, and the first floor is home to hospitality facilities (MijnStation, 2021). The train station has three entrance-exit points, which are barricaded by access gates. On the east side, the station entrance-exit leads to the Stationsplein where the entrance to the shopping center Hoog Catharijne is located, and underneath which are bicycle storage facilities (Figure 3). The entrance at the west side of the station opens onto the Stadsplateau from which you look down at the Jaarbeursplein, where the bus and subway stations are located. There is a 24/7 pedestrian route through the station and a bicycle bridge (Moreelsebrug).

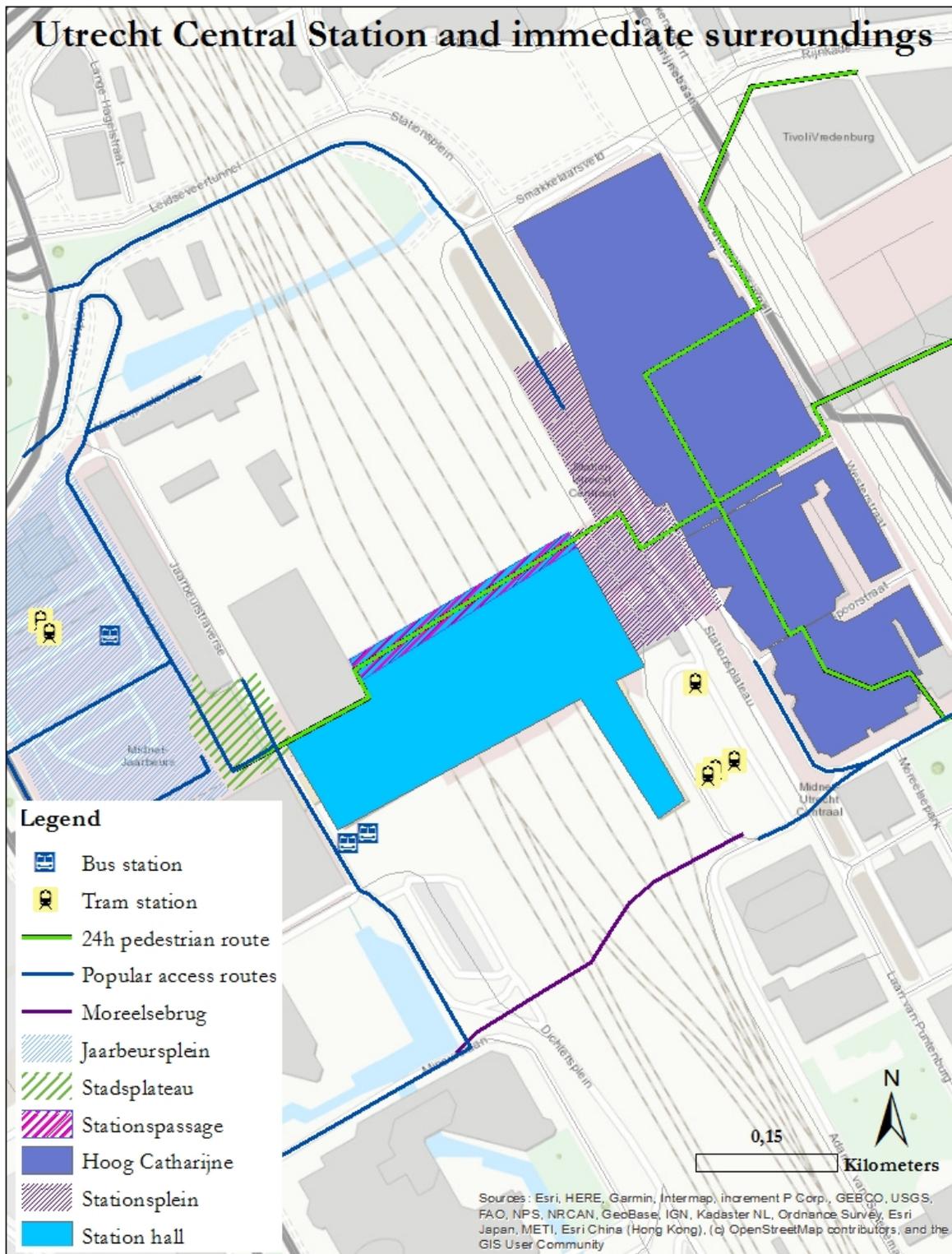


Figure 3: Map of Utrecht Central Station and immediate surroundings (Sources: CU2030, 2015; NS, n.a.)

3.2. Data collection

3.2.1. Literature review

A literature review has been conducted to answer the first sub-question (see 2.2.). The search for academic publications was conducted using three databases: SmartCat, Scopus, and Google Scholar. To find suitable literature, various combinations of the following keywords were used: “*perceived safety*”, “*train station*”, “*railway station*”, “*transit environments*”, “*fear of crime*”, “*CPTED*”, “*VOB*”, and “*built environment*”. It was decided to include gray literature in the search that was relevant to the topic. In total, fifteen publications and one report were compiled that have been analyzed for important BE characteristics.

3.2.2. Survey

To answer the second, third, and fourth sub-questions, empirical research has been done through a survey. Surveys can be used well for descriptive research that estimates specific parameters and describes associations (Kelly *et al.*, 2003). This survey asked the respondents about their socio-demographic characteristics (age and gender), perceptions of safety (at the station and the access routes of the station), and travel behavior (frequency and time of day). After that, the survey presented the respondents with twenty-three BE characteristics. The respondents were asked to indicate to which extent the BE characteristics influence their perception of safety using a unipolar 5-point Likert scale, ranging from *not at all* to *extremely*. The survey consisted mainly of closed questions and ended with room for comments.

To gather participants who could give informed responses to the questions about UCS, they must be familiar with the station and its immediate surroundings. The respondents were, therefore, recruited using a convenience sampling technique by which passengers were approached in the station hall and at the station’s entrances. In addition, a snowball-sampling technique was used by which the survey was shared with acquaintances. The complete survey and overview of the sampling procedure can be found in Appendix 1.

3.3. Data analysis

The perceptions of safety are rated by the respondents on a scale from 1 to 10. It can be argued that since the intervals on the scale are not necessarily for everyone the same, this results in ordinal data. However, since there are 10 possible responses, the difference between the steps is small and even, and can therefore be treated as continuous data. This will make it possible to generate the mean grade for perceived safety from crime to answer sub-question two. In addition, different comparison-of-means techniques are used to compare the mean grades based on socio-demographic characteristics.

To answer the third sub-question, the responses to the Likert scale questions are used. The response to the Likert scale is ordinal data since the values have a rank order and the intervals between values are not necessarily equal. The medians and confidence intervals of the medians will be used to indicate which BE characteristics have significantly larger impacts on perceived safety from crime than others. If the confidence intervals do not overlap, the difference between the medians is significant. In addition, Spearman’s rank correlation analyses have been performed to indicate how the separate BE characteristics are related to the overall perceived safety from crime at UCS. The Spearman’s rank test is used since the research concerns ordinal data and indicates the strength and direction of the relationship.

Lastly, to answer sub-question four, the relationship between perceived safety from crime and the frequency of use of public transport is analyzed. The grade for overall perceived safety from crime is treated as continuous data. The frequency of use of public transport has been indicated in the number of days a month and is, therefore, also a scale variable. Since the aim is to test if there is a correlation between two scale variables, the Pearson Correlation analysis is used. Figure 4 shows a visualization of the research design.

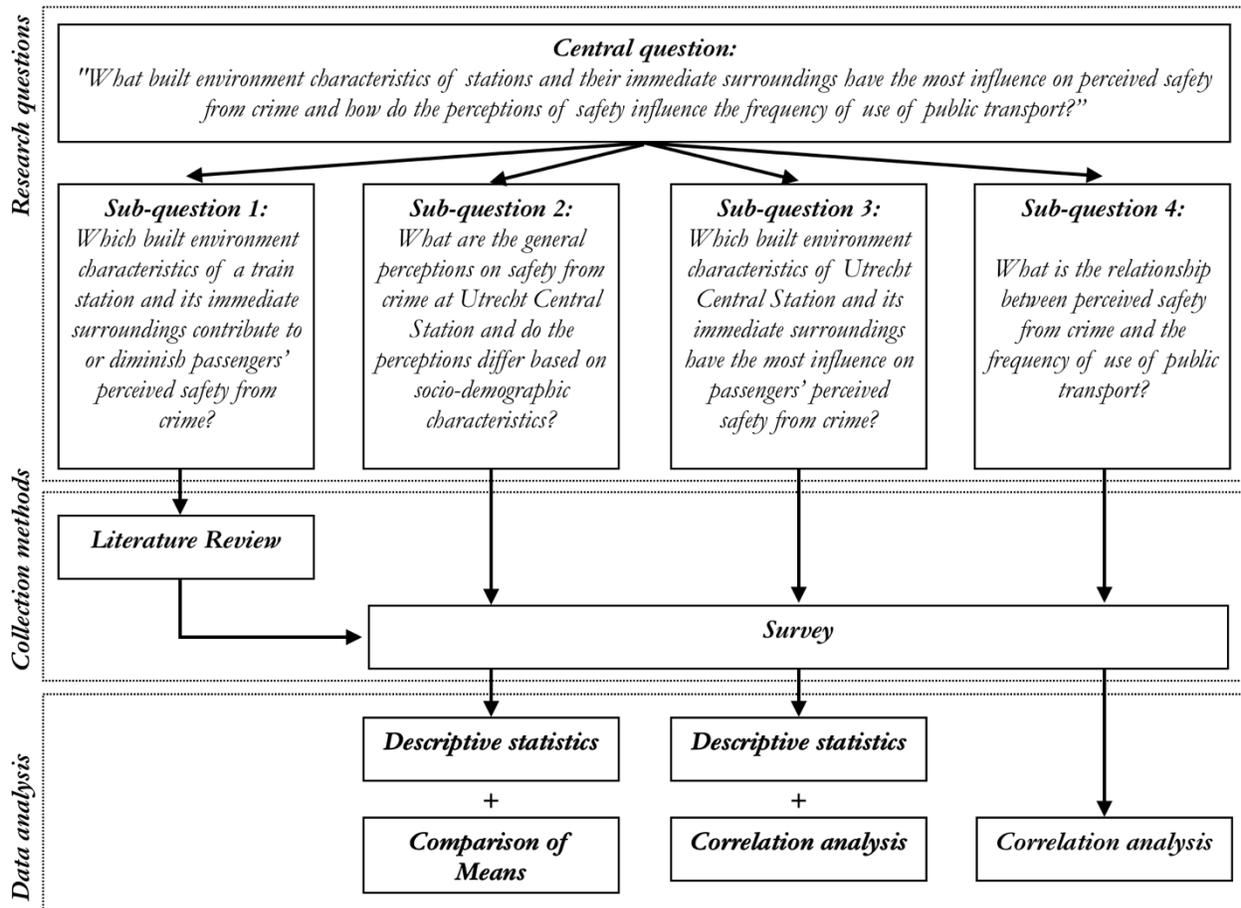


Figure 4: Schematic overview of the research design

3.4. Ethical considerations

To ensure that the respondents felt comfortable filling out the survey, respondents were well informed about the purpose of the research, that completion is fully anonymous, and that the results of the survey will be shared with NS. This is done before starting the survey. Since the research is dependent on the willingness of travelers to fill out the survey, the results may differ from reality since travelers with specific positive or negative experiences may have been more inclined to participate. This possible difference between the sample and the population due to the under-representation of certain respondents is called non-response bias (Berg, 2005).

Since COVID-19 has also affected public transit, it might influence the perceptions of passengers. Therefore, the survey stated that participants should answer the questions in the survey while keeping in mind the conditions at the station pre-COVID-19. While surveying, the corona measurements were carefully adhered to through wearing a mask and gloves and keeping 1.5 meters distance.

4. Results & Discussion

This chapter shows the results of the survey per sub-question that is answered using the collected data. After each result has been presented, the findings are discussed in the light of previous literature. All *means* presented in these results are rounded to one decimal place. The raw data of the survey can be found in Appendix 2 and the analysis outcomes in Appendix 3.

4.1. About the dataset

A total of 200 responses were recorded in Qualtrics. Of these responses, 26 were not filled out completely and were, therefore, removed from the dataset. This resulted in a dataset with 174 valid cases. According to the Central Limit Theorem, the sampling distribution becomes more normal as the sample size gets larger (Mehmetoglu & Jakobsen, 2017). A dataset is considered ‘large’ when it exceeds 30 cases. Since this research has a dataset consisting of 174 cases, it is assumed that the sampling distribution is normal.

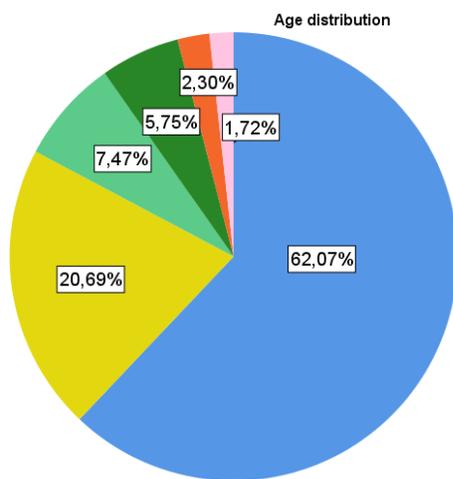


Figure 5: Pie chart age distribution

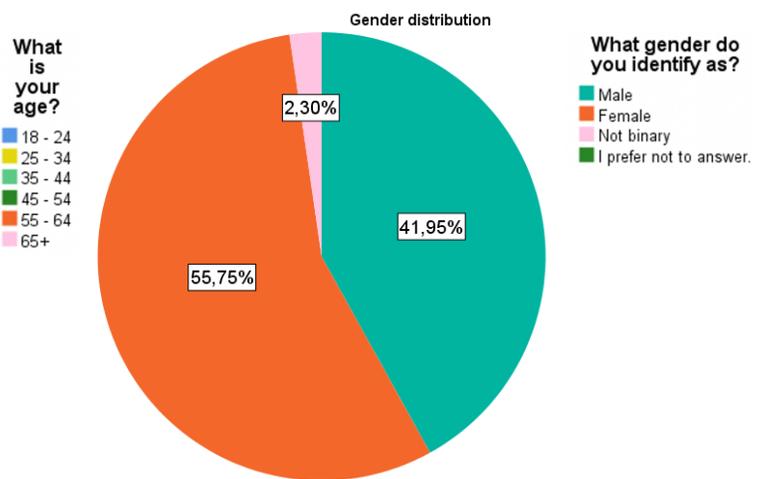


Figure 6: Pie chart gender distribution

Figures 5 and 6 show a distribution of the respondents based on age and gender. Of the respondents, 62.1% are between 18 and 24 years old. While this group might seem disproportionate, the distribution seems comparable to the traveler population in Utrecht in previous years as according to CROW (2020) (Table 2).

| Age group | 2020 | 2019 | 2018 |
|-----------|------|------|------|
| - 18 | 8% | 7% | 8% |
| 18 - 27 | 54% | 56% | 57% |
| 28 - 40 | 15% | 17% | 15% |
| 41 - 64 | 18% | 15% | 15% |
| 65 + | 5% | 5% | 4% |

Table 2: Traveler population Utrecht Centraal (Translated from CROW, 2020)

4.2. General perceptions on safety from crime

This section will give an answer to the second sub-question: “*What are the general perceptions on safety from crime at Utrecht Central Station and do the perceptions differ based on socio-demographic characteristics?*”

Resulting from the collected data, the mean grade for overall safety at UCS is **7.9** and the mean grade for overall safety at the access routes of the station is **7.4** (see Appendix 3). A Paired Samples T-test is used to indicate whether the difference between the two mean grades is significant. The null hypothesis for this test is as follows: ‘ H_0 : In the population, there is no difference between the mean grade for safety from crime at Utrecht Central Station and at the access routes of the station.’

Paired Samples Correlations

| | | N | Correlation | Sig. |
|--------|---|-----|-------------|------|
| Pair 1 | On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe & On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | 174 | ,623 | ,000 |

Table 3: Outcomes Paired Samples Correlations

Paired Samples Test

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|--------|---|--------------------|----------------|-----------------|---|--------|-------|-----|-----------------|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe - On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | ,58621 | 1,08112 | ,08196 | ,42444 | ,74798 | 7,152 | 173 | ,000 |

Table 4: Outcomes Paired Samples T-test

Table 3 shows that there is a **significant correlation** between the two grades with a coefficient of 0.623, which indicates that when a respondent gave a higher grade for safety at the station, they also gave a higher grade for safety at the access routes. Table 4 shows that the Paired Samples T-test is **significant** ($p = 0.000 < p = 0.05$). The **H_0 is rejected**, and, therefore, it is assumed that there is a difference between how safe from crime people feel at UCS and at the access routes of the station.

Independent Samples T-tests were used to indicate whether a difference exists in the mean grade for safety from crime between males and females. The null hypotheses for these tests are as follows: ‘ H_0 : In the population, there is no difference in the mean grade for safety from crime at Utrecht Central Station between males and females.’ and ‘ H_0 : In the population, there is no difference in the mean grade for safety from crime at the access routes of the station between males and females.’

| | | Independent Samples Test | | | | | | | | |
|--|-----------------------------|---|------|------------------------------|---------|-----------------|-----------------|-----------------------|---|---------|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe | Equal variances assumed | ,039 | ,843 | 4,808 | 168 | ,000 | ,82333 | ,17123 | ,48529 | 1,16137 |
| | Equal variances not assumed | | | 4,851 | 159,962 | ,000 | ,82333 | ,16971 | ,48817 | 1,15849 |

Table 5: Outcomes Independent Samples T-test for UCS

| | | Independent Samples Test | | | | | | | | |
|--|-----------------------------|---|------|------------------------------|---------|-----------------|-----------------|-----------------------|---|---------|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | Equal variances assumed | ,019 | ,890 | 4,847 | 168 | ,000 | ,92826 | ,19150 | ,55019 | 1,30632 |
| | Equal variances not assumed | | | 4,938 | 164,039 | ,000 | ,92826 | ,18799 | ,55707 | 1,29945 |

Table 6: Outcomes Independent Samples T-test for the access routes of the station

The mean grade for safety from crime at UCS is **8.4** for males and **7.6** for females. The mean grade for safety from crime at the access routes of the station is **7.9** for males and **6.9** for females (see Appendix 3). Tables 5 and 6 show that the Independent Samples T-test is **significant** for both tests ($p = 0.000 < p = 0.05$). The **H₀ is rejected** for both tests, so we can assume that there is a difference in the grades given for safety from crime between males and females.

Lastly, One-way ANOVAs were performed to indicate whether there is a difference in the mean grade for safety from crime between age groups. The null hypotheses for these tests are as follows: 'H₀: In the population, there is no difference in the mean grade for safety from crime at Utrecht Central Station based on age groups.' and 'H₀: In the population, there is no difference in the mean grade for safety from crime at the access routes of the station based on age groups.' The results of the tests can be found in Appendix 3. The tests did not show any significant differences, so the **H₀ is accepted**. We can assume that there are no significant differences in the mean grades for safety from crime based on age groups.

4.2.1. Discussion of the general perceptions on safety from crime

The mean grade of 7.9 for safety from crime at UCS is comparable to the general safety for NS in 2020, graded 8.1 by travelers (CROW, 2020). The shown positive difference between the mean grades for UCS and the access routes of the station indicates that travelers generally feel safer at UCS than at the access routes. Since no clear reason is found yet for this difference, it can be investigated whether the built environment plays a role. The results also show a significant difference between the mean grades given by males and females, which indicates males generally feel safer than females. This is in line with the findings in the literature that state females often perceive more fear of crime in public space than males (Jorgensen *et al.*, 2012). However, contradicting previous findings by Fattah & Sacco (2012), age does not seem to have a significant influence on perceived safety from crime. According to Yavuz & Welch (2010), it might be that elderly have become familiar with transit environments, positively affecting their perception of safety. Yet, the insignificant result may also be attributed to the small sample of elderly in this research.

4.3. The influence of built environment characteristics

This section will give an answer to the third sub-question: “Which built environment characteristics of Utrecht Central Station and its immediate surroundings have the most influence on passengers’ perceived safety from crime?”

4.3.1. Descriptive statistics

The medians of the responses to the 23 BE (built environment) characteristics are shown in bar charts with error bars (Figure 7; 8). The numbers on the Y-axis correspond to the answers on the 5-point Likert scale (1=Not at all, 2=Slightly, 3=Moderately, 4=Very, 5=Extremely). As shown by the figures, most BE characteristics appear to be *moderately* influential for perceived safety from crime. The error bars represent the 95% confidence interval of the median. The confidence intervals for sixteen of the 23 BE characteristics are 0, which means it can be said with 95% confidence that the population median of these BE characteristics is the same as in the sample.

From Figure 7 can be seen that there are no BE characteristics of stations of which the median is distinctively higher than all others, showing no overlap with other confidence intervals. However, ‘Lighting on the platforms and in the station hall’ and ‘The presence of other users of the station’, rated as *extremely* influential, show the least overlap with other error bars and, therefore, have a significantly larger influence on perceived safety from crime than most other characteristics. This assumption must be made with caution since the confidence intervals do show overlap with ‘Clear views around you on the platforms and in the station hall’ and ‘Security cameras on the platforms and in the station hall’. These two BE characteristics show the widest confidence intervals, meaning the median is a rougher estimate. In the population, the four BE characteristics may be rated equally influential. When looking at the error bars of the BE characteristics of the station’s surroundings (Figure 8), ‘The lighting on the access roads and parking spaces’, rated as *very* influential, shows the least overlap with other confidence intervals. A ranking of all BE characteristics based on the significant positive differences between medians is found in Appendix 4.

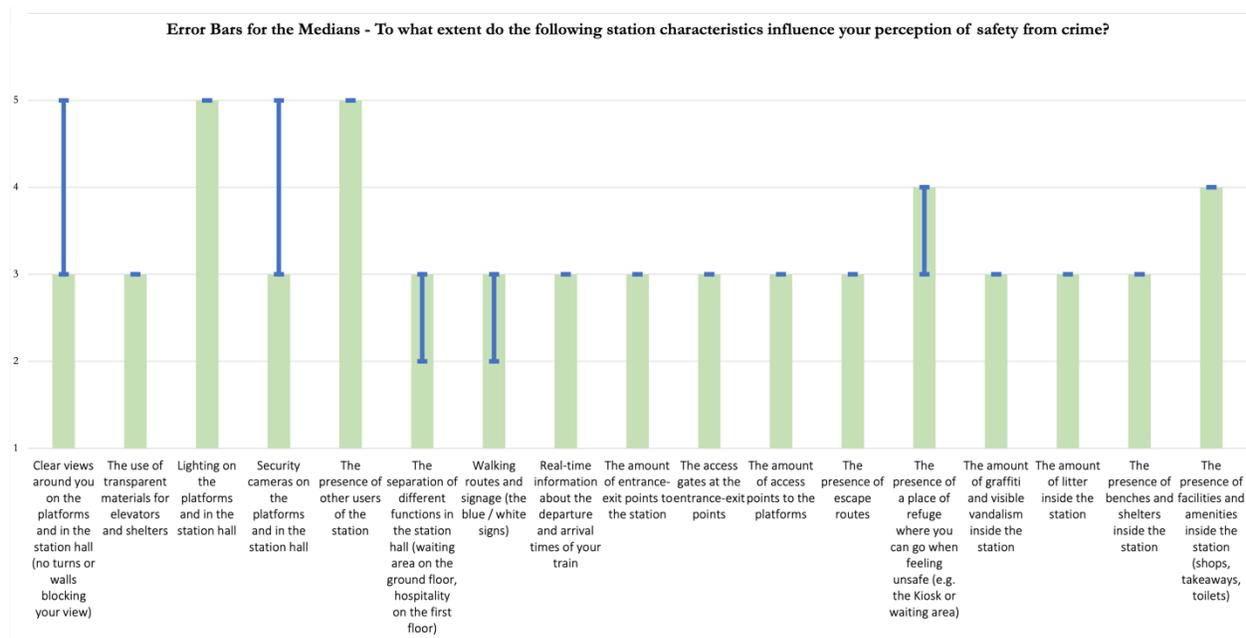


Figure 7: Error Bars for the Medians – Station characteristics

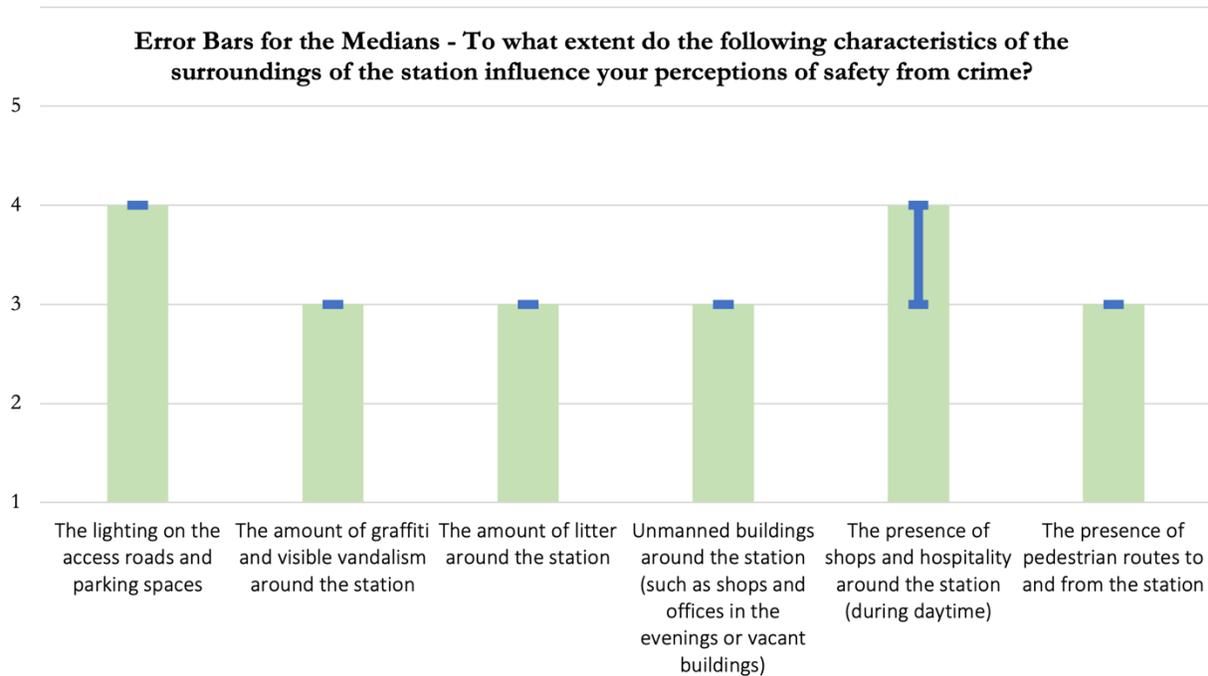


Figure 8: Error Bars for the Medians – Characteristics of stations’ surroundings

4.3.2. Correlation analysis

In addition, a Spearman’s rank correlation analysis has been performed for each BE characteristic, to indicate the relationship between the separate BE characteristics and overall perceived safety from crime for Utrecht as graded by the respondents. The results of these tests can be found in Appendix 3. Interestingly, these tests have resulted in eleven of the 23 BE characteristics showing a significant relationship with the overall grade for perceived safety from crime. The BE characteristic that shows the strongest relationship with overall perceived safety from crime at UCS is ‘The amount of access points to the platforms’. The BE characteristic that shows the strongest relationship with overall perceived safety from crime at the access routes of the station is ‘Unmanned buildings around the station’.

While eleven BE characteristics show a significant relationship with the overall grades for perceived safety from crime and therefore have impact on how safe travelers feel at UCS, the relationships are relatively weak with a correlation coefficient between +/-0.01 and +/-0.291. Interestingly, many of the correlation coefficients also are negative numbers and therefore imply that if the respective BE characteristic is rated higher on the Likert scale the overall grade for perceived safety from crime is lower, and vice versa. This can indicate that the BE characteristic, as perceived by the passengers, is not (sufficiently) present at UCS.

4.3.3. Discussion of the influence of built environment characteristics

The descriptive statistics show which BE characteristics of stations and their surroundings are viewed by the travelers as having the most influence on safety from crime in general. Based on the medians, it can be assumed that travelers view 'Lighting on the platforms and in the station hall' and 'The presence of other users of the station' generally have the most influence on safety from crime at the station. 'The lighting on the access roads and parking spaces' as viewed by travelers, has the most influence on safety from crime in a station's surroundings. These BE characteristics, namely, show the most significant positive differences with the medians of other BE characteristics.

The correlation analysis indicated the relationship between the BE characteristics and the grade that is given for safety from crime at UCS and may give an insight into the performance of the BE characteristics at UCS. Of the BE characteristics, 'The amount of access points to the platforms' shows the strongest relationship with overall perceived safety from crime at UCS. The correlation coefficient (-0.277) is negative, which means that when a respondent has rated the influence of 'The amount of access points to the platforms' higher on the Likert scale, the overall perceived safety from crime is graded lower. The negative correlation coefficient might, therefore, indicate that the amount of access points to the platforms at UCS is perceived by the respondents as insufficient. The same is true for 'Unmanned buildings around the station', which shows a negative correlation (-0.291) with perceived safety from crime at the access routes of the station.

The relatively weak relationships that are seen, may be explained by the fact that in the grading of overall safety from crime respondents may weigh in aspects of the station that were not covered in the survey. For example, six of the 174 respondents mentioned that the presence of staff affects their perceptions of safety (Respondents 2, 44, 51, 94, 105, 164, Appendix 2, p. 41-43). Including aspects besides physical characteristics of the station, such as management-related aspects, might give a better insight into how the perceptions of safety from crime at UCS are influenced.

4.4. Perceived safety from crime and frequency of use of public transport

This section will give an answer to the fourth sub-question: “*What is the relationship between perceived safety from crime and the frequency of use of public transport?*”

Firstly, a scatter plot was drawn of the grade for perceived safety from crime and the times traveled by public transport to check for linearity (Appendix 3). The scatterplot did not indicate a linear relationship and so, a Pearson Correlation analysis was conducted to confirm (Table 7). The null hypothesis of the test is as follows: ‘ H_0 : In the population, there is no linear relationship between perceived safety from crime at Utrecht Central Station and the times traveled by public transport via Utrecht Central Station.’ The Pearson correlation test was **not significant** ($p = 0.641 > p = 0.05$). The **H_0 is accepted**, so it can be assumed that there is no linear relationship between perceived safety from crime at Utrecht Central Station and the times traveled by public transport.

Correlations

| | | On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe | On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only) |
|--|---------------------|--|--|
| On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe | Pearson Correlation | 1 | -,036 |
| | Sig. (2-tailed) | | ,641 |
| | N | 174 | 174 |
| On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only) | Pearson Correlation | -,036 | 1 |
| | Sig. (2-tailed) | ,641 | |
| | N | 174 | 174 |

Table 7: Outcomes Pearson Correlation analysis for UCS

The same test has been applied for perceived safety from crime at the access routes of the station (Table 8). The null hypothesis of the test is as follows: ‘ H_0 : In the population, there is no linear relationship between perceived safety from crime at the access routes of the station and the times traveled by public transport via Utrecht Central Station.’ The Pearson correlation test was **not significant** ($p = 0.270 > p = 0.05$). The **H_0 is accepted**, so it can be assumed that there is also no linear relationship between perceived safety from crime at the access routes of the station and the times traveled by public transport.

Correlations

| | | On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only) |
|--|---------------------|--|--|
| On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | Pearson Correlation | 1 | -,084 |
| | Sig. (2-tailed) | | ,270 |
| | N | 174 | 174 |
| On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only) | Pearson Correlation | -,084 | 1 |
| | Sig. (2-tailed) | ,270 | |
| | N | 174 | 174 |

Table 8: Outcomes Pearson Correlation analysis for the access routes of the station

4.4.1. Discussion of perceived safety from crime and frequency of use of public transport

Since the results show no significant relationships between the variables, it cannot be said that a direct relationship between perceived safety from crime and the frequency of use of public transport exists. This is contradicting the expectation that the perception of safety influences travel behavior, regardless of its accuracy. The use of public transport, however, is also influenced by other factors that can determine the choice of travel mode, such as car ownership, individual attitudes, and accessibility of transit environments (Ceccato, 2013). It may be that these factors outweigh perceived safety from crime. The built environment and socio-demographic characteristics might therefore have direct impacts on the frequency of use of public transport (Figure 9). In addition, this may be explained by the chosen data collection strategy. Since the sample consists of current train travelers, it can be argued that the persons whose use of public transport is most influenced by perceived safety from crime are not included in the sample. Including non-train travelers may influence the outcome of the correlation analysis.

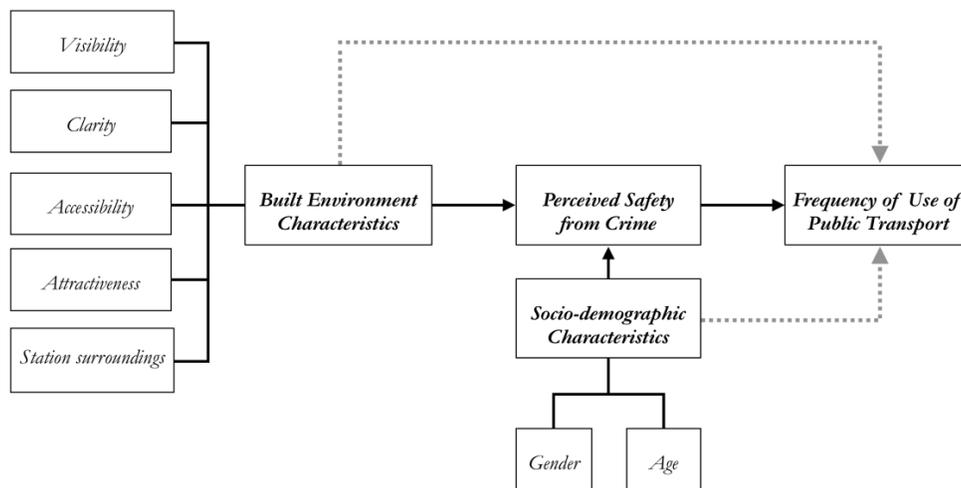


Figure 9: Revised conceptual model

5. Conclusion

This study aimed to identify which built environment characteristics of a train station and its immediate surroundings have the most influence on passengers' perceived safety from crime. In addition, it aimed to explore whether the perceptions of safety influence the frequency of use of public transport.

To answer the first part of the main research question "*What built environment characteristics of stations and their immediate surroundings have the most influence on perceived safety from crime?*", the presence of other users of the station and lighting in and around the station are recognized by travelers as the BE characteristics that have the most influence on perceived safety from crime in general. These assumptions, however, must be made with caution since there are other BE characteristics that, in the population, might be recognized as equally influential, but of which this research was not able to provide a precise estimate of the influence. When relating the BE characteristics to the overall grade for perceived safety from crime at UCS, the amount of access points to the platforms and the unmanned buildings around the station show the strongest relationship with perceived safety from crime. Both relationships show negative correlations, indicating that the current amount of access points to the platforms and the unmanned buildings around Utrecht Central Station are perceived by travelers as insufficient.

To answer the second part of the main research question, "*how do the perceptions of safety influence the frequency of use of public transport?*", the perceptions of safety do not influence the frequency of use of public transport for the researched population. The results of the analysis do not show a significant relationship between the grade for perceived safety from crime and the times traveled by public transport. This may be explained by the fact that more factors influence the frequency of use of public transport, such as car-ownership, individual attitudes, and accessibility of transit environments (Ceccato, 2013).

5.1. Recommendations for planning practice

To improve the performance of stations regarding safety, and thus travelers' experience, this research has indicated possible trade-offs to be made between physical characteristics. Generally, a focus should be on the lighting in and around the station and on supporting the presence of people, which can be done through, for example, the presence of facilities and amenities (Kruger & Landman, 2007). For Utrecht Central Station specifically, this research has indicated that the amount of access points to the platforms may be insufficient. Further research is necessary to indicate what the amount of access points should be to improve its effect on perceived safety from crime. In addition, this research has indicated that unmanned buildings around the station currently negatively influence passengers' perceived safety from crime. Increasing mixed land use around the station can facilitate natural surveillance at different times during the day (Loukaitou-Sideris *et al.*, 2006).

5.2. Limitations & Future research directions

This research considered a single case study to provide an in-depth analysis of the role of the built environment in perceived safety and the results may not be generalizable other stations.

5.2.1. Data collection

To gather participants who could give informed responses about UCS, participants were recruited in the station hall and at the station's entrances. In hindsight, this may have resulted in people who feel the least safe at UCS not being included in the study because they are not found at the station. The sample might have been more representative if it included both train travelers and non-train travelers. This may influence the overall grades given for perceived safety from crime. As mentioned in chapter 4.4.1., it may also influence the outcome of the correlation analysis for perceived safety from crime and the frequency of use of public transport.

Of the 200 responses to the survey, 26 were not filled out completely. Although it is difficult to estimate the reason for this, one explanation may be the mobile-friendliness of the survey. According to Qualtrics (n.a.), the use of matrix questions, as was done in the survey of this study for the Likert scale questions, is not fully compatible for mobile use. Making sure the survey is completely mobile-friendly could result in an even higher response rate. Additionally, the language used in the survey could have been experienced as difficult by some, as was also mentioned in the comment section by one of the respondents (Respondent 163, Appendix 2, p. 43).

5.2.2. Data analysis

This research looked at the stand-alone relationships between BE characteristics and perceived safety from crime, and perceived safety from crime and the frequency of use of public transport. However, since perceived safety from crime may be influenced by factors besides physical characteristics of the station (chapter 4.3.4.), and the frequency of use of public transport may be influenced directly by the built environment and socio-demographic characteristics (chapter 4.4.1.), this research may have adopted a too simplistic conceptual model. In the future, more complex conceptual frameworks should be studied that analyze the interrelationships between the used variables in this research, as shown in the revised conceptual model in chapter 4.4.1. In addition, to gain more insights into how perceptions of safety are influenced, management-related characteristics may be considered as additional variables. To be able to study these interrelationships, further research could perform a multiple regression analysis and use factor analysis to account for possible multicollinearity between the BE characteristics. Another option would be to perform structural equation modeling and use both perceived safety from crime and the frequency of use of public transport as outcome variables.

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Appendices

Overview

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- Appendix 3: Analysis outcomes - p. 44
- Appendix 4: Ranking BE characteristics - p. 52

Appendix 1: Complete survey

1.1 Sampling procedure

The participants were recruited in the station hall and at the station entrances on two weekdays and one weekend day (table a). The purpose of the research was explained to the respondents before they would be handed the flyer with a QR-code to the online survey (figure a). The 14 responses that were not recorded during the sampling days, were recorded on different dates, and mainly result from the snow-ball sampling technique.

| Date | Time | Number of respondents | Location |
|------------|---------------------|-----------------------|---|
| 27/03/2021 | 11:00 AM – 03:00 PM | 46 | Utrecht Central Station – hall and entrances |
| 29/03/2021 | 11:00 AM – 03:00 PM | 53 | Utrecht Central Station – hall and entrances |
| 01/04/2021 | 11:00 AM – 02:30 PM | 61 | Utrecht Central Station – hall and entrances |
| - | - | 14 | - |

Table a: Overview sampling days

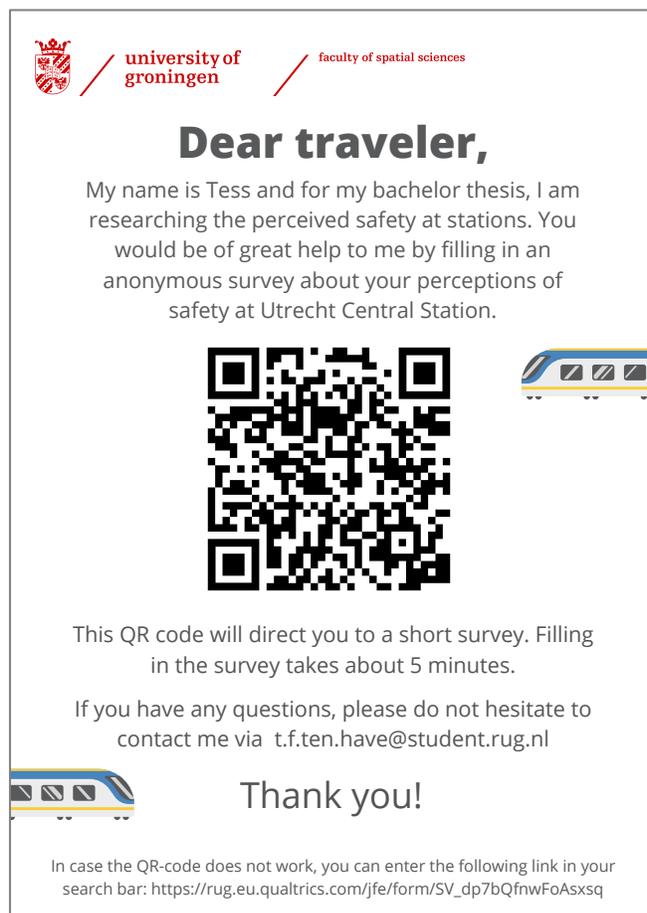


Figure a: Flyer

1.2. Complete survey

Perceived Safety at Utrecht Central Station

Start of Block: Start

Dear respondent,

Thank you for participating! Your contribution is very valuable.

The purpose of this survey is to gain insight into the extent to which certain physical elements of the station affect your perception of safety. The survey will take about 5 minutes.

The results of this survey are used for writing a bachelor's project and it therefore has educational purposes. Completion of the survey is completely anonymous. The results of the survey will be shared with the Nederlandse Spoorwegen (NS).

In case you have any questions, do not hesitate to contact me (Tess ten Have) via t.f.ten.have@student.rug.nl

End of Block: Start

Start of Block: Block 9

By completing this survey you agree that your anonymous answers will be used in the bachelor project. Do you agree with this?

Yes

End of Block: Block 9

Start of Block: Kenmerken respondent

Q1 What is your age?

18 - 24

25 - 34

35 - 44

45 - 54

55 - 64

65+

Q2 What gender do you identify as?

- Male
- Female
- Not binary
- I prefer not to answer.

End of Block: Kenmerken respondent

Start of Block: Veiligheidsbeleving

In this part of the survey, you will be asked questions about your perception of safety at the station. I want to ask you to answer the questions with the conditions at the station prior to COVID-19 in mind. The COVID-19 situation may have affected your travel behavior and your perception of safety, but please try to answer without taking into account the current unusual situation.

Q3 On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station?

1 2 3 4 5 6 7 8 9 10

1 = not at all safe, 10 = very safe



Q4 On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station?

1 2 3 4 5 6 7 8 9 10

1 = not at all safe, 10 = very safe



Q5 On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only)

Q6 When do you usually travel via Utrecht Central Station?

- During the day
- In the evening

End of Block: Veiligheidsbeleving

Start of Block: Zichtbaarheid

In this part of the survey, you will be asked questions in five categories: visibility, clarity, accessibility, attractiveness, and the surroundings of the station. For each category, you will be asked to indicate to what extent the mentioned characteristics of the station influence your feeling of safety. There are 5 possible answers: not at all - slightly - moderately - very - extremely.

The purpose of this section is to understand how you think the individual characteristics of the station affect how safe you feel. This is therefore not an assessment of the characteristic as it is currently present at Utrecht Central Station.

In this section, a number of characteristics of the station are mentioned that are related to **visibility**.

Q7 To what extent do the following station characteristics influence your perceptions of safety from crime?

| | Not at all | Slightly | Moderately | Very | Extremely |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Clear views around you on the platforms and in the station hall (no turns or walls blocking your view) | <input type="radio"/> |
| The use of transparent materials for elevators and shelters | <input type="radio"/> |
| Lighting on the platforms and in the station hall | <input type="radio"/> |
| Security cameras on the platforms and in the station hall | <input type="radio"/> |
| The presence of other users of the station | <input type="radio"/> |

End of Block: Zichtbaarheid

Start of Block: Overzichtelijkheid

In this section, a number of characteristics of the station are mentioned that are related to **clarity**.

Q8 To what extent do the following station characteristics influence your perceptions of safety from crime?

| | Not at all | Slightly | Moderately | Very | Extremely |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| The separation of different functions in the station hall (waiting area on the ground floor, hospitality on the first floor) | <input type="radio"/> |
| Walking routes and signage (the blue / white signs) | <input type="radio"/> |
| Real-time information about the departure and arrival times of your train | <input type="radio"/> |

End of Block: Overzichtelijkheid

Start of Block: Toegankelijkheid

In this section, a number of characteristics of the station are mentioned that are related to **accessibility**.

Q9 To what extent do the following station characteristics influence your perceptions of safety from crime?

| | Not at all | Slightly | Moderately | Very | Extremely |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| The amount of entrance-exit points to the station | <input type="radio"/> |
| The access gates at the entrance-exit points | <input type="radio"/> |
| The amount of access points to the platforms | <input type="radio"/> |
| The presence of escape routes | <input type="radio"/> |
| The presence of a place of refuge where you can go when feeling unsafe (e.g. the Kiosk or waiting area) | <input type="radio"/> |

End of Block: Toegankelijkheid

Start of Block: Aantrekkelijkheid

In this section, a number of characteristics of the station are mentioned that are related to **attractiveness**.

Q10 To what extent do the following station characteristics influence your perceptions of safety from crime?

| | Not at all | Slightly | Moderately | Very | Extremely |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| The amount of graffiti and visible vandalism inside the station | <input type="radio"/> |
| The amount of litter inside the station | <input type="radio"/> |
| The presence of benches and shelters inside the station | <input type="radio"/> |
| The presence of facilities and amenities inside the station (shops, takeaways, toilets) | <input type="radio"/> |

End of Block: Aantrekkelijkheid

Start of Block: Stationsomgeving

In this section, a number of characteristics are mentioned that are related to the **immediate surroundings of the station**.

Q11 To what extent do the following characteristics of the surroundings of the station influence your perceptions of safety from crime?

| | Not at all | Slightly | Moderately | Very | Extremely |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| The lighting on the access roads and parking spaces | <input type="radio"/> |
| The amount of graffiti and visible vandalism around the station | <input type="radio"/> |
| The amount of litter around the station | <input type="radio"/> |
| Unmanned buildings around the station (such as shops and offices in the evenings or vacant buildings) | <input type="radio"/> |
| The presence of shops and hospitality around the station (during daytime) | <input type="radio"/> |
| The presence of pedestrian routes to and from the station | <input type="radio"/> |

End of Block: Stationsomgeving

Start of Block: Einde

This is the end of the survey. Thank you for your participation! If you have any other comments, please leave them below.

If you have any questions, do not hesitate to contact me (Tess ten Have) via t.f.ten.have@student.rug.nl

End of Block: Einde

Appendix 2: Raw data

Respondents

Total: 200

Completed: 174

Deleted: 26

User language

Dutch: 151

English: 23

Q1 - What is your age?

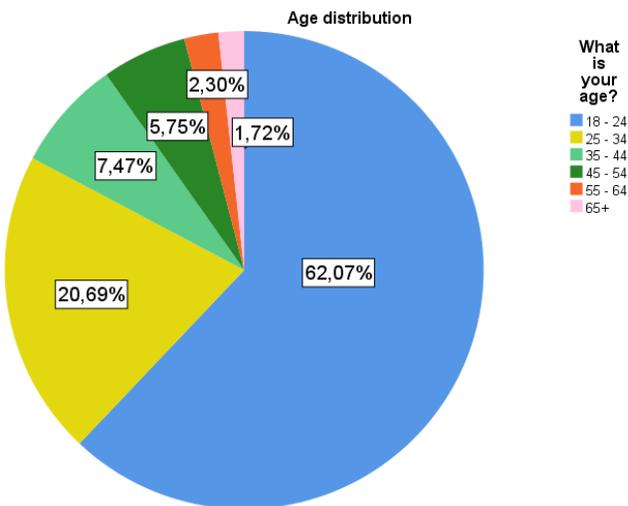


Figure b: Age distribution

Q2 - What gender do you identify as?

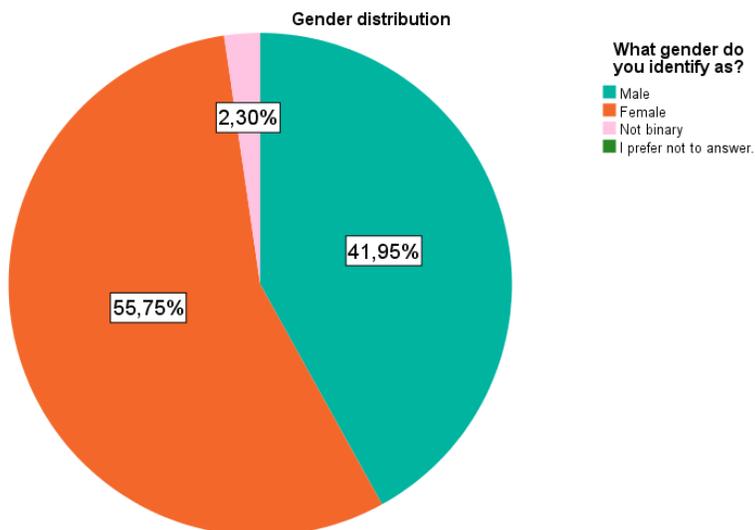


Figure c: Gender distribution

Q3 - On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station?

| Field | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|-------------------------------------|---------|---------|------|---------------|----------|-------|
| 1 = not at all safe, 10 = very safe | 4.00 | 10.00 | 7.94 | 1.16 | 1.35 | 174 |

*Table b: Descriptive data question 3***Q4 - On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station?**

| Field | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|-------------------------------------|---------|---------|------|---------------|----------|-------|
| 1 = not at all safe, 10 = very safe | 4.00 | 10.00 | 7.36 | 1.30 | 1.70 | 174 |

*Table c: Descriptive data question 4***Q5 - On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only)***Table d: Descriptive data question 5***Q6 - When do you usually travel via Utrecht Central Station?**

| | | | |
|---|----------------|--------|-----|
| 1 | During the day | 85.06% | 148 |
| 2 | In the evening | 14.94% | 26 |
| | | | 174 |

Table e: Descriptive data question 6

Q7 - To what extent do the following station characteristics influence your perceptions of safety from crime?

| # | Field | Not at all | Slightly | Moderately | Very | Extremely | Total |
|---|--|------------|-----------|------------|-----------|-----------|-------|
| 1 | Clear views around you on the platforms and in the station hall (no turns or walls blocking your view) | 3.45% 6 | 14.37% 25 | 36.78% 64 | 38.51% 67 | 6.90% 12 | 174 |
| 2 | The use of transparent materials for elevators and shelters | 3.45% 6 | 21.26% 37 | 33.33% 58 | 35.63% 62 | 6.32% 11 | 174 |
| 3 | Lighting on the platforms and in the station hall | 0.00% 0 | 2.30% 4 | 13.22% 23 | 46.55% 81 | 37.93% 66 | 174 |
| 4 | Security cameras on the platforms and in the station hall | 4.02% 7 | 14.37% 25 | 32.18% 56 | 36.21% 63 | 13.22% 23 | 174 |
| 5 | The presence of other users of the station | 0.57% 1 | 8.05% 14 | 18.39% 32 | 45.40% 79 | 27.59% 48 | 174 |

Showing rows 1 - 5 of 5

Table f: Descriptive data question 7

Q8 - To what extent do the following station characteristics influence your perceptions of safety from crime?

| # | Field | Not at all | Slightly | Moderately | Very | Extremely | Total |
|---|--|------------|-----------|------------|-----------|-----------|-------|
| 1 | The separation of different functions in the station hall (waiting area on the ground floor, hospitality on the first floor) | 17.82% 31 | 31.61% 55 | 34.48% 60 | 14.37% 25 | 1.72% 3 | 174 |
| 2 | Walking routes and signage (the blue / white signs) | 9.20% 16 | 35.63% 62 | 26.44% 46 | 25.86% 45 | 2.87% 5 | 174 |
| 3 | Real-time information about the departure and arrival times of your train | 9.77% 17 | 21.26% 37 | 27.59% 48 | 32.76% 57 | 8.62% 15 | 174 |

Showing rows 1 - 3 of 3

Table g: Descriptive data question 8

Q9 – To what extent do the following station characteristics influence your perceptions of safety from crime?

| # | Field | Not at all | Slightly | Moderately | Very | Extremely | Total |
|---|---|------------|-----------|------------|-----------|-----------|-------|
| 4 | The presence of escape routes | 5.75% 10 | 18.39% 32 | 37.36% 65 | 27.59% 48 | 10.92% 19 | 174 |
| 5 | The presence of a place of refuge where you can go when feeling unsafe (e.g. the Kiosk or waiting area) | 5.75% 10 | 18.39% 32 | 22.99% 40 | 35.63% 62 | 17.24% 30 | 174 |
| 1 | The amount of entrance-exit points to the station | 5.75% 10 | 15.52% 27 | 40.80% 71 | 27.59% 48 | 10.34% 18 | 174 |
| 3 | The amount of access points to the platforms | 5.75% 10 | 21.84% 38 | 45.98% 80 | 21.84% 38 | 4.60% 8 | 174 |
| 2 | The access gates at the entrance-exit points | 3.45% 6 | 23.56% 41 | 33.33% 58 | 29.31% 51 | 10.34% 18 | 174 |

Showing rows 1 - 5 of 5

Table h: Descriptive data question 9

Q10 - To what extent do the following station characteristics influence your perceptions of safety from crime?

| # | Field | Not at all | Slightly | Moderately | Very | Extremely | Total |
|---|---|------------|-----------|------------|-----------|-----------|-------|
| 1 | The amount of graffiti and visible vandalism inside the station | 13.22% 23 | 26.44% 46 | 28.74% 50 | 25.86% 45 | 5.75% 10 | 174 |
| 2 | The amount of litter inside the station | 4.02% 7 | 25.86% 45 | 32.76% 57 | 28.16% 49 | 9.20% 16 | 174 |
| 3 | The presence of benches and shelters inside the station | 5.75% 10 | 22.41% 39 | 37.36% 65 | 29.89% 52 | 4.60% 8 | 174 |
| 4 | The presence of facilities and amenities inside the station (shops, takeaways, toilets) | 2.30% 4 | 8.62% 15 | 22.99% 40 | 47.70% 83 | 18.39% 32 | 174 |

Showing rows 1 - 4 of 4

Table i: Descriptive data question 10

Q11 – To what extent do the following characteristics of the surroundings of the station influence your perceptions of safety from crime?

| # | Field | Not at all | Slightly | Moderately | Very | Extremely | Total |
|---|---|------------|-----------|------------|-----------|-----------|-------|
| 4 | Unmanned buildings around the station (such as shops and offices in the evenings or vacant buildings) | 4.60% 8 | 17.82% 31 | 36.21% 63 | 36.78% 64 | 4.60% 8 | 174 |
| 5 | The presence of shops and hospitality around the station (during daytime) | 6.32% 11 | 10.34% 18 | 28.74% 50 | 42.53% 74 | 12.07% 21 | 174 |
| 6 | The presence of pedestrian routes to and from the station | 5.17% 9 | 19.54% 34 | 36.78% 64 | 30.46% 53 | 8.05% 14 | 174 |
| 1 | The lighting on the access roads and parking spaces | 3.45% 6 | 8.05% 14 | 23.56% 41 | 47.70% 83 | 17.24% 30 | 174 |
| 3 | The amount of litter around the station | 7.47% 13 | 25.86% 45 | 29.89% 52 | 27.59% 48 | 9.20% 16 | 174 |
| 2 | The amount of graffiti and visible vandalism around the station | 10.34% 18 | 27.01% 47 | 25.86% 45 | 31.61% 55 | 5.17% 9 | 174 |

Showing rows 1 - 6 of 6

Table j: Descriptive data question 11

Comment section:

| Respondent | Comment | English translation |
|------------|--|---|
| 2 | Overzichtelijke transparante ruimte's met eveneens toezichhouders en NS personeel om eventueel aan te spreken. Bezuinig niet op medewerkers, liever op het gebouw. Maak het gebouw niet onnodig duur maar vooral functioneel, overzichtelijk en goed doordacht voor veiligheid voor reiziger en goederen. Denk aan statafels ipv zithoeken, weinig straatmeubilair rondom stationgebouwen, goede verlichting, ook IR bewakingscamera's voor nachtelijk | Clear transparent areas with also supervisors and NS staff to address if necessary. Do not cut back on employees, rather on the building. Do not make the building unnecessarily expensive, but above all functional, well-organized and well thought out for safety for travelers and goods. Think of standing tables instead of sitting areas, little street furniture around station |

| | | |
|-----|---|--|
| | toezicht en open bebouwing. Meer blauw op straat, en eventueel de omgeving ook een opknopbeurt geven. M. vr. gr. Reiziger | buildings, good lighting, also IR surveillance cameras for nighttime surveillance and open buildings. More blue on the street, and possibly also give the environment a makeover. Kind regards, Traveler |
| 8 | Lekker bezig Tess | Doing good Tess |
| 9 | Succes! | Goodluck! |
| 15 | Fijn en makkelijk in te vullen enquête. Heel veel succes ;) | Nice and easy to fill out survey. Goodluck ;) |
| 21 | Het station is zoooo verbeterd in de afgelopen sinds jaren. Echt helemaal geweldig. | The station has improved soooo much in the last few years. Really really great. |
| 32 | Succes! | Goodluck! |
| 36 | Good luck with your thesis. | - |
| 44 | Wat mij juist een onveilig gevoel geeft zijn politie etc met zichtbare geweren etc | What gives me an unsafe feeling is police etc with visible guns etc. |
| 51 | Er fijn dat er ook bijna altijd beveiliging aanwezig op het centraal station dat geeft een veilige sfeer. | It is nice that there is almost always security at the station, which gives it a safe atmosphere. |
| 68 | You could consider personal noise-behavior as a variable, too. I feel unsafe when someone shouts/yells around, talks on the phone loudly, listens to music loudly (with speakers or smth) or just looks unhygienic but still careless. (The last one might be a very personal feeling, the rest seems legit and meaningful to me). Good luck with your studies! | - |
| 69 | good luck | - |
| 79 | Good luck! | - |
| 94 | Het valt mij op dat met name in de avond toch veel zwartrijders zijn die over de poortjes heen springen waar niet tegen opgetreden wordt. Dit draagt niet bij aan het gevoel van veiligheid | It strikes me that especially in the evening there are many fare dodgers who jump over the gates against which no action is taken. This does not contribute to the feeling of safety |
| 99 | None | - |
| 102 | Veel succes en wijsheid met uw bachelor scriptie! | Goodluck and wisdom with your bachelor thesis! |
| 104 | Succes! | Goodluck! |
| 105 | Ondanks dat het geen fysiek kenmerk van een station is, zijn handhavers of NS-personeel van | Despite the fact that it is not a physical characteristic of a station, enforcers or NS |

| | | |
|-----|--|---|
| | grote invloed op mijn veiligheid op het station en kan dit fysiek onveilige kenmerken compenseren. | personnel have a major influence on my safety at the station and can compensate for physically unsafe characteristics. |
| 107 | Succes met je scriptie Tess!! | Goodluck with your thesis Tess!! |
| 118 | Geen vragen: wel leuk dat je het initiatief neemt om iedereen die op t bankje zat te benaderen. Succes met je bachelor scriptie! | No questions: it is nice that you took the initiative to approach everyone sitting on the bench. Goodluck with you bachelor thesis! |
| 120 | n.v.t | n.a. |
| 121 | Succes met je thesis! | Goodluck with your thesis! |
| 122 | Succes met jouw scriptie! | Goodluck with your thesis! |
| 127 | Succes! | Goodluck! |
| 129 | Let op! Een aantal vragen stuurt mijn mening al een beetje, met name over de overzichtelijkheid van het station en de aanwezigheid van (bemenste) voorzieningen! Natuurlijk voel ik mij veiliger als ik goed zichtbaar ben en er anderen in de buurt zijn! 😊 succes met afstuderen! | Pay attention! A number of questions already guide my opinion a bit, especially about the clarity of the station and the presence of (staffed) facilities! Of course I feel safer when I am clearly visible and there are others around! 😊 Goodluck with graduation! |
| 130 | Good Luck:) | - |
| 133 | Ik wens je succes met de opleiding en veel besef van God liefde! | I wish you goodluck with your education and a great understanding of Gods love! |
| 137 | Succes met het schrijven van je scriptie 😊 | Goodluck with writing your thesis 😊 |
| 146 | Aanwezigheid van politie en/handhaving op de stations geeft een prettig gevoel. | The presence of police and/enforcers at the station gives a pleasant feeling. |
| 163 | Beste Tess, Als ik je één advies mag geven, dan het volgende: gebruik eenvoudigere taal in de enquête. Sommige zinnen en formuleringen zijn best ingewikkeld waardoor niet iedereen het kan begrijpen. Onbemenste bebouwing liet mij in ieder geval even grinniken. Succes met je scriptie! :) | Dear Tess, If I can give you one piece of advice, it's this: use simpler language in the survey. Some sentences and phrases are quite complicated, so not everyone can understand. In any case, unmanned buildings made me chuckle. Goodluck with your thesis! :) |

Table k: Original comments respondents and translation

Appendix 3: Analysis outcomes

3.1. Descriptive Statistics

| Descriptive Statistics | | | | | |
|--|-----|---------|---------|--------|----------------|
| | N | Minimum | Maximum | Mean | Std. Deviation |
| On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe | 174 | 4,00 | 10,00 | 7,9425 | 1,16655 |
| On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | 174 | 4,00 | 10,00 | 7,3563 | 1,30784 |
| Valid N (listwise) | 174 | | | | |

Table l: Descriptive Statistics for perceived safety from crime at Utrecht Central Station and at the access routes of the station

3.2. Paired samples T-test

| Paired Samples Test | | | | | | | | | |
|---------------------|---|--------------------|----------------|-----------------|---|--------|-------|-----|-----------------|
| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| Pair | | | | | Lower | Upper | | | |
| 1 | On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe - On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | ,58621 | 1,08112 | ,08196 | ,42444 | ,74798 | 7,152 | 173 | ,000 |

Table m: Paired samples t-test for safety from crime at Utrecht Central Station and at the access routes of the station

| Paired Samples Correlations | | | | N | Correlation | Sig. |
|-----------------------------|---|--|--|-----|-------------|------|
| 1 | On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe & On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | | | 174 | ,623 | ,000 |

Table n: Paired samples correlations for safety from crime at UCS and at the access routes of the station

3.3. Independent samples T-test

| Group Statistics | | | | | | |
|------------------|--|---------------------------------|----|--------|----------------|-----------------|
| | | What gender do you identify as? | N | Mean | Std. Deviation | Std. Error Mean |
| 1 | On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe | Male | 73 | 8,4110 | 1,06505 | ,12465 |
| | | Female | 97 | 7,5876 | 1,13425 | ,11517 |

Table o: Group statistics for safety from crime at UCS for males and females

Independent Samples Test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | 95% Confidence Interval of the Difference | |
|--|-----------------------------|---|------|------------------------------|---------|-----------------|-----------------|-----------------------|---|---------|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe | Equal variances assumed | ,039 | ,843 | 4,808 | 168 | ,000 | ,82333 | ,17123 | ,48529 | 1,16137 |
| | Equal variances not assumed | | | 4,851 | 159,962 | ,000 | ,82333 | ,16971 | ,48817 | 1,15849 |

Table p: Independent samples t-test for safety from crime at UCS for males and females

Group Statistics

| | What gender do you identify as? | N | Mean | Std. Deviation | Std. Error Mean |
|--|---------------------------------|----|--------|----------------|-----------------|
| On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | Male | 73 | 7,8767 | 1,14194 | ,13365 |
| | Female | 97 | 6,9485 | 1,30201 | ,13220 |

Table q: Group statistics for safety from crime at the access routes of the station for males and females

Independent Samples Test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | 95% Confidence Interval of the Difference | |
|--|-----------------------------|---|------|------------------------------|---------|-----------------|-----------------|-----------------------|---|---------|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | Equal variances assumed | ,019 | ,890 | 4,847 | 168 | ,000 | ,92826 | ,19150 | ,55019 | 1,30632 |
| | Equal variances not assumed | | | 4,938 | 164,039 | ,000 | ,92826 | ,18799 | ,55707 | 1,29945 |

Table r: Independent samples t-test for safety from crime at the access routes of the station for males and females

3.4. One-way ANOVA

Test of Homogeneity of Variances

| | | Levene Statistic | df1 | df2 | Sig. |
|--|--------------------------------------|------------------|-----|---------|------|
| On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe | Based on Mean | ,159 | 5 | 168 | ,977 |
| | Based on Median | ,267 | 5 | 168 | ,931 |
| | Based on Median and with adjusted df | ,267 | 5 | 165,603 | ,931 |
| | Based on trimmed mean | ,181 | 5 | 168 | ,969 |

Table s: Test of homogeneity of Variances for safety from crime at UCS

ANOVA

On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe

| | Sum of Squares | df | Mean Square | F | Sig. |
|----------------|----------------|-----|-------------|-------|------|
| Between Groups | 14,609 | 5 | 2,922 | 2,223 | ,054 |
| Within Groups | 220,816 | 168 | 1,314 | | |
| Total | 235,425 | 173 | | | |

Table t: ANOVA for safety from crime at UCS

Multiple Comparisons

Dependent Variable: On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe

Tukey HSD

| (I) What is your age? | (J) What is your age? | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|-----------------------|-----------------------|-----------------------|------------|-------|-------------------------|-------------|
| | | | | | Lower Bound | Upper Bound |
| 18 - 24 | 25 - 34 | -,47222 | ,22064 | ,272 | -1,1083 | ,1639 |
| | 35 - 44 | -,86538 | ,33657 | ,110 | -1,8357 | ,1049 |
| | 45 - 54 | -,45000 | ,37896 | ,842 | -1,5425 | ,6425 |
| | 55 - 64 | ,25000 | ,58375 | ,998 | -1,4329 | 1,9329 |
| | 65+ | -,58333 | ,67104 | ,953 | -2,5179 | 1,3512 |
| 25 - 34 | 18 - 24 | ,47222 | ,22064 | ,272 | -,1639 | 1,1083 |
| | 35 - 44 | -,39316 | ,37097 | ,896 | -1,4626 | ,6763 |
| | 45 - 54 | ,02222 | ,40982 | 1,000 | -1,1592 | 1,2037 |
| | 55 - 64 | ,72222 | ,60424 | ,839 | -1,0197 | 2,4642 |
| | 65+ | -,11111 | ,68894 | 1,000 | -2,0973 | 1,8750 |
| 35 - 44 | 18 - 24 | ,86538 | ,33657 | ,110 | -,1049 | 1,8357 |
| | 25 - 34 | ,39316 | ,37097 | ,896 | -,6763 | 1,4626 |
| | 45 - 54 | ,41538 | ,48223 | ,955 | -,9748 | 1,8056 |
| | 55 - 64 | 1,11538 | ,65552 | ,533 | -,7744 | 3,0052 |
| | 65+ | ,28205 | ,73432 | ,999 | -1,8349 | 2,3990 |
| 45 - 54 | 18 - 24 | ,45000 | ,37896 | ,842 | -,6425 | 1,5425 |
| | 25 - 34 | -,02222 | ,40982 | 1,000 | -1,2037 | 1,1592 |
| | 35 - 44 | -,41538 | ,48223 | ,955 | -1,8056 | ,9748 |
| | 55 - 64 | ,70000 | ,67826 | ,907 | -1,2553 | 2,6553 |
| | 65+ | -,13333 | ,75470 | 1,000 | -2,3090 | 2,0424 |
| 55 - 64 | 18 - 24 | -,25000 | ,58375 | ,998 | -1,9329 | 1,4329 |
| | 25 - 34 | -,72222 | ,60424 | ,839 | -2,4642 | 1,0197 |

| | | | | | | |
|-----|---------|----------|--------|-------|---------|--------|
| | 35 - 44 | -1,11538 | ,65552 | ,533 | -3,0052 | ,7744 |
| | 45 - 54 | -,70000 | ,67826 | ,907 | -2,6553 | 1,2553 |
| | 65+ | -,83333 | ,87563 | ,932 | -3,3577 | 1,6910 |
| 65+ | 18 - 24 | ,58333 | ,67104 | ,953 | -1,3512 | 2,5179 |
| | 25 - 34 | ,11111 | ,68894 | 1,000 | -1,8750 | 2,0973 |
| | 35 - 44 | -,28205 | ,73432 | ,999 | -2,3990 | 1,8349 |
| | 45 - 54 | ,13333 | ,75470 | 1,000 | -2,0424 | 2,3090 |
| | 55 - 64 | ,83333 | ,87563 | ,932 | -1,6910 | 3,3577 |

Table u: Multiple comparisons for safety from crime at UCS

Test of Homogeneity of Variances

| | | Levene Statistic | df1 | df2 | Sig. |
|--|--------------------------------------|------------------|-----|---------|------|
| On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | Based on Mean | 1,202 | 5 | 168 | ,310 |
| | Based on Median | 1,022 | 5 | 168 | ,407 |
| | Based on Median and with adjusted df | 1,022 | 5 | 162,626 | ,407 |
| | Based on trimmed mean | 1,213 | 5 | 168 | ,305 |

Table v: Test of homogeneity of Variances for safety from crime at the access routes of the station

ANOVA

On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe

| | Sum of Squares | df | Mean Square | F | Sig. |
|----------------|----------------|-----|-------------|-------|------|
| Between Groups | 9,110 | 5 | 1,822 | 1,067 | ,380 |
| Within Groups | 286,798 | 168 | 1,707 | | |
| Total | 295,908 | 173 | | | |

Table w: ANOVA for safety from crime at the access routes of the station

Multiple Comparisons

Dependent Variable: On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe

Tukey HSD

| (I) What is your age? | (J) What is your age? | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|-----------------------|-----------------------|-----------------------|------------|-------|-------------------------|-------------|
| | | | | | Lower Bound | Upper Bound |
| 18 - 24 | 25 - 34 | -,09259 | ,25145 | ,999 | -,8175 | ,6323 |
| | 35 - 44 | -,52849 | ,38357 | ,740 | -1,6343 | ,5773 |
| | 45 - 54 | -,75926 | ,43188 | ,496 | -2,0043 | ,4858 |
| | 55 - 64 | -,00926 | ,66527 | 1,000 | -1,9272 | 1,9087 |
| | 65+ | -,75926 | ,76476 | ,920 | -2,9640 | 1,4455 |
| 25 - 34 | 18 - 24 | ,09259 | ,25145 | ,999 | -,6323 | ,8175 |

| | | | | | | |
|---------|---------|---------|--------|-------|---------|--------|
| | 35 - 44 | -,43590 | ,42277 | ,907 | -1,6547 | ,7829 |
| | 45 - 54 | -,66667 | ,46705 | ,710 | -2,0131 | ,6798 |
| | 55 - 64 | ,08333 | ,68862 | 1,000 | -1,9019 | 2,0686 |
| | 65+ | -,66667 | ,78515 | ,958 | -2,9302 | 1,5968 |
| 35 - 44 | 18 - 24 | ,52849 | ,38357 | ,740 | -,5773 | 1,6343 |
| | 25 - 34 | ,43590 | ,42277 | ,907 | -,7829 | 1,6547 |
| | 45 - 54 | -,23077 | ,54957 | ,998 | -1,8151 | 1,3536 |
| | 55 - 64 | ,51923 | ,74706 | ,982 | -1,6345 | 2,6729 |
| | 65+ | -,23077 | ,83688 | 1,000 | -2,6434 | 2,1819 |
| 45 - 54 | 18 - 24 | ,75926 | ,43188 | ,496 | -,4858 | 2,0043 |
| | 25 - 34 | ,66667 | ,46705 | ,710 | -,6798 | 2,0131 |
| | 35 - 44 | ,23077 | ,54957 | ,998 | -1,3536 | 1,8151 |
| | 55 - 64 | ,75000 | ,77298 | ,927 | -1,4784 | 2,9784 |
| | 65+ | ,00000 | ,86009 | 1,000 | -2,4796 | 2,4796 |
| 55 - 64 | 18 - 24 | ,00926 | ,66527 | 1,000 | -1,9087 | 1,9272 |
| | 25 - 34 | -,08333 | ,68862 | 1,000 | -2,0686 | 1,9019 |
| | 35 - 44 | -,51923 | ,74706 | ,982 | -2,6729 | 1,6345 |
| | 45 - 54 | -,75000 | ,77298 | ,927 | -2,9784 | 1,4784 |
| | 65+ | -,75000 | ,99791 | ,975 | -3,6269 | 2,1269 |
| 65+ | 18 - 24 | ,75926 | ,76476 | ,920 | -1,4455 | 2,9640 |
| | 25 - 34 | ,66667 | ,78515 | ,958 | -1,5968 | 2,9302 |
| | 35 - 44 | ,23077 | ,83688 | 1,000 | -2,1819 | 2,6434 |
| | 45 - 54 | ,00000 | ,86009 | 1,000 | -2,4796 | 2,4796 |
| | 55 - 64 | ,75000 | ,99791 | ,975 | -2,1269 | 3,6269 |

Table x: Multiple comparisons for safety from crime at the access routes of the station

3.5. Spearman's Rank Correlation Analysis

| BE characteristic of UCS | Spearman's rank correlation coefficient | Significance |
|--|---|--------------|
| Clear views around you on the platforms and in the station hall (no turns or walls blocking your view) | 0.068 | 0.374 |
| The use of transparent materials for elevators and shelters | 0.047 | 0.534 |
| Lighting on the platforms and in the station hall | -0.034 | 0.651 |
| Security cameras on the platforms and in the station hall | -0.198* | 0.013 |
| The presence of other users of the station | -0.01 | 0.992 |
| The separation of different functions in the station hall (waiting area on the ground floor, hospitality on the first floor) | -0.159* | 0.037 |

| | | |
|---|---------|-------|
| Walking routes and signage (the blue / white signs) | -0.172* | 0.023 |
| Real-time information about the departure and arrival times of your train | -0.173* | 0.022 |
| The amount of entrance-exit points to the station | -0.0125 | 0.101 |
| The access gates at the entrance-exit points | -0.098 | 0.198 |
| The amount of access points to the platforms | -0.277* | 0.000 |
| The presence of escape routes | -0.196* | 0.010 |
| The presence of a place of refuge where you can go when feeling unsafe (e.g. the Kiosk or waiting area) | -0.198* | 0.009 |
| The amount of graffiti and visible vandalism inside the station | -0.066 | 0.388 |
| The amount of litter inside the station | 0.04 | 0.956 |
| The presence of benches and shelters inside the station | -0.194* | 0.010 |
| The presence of facilities and amenities inside the station (shops, takeaways, toilets) | -0.159* | 0.036 |

Table y: Spearman's rank correlation coefficients and significance values for the BE characteristics of UCS

| BE characteristic at the access routes of the station | Spearman's rank correlation coefficient | Significance |
|---|---|--------------|
| The lighting on the access roads and parking spaces | -0.030 | 0.690 |
| The amount of graffiti and visible vandalism around the station | -0.107 | 0.160 |
| The amount of litter around the station | -0.097 | 0.201 |
| Unmanned buildings around the station (such as shops and offices in the evenings or vacant buildings) | -0.291* | 0.000 |
| The presence of shops and hospitality around the station (during daytime) | -0.221* | 0.003 |
| The presence of pedestrian routes to and from the station | -0.117 | 0.125 |

Table z: Spearman's rank correlation coefficients and significance values for the BE characteristics at the access routes of the station

3.6. Pearson Correlation Analysis

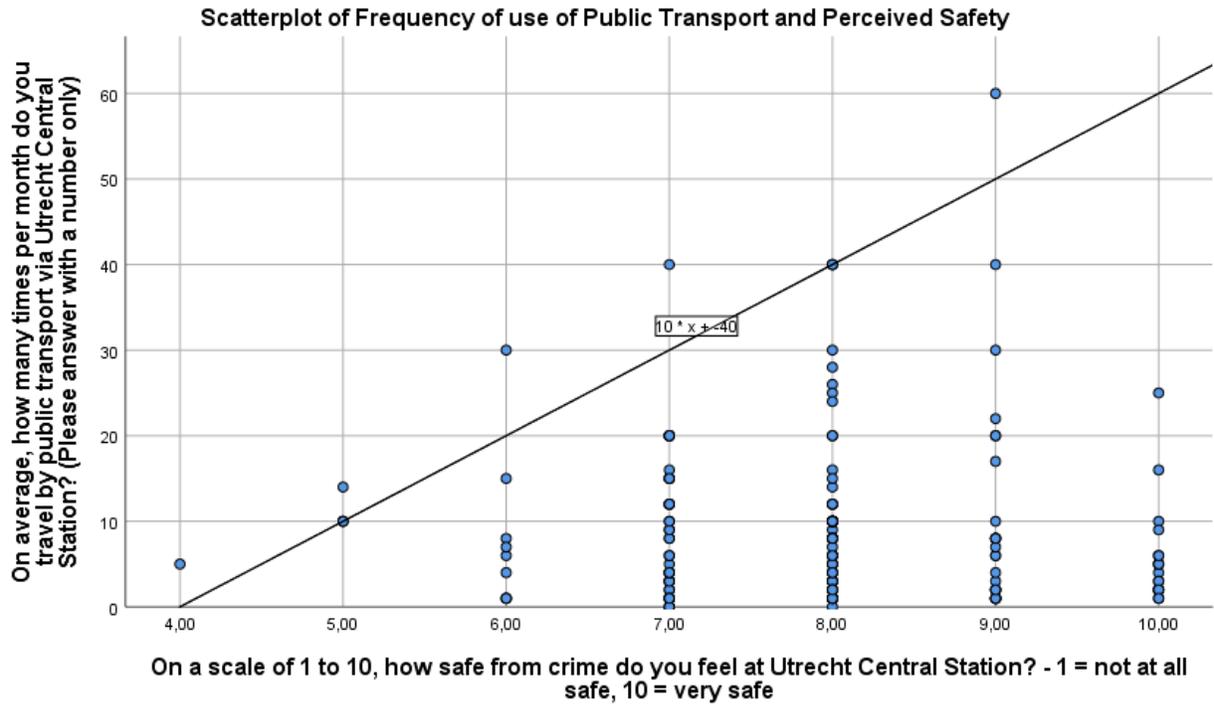


Figure d: Scatterplot for the frequency of use of public transport and perceived safety at UCS

Correlations

| | | On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe | On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only) |
|--|---------------------|--|--|
| On a scale of 1 to 10, how safe from crime do you feel at Utrecht Central Station? - 1 = not at all safe, 10 = very safe | Pearson Correlation | 1 | -,036 |
| | Sig. (2-tailed) | | ,641 |
| | N | 174 | 174 |
| On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only) | Pearson Correlation | -,036 | 1 |
| | Sig. (2-tailed) | ,641 | |
| | N | 174 | 174 |

Table !: Pearson correlation analysis for frequency of use of public transport and perceived safety at UCS

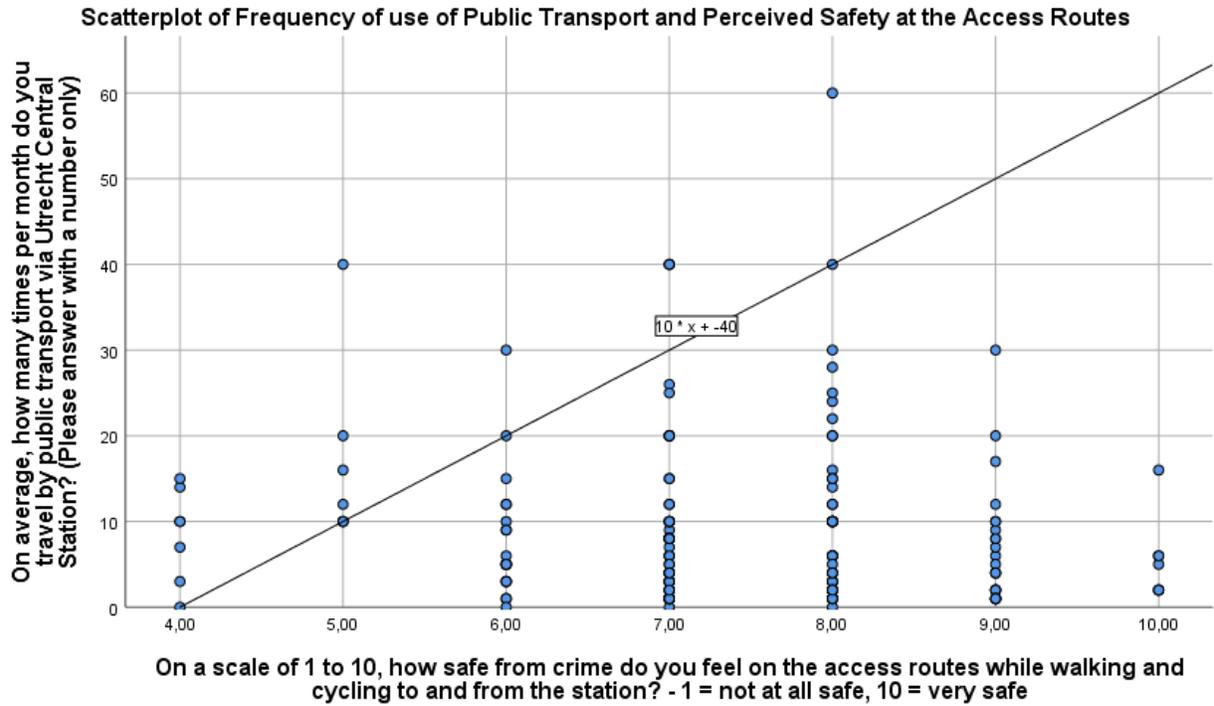


Figure e: Scatterplot for the frequency of use of public transport and perceived safety at the access routes to and from the station

Correlations

On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe

On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only)

| | | | |
|--|---------------------|-------|-------|
| On a scale of 1 to 10, how safe from crime do you feel on the access routes while walking and cycling to and from the station? - 1 = not at all safe, 10 = very safe | Pearson Correlation | 1 | -,084 |
| | Sig. (2-tailed) | | ,270 |
| | N | 174 | 174 |
| On average, how many times per month do you travel by public transport via Utrecht Central Station? (Please answer with a number only) | Pearson Correlation | -,084 | 1 |
| | Sig. (2-tailed) | ,270 | |
| | N | 174 | 174 |

Table @: Pearson correlation analysis for frequency of use of public transport and perceived safety at the access routes of the station

Appendix 4: Ranking BE characteristics

The colored tables show which BE characteristics have overlapping confidence intervals and which don't. A gray box means there is overlap in the confidence intervals of the two characteristics and so there is no significant difference. A green box means there is a positive difference between the confidence intervals (no overlap) and an orange box means there is negative difference between the confidence intervals (no overlap). So, a green box means the median of the BE characteristic is significantly higher than the other, and, therefore, more important in influencing perceived safety.

4.1. BE characteristics of Utrecht Central Station

| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | - | | | | | | | | | | | | | | | | |
| b | | - | | | | | | | | | | | | | | | |
| c | | | - | | | | | | | | | | | | | | |
| d | | | | - | | | | | | | | | | | | | |
| e | | | | | - | | | | | | | | | | | | |
| f | | | | | | - | | | | | | | | | | | |
| g | | | | | | | - | | | | | | | | | | |
| h | | | | | | | | - | | | | | | | | | |
| i | | | | | | | | | - | | | | | | | | |
| j | | | | | | | | | | - | | | | | | | |
| k | | | | | | | | | | | - | | | | | | |
| l | | | | | | | | | | | | - | | | | | |
| m | | | | | | | | | | | | | - | | | | |
| n | | | | | | | | | | | | | | - | | | |
| o | | | | | | | | | | | | | | | - | | |
| p | | | | | | | | | | | | | | | | - | |
| q | | | | | | | | | | | | | | | | | - |

Table 2: Overview of the positive, negative, and absent overlap between the confidence intervals of the medians of the BE characteristics of UCS

Gray = overlap

Green = positive difference

Orange = negative difference

| | | |
|---|--|----|
| a | Clear views around you on the platforms and in the station hall (no turns or walls blocking your view) | 0 |
| b | The use of transparent materials for elevators and shelters | -3 |
| c | Lighting on the platforms and in the station hall | 13 |
| d | Security cameras on the platforms and in the station hall | 0 |
| e | The presence of other users of the station | 13 |
| f | The separation of different functions in the station hall (waiting area on the ground floor, hospitality on the first floor) | -3 |
| g | Walking routes and signage (the blue / white signs) | -3 |

| | | |
|---|---|----|
| h | Real-time information about the departure and arrival times of your train | -3 |
| i | The amount of entrance-exit points to the station | -3 |
| j | The access gates at the entrance-exit points | -3 |
| k | The amount of access points to the platforms | -3 |
| l | The presence of escape routes | -3 |
| m | The presence of a place of refuge where you can go when feeling unsafe (e.g. the Kiosk or waiting area) | -2 |
| n | The amount of graffiti and visible vandalism inside the station | -3 |
| o | The amount of litter inside the station | -3 |
| p | The presence of benches and shelters inside the station | -3 |
| q | The presence of facilities and amenities inside the station (shops, takeaways, toilets) | 9 |

Table #: Overview of the BE characteristics and the number of positive differences

Ranking from most positive differences to most negative differences:

| | |
|----------|--|
| 1. – 2. | Lighting on the platforms and in the station hall |
| 1. – 2. | The presence of other users of the station |
| 3. | The presence of facilities and amenities inside the station (shops, takeaways, toilets) |
| 4. – 5. | Clear views around you on the platforms and in the station hall (no turns or walls blocking your view) |
| 4. – 5. | Security cameras on the platforms and in the station hall |
| 6. | The presence of a place of refuge where you can go when feeling unsafe (e.g. the Kiosk or waiting area) |
| 6. – 17. | The use of transparent materials for elevators and shelters |
| 6. – 17. | The separation of different functions in the station hall (waiting area on the ground floor, hospitality on the first floor) |
| 6. – 17. | Walking routes and signage (the blue / white signs) |
| 6. – 17. | Real-time information about the departure and arrival times of your train |
| 6. – 17. | The amount of entrance-exit points to the station |
| 6. – 17. | The access gates at the entrance-exit points |
| 6. – 17. | The amount of access points to the platforms |
| 6. – 17. | The presence of escape routes |
| 6. – 17. | The amount of graffiti and visible vandalism inside the station |
| 6. – 17. | The amount of litter inside the station |
| 6. – 17. | The presence of benches and shelters inside the station |

Table §: Ranking of the BE characteristics of UCS starting from most positive difference

4.2. BE characteristics of the access routes to and from the station

| | | | | | | |
|---|---|---|---|---|---|---|
| | a | b | c | d | e | f |
| a | - | | | | | |
| b | | - | | | | |
| c | | | - | | | |
| d | | | | - | | |
| e | | | | | - | |
| f | | | | | | - |

Table %: Overview of the positive, negative, and absent overlap between the confidence intervals of the medians of the BE characteristics of the access routes of the station

| | | |
|---|---|----|
| a | The lighting on the access roads and parking spaces | 4 |
| b | The amount of graffiti and visible vandalism around the station | -1 |
| c | The amount of litter around the station | -1 |
| d | Unmanned buildings around the station (such as shops and offices in the evenings or vacant buildings) | -1 |
| e | The presence of shops and hospitality around the station (during daytime) | 0 |
| f | The presence of pedestrian routes to and from the station | -1 |

Table %: Overview of the BE characteristics and the number of positive differences

Ranking from most positive differences to most negative differences:

| | |
|---------|---|
| 1. | The lighting on the access roads and parking spaces |
| 2. | The presence of shops and hospitality around the station (during daytime) |
| 3. – 6. | The amount of graffiti and visible vandalism around the station |
| 3. – 6. | The amount of litter around the station |
| 3. – 6. | Unmanned buildings around the station (such as shops and offices in the evenings or vacant buildings) |
| 3. – 6. | The presence of pedestrian routes to and from the station |

Table *: Ranking of the BE characteristics of the access routes of the station starting from most positive difference