



Planning for pedestrians: Shared space
transformation in a cycling dominant
inner-city

A Groningen case study

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Abstract:

This study explores how shared-space street transformation can include pedestrians in a cycling dominant inner-city. Astraat, Groningen, is used as a case study to explore the effectiveness of typical characteristics and elements of a shared-street design. Three main domains of accessibility, connectivity and spatial legibility have been used to explore the different elements. The results show a large disparity in how the population experiences shared street transformation. Certain street design elements can be either an opportunity or barrier. The results show that cyclists have the perceived priority in this space and that most are against a lack of traditional road rules. The main recommendation would be to do further comparative research in the study area in order to identify definitive changes, both in terms of rules and physical design.

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1. An Introduction to shared space transformation of the inner city of Groningen (The Netherlands)

Background and Research Problem

Groningen is a bustling, densely populated student city of approximately 230,000 inhabitants. With roughly 60% of all journeys in the city made with a bicycle, Groningen is naturally one of the most bicycle friendly cities in the world (Groningen.nl, 2021).

The inner city of Groningen has seen various historical transformations throughout history. One of the most significant inner city transformations to stimulate cycling and pedestrianisation was the Traffic Circulation Plan (VCP) of 1977 (PPRreunion, 2019). Figure 1 presents the original VCP, displaying a four sector system in which cars were prevented from crossing sectoral lines to move across the inner city (PPRreunion, 2019). Cars were, and are still to this day, forced to travel around the central canal roads should they wish to enter another sector of the inner city. Driving a car in or around the inner city became an extremely tedious and time-consuming task, whereas cycling became the quickest and easiest mode of transportation (van der Zee, 2015). The VCP played a pivotal role in stimulating bicycle use and transforming the inner city streets from the traditionally car dominated street, to a cycling and pedestrian prioritised street network (Tsubohara, 2007). Since 1993, the Better Inner City plan for Groningen has been the masterplan approach to all issues that relate to the design of public space (Kalfsbeek and van Osnabrugge, 2016).



Figure 1. Traffic circulation plan of Groningen, 1977 (PPRreunion, 2019).

Figure 2. The new cycling route network and pedestrian zones identified within the Bestemming Binnenstad plan of 2016 (Gemeente Groningen, 2016).

With the ‘Bestemming Binnenstad’ policy plan, issued by the municipality of Groningen in 2016, a green light was given to the inner city’s transformation strategy ‘Ruimte voor jou’. Figure 2 displays the Implementations that opted to expand and improve the pedestrian areas through a network of recognizable and attractive walking routes, whilst strengthening robustness of the bicycle network in order to avoid conflicts with heavy motorised traffic (Gemeente Groningen, 2016). The motto ‘Accessible Public Space for Everyone’ especially focused on the main entrance routes to the inner city center, including Westerhaven - the Aastraat transformation into shared space (Gemeente Groningen, 2016).

A new design guide was introduced in 2016 by the municipality in cooperation with STIPO and LOLA Landscape Architects at a 'Placemaking in Groningen' masterclass (Kalfsbeek and van Osnabrugge, 2016). As part of a worldwide programme for urban development, the article by Kalfsbeek and van Osnabrugge (2016) explained that it was an opportunity to gain experience in thinking about the city centre as a system, by analysing locations and in applying strategies to involve various stakeholders. One of such experiments was the redevelopment of the Aastrat & Brugstraat public space. The urban planners of the municipality of Groningen, Kalfsbeek and van Osnabrugge informed how these experiments led to the idea to transform Aastrat & Brugstraat into a single level continuous street with a focus on visitors, rather than the bicycle (Kalfsbeek and van Osnabrugge, 2016):

"The redevelopment of Aastrat/Brugstraat, which began in September 2017, is one of these initial 'carefully considered experiments'. Every day, 25,000 cyclists and 10,000 pedestrians travel down that street," Van Osnabrugge says. "Sixty-one per cent of the visitors to the city centre of Groningen come by bike. That's partly the result of the fact that we have been indulging cyclists. But we're starting to reach the limit when it comes to parking facilities for bikes and effectively combining different kinds of traffic. Indeed, increasingly there are conflicts with pedestrians. So now we're saying: we want to prioritise the pedestrian. "

Problem Statement

Shared space streets are by design, free of the normal restrictions of a traditional road (Hamilton-Baillie, 2008). Instead of relying on traditional street signage, priorities and layouts, authority is given to road users to allow increased awareness of other road users and to behave accordingly with common sense (Hamilton-Baillie, 2008). However, vulnerable groups can often be left behind in shared space designs, with elderly, physically disabled and visually impaired groups lacking the reflexes and awareness to react

to an increasingly complex traffic situation (Gerlach et al., 2009). Shared space appears to be only effective with a certain amount of traffic and different road users (Gerlach et al., 2009). Previous studies have also indicated that shared space transformation can lead to an increase in conflicts and risk to both cyclists and pedestrians (Hammond & Musselwhite, 2013). Other studies on pedestrians in shared space have focused on pedestrian gap acceptance, traffic conflicts and behavioural interactions (Kaparia et al., 2016). So far there has been little to no focus on pedestrian usage of shared space in a cycling cultural context. Moreover, there are many urban cities and environments where walking and cycling are the main modes of transport, but there is very little research into the safety when the two mix (Chong et al., 2010). As more and more inner cities around the world look to transform streets to accommodate increased bicycle use, as well as increasing attention to pedestrian priority, it is relevant to analyze a cycling dominant inner city where such a transformation towards pedestrian inclusiveness has been implemented. Therefore, a Groningen case study is chosen and the following main research question is proposed:

How can the transformation from traditional street design to shared space street design include pedestrians in a cycling dominant inner city context?

The following theoretical Sub-Questions are used to construct the theoretical framework:

- 1) What are the main differences between traditional and shared space street design with respect to pedestrian inclusiveness?
- 2) What are the possible street design strategies that allow pedestrian-cyclist coexistence in shared spaces?

Empirical sub-questions:

- 1) How have pedestrians experienced shared-space transformation in Groningen?
- 2) To what extent do shared space planning initiatives in Groningen account for pedestrian-friendly design implications with respect to cycling dominance?

Reading Guide

The next chapter presents the Theoretical Framework, where the research begins by introducing the core concepts of this study, in order to distinguish between the traditional and shared space street design with respect to pedestrians. It extends to discuss and review possible street design strategies that allow pedestrian-cyclist coexistence in shared spaces, and summarises the theoretical understanding in the conceptual model. The next chapter explains the research methodology in greater detail, interpreting the application of questionnaires and policy documents, as well as media content analysis. The fourth chapter illustrates the results of the research. The final chapter explores any conclusions, limitations and recommendations made.

2. Theoretical Framework

Theoretical understanding and definitions

Various authors suggest that inclusive urban space prioritizes pedestrians, by providing accessible pathways with a separation from non-pedestrian traffic (Salingaros, 1999; Cho et al. 2015). Traditional street design practices convey a clear hierarchy in spatial design layouts to provide efficient vehicle flow (Beitel et al., 2018) and access to all user groups (Moody & Melia, 2012). Shared space pedestrian inclusiveness becomes a part of behavioural change for sharing the space with other non-pedestrian traffic flows, including cyclists or motorized vehicles (Hamilton-Baillie, 2008).

With influence of the Dutch concept ‘woonerf - the living street’, increasingly the shared-space street design practices have been implemented across European countries (Hamilton-Baillie, 2008; Moody & Melia, 2012). The foundation of ‘shared spaces’ dates back to the Dutch province of Friesland, introduced by traffic engineer Hans Monderman, as a response to dissatisfaction with strict rule guidance (Hammond & Musselwhite, 2013) and the physical obstacles associated with traditional street design (Moody & Melia, 2012). The attempt originally intended to improve the flow of traffic and to reduce traffic accidents (Moody & Melia, 2012). Within the context of urban space, Hamilton-Baillie (2008, p 166) defined shared space as:

“all street users move and interact in their use of space on the basis of informal social protocols and negotiations.”

According to the Urban Space Framework by Cho et al. (2012), several urban space attributes can be distinguished between the two street design strategies, further adopted and summarised in Table 1 from additional literature review.

Table 1. Main characteristics of traditional vs. shared-space street design with respect to pedestrian inclusiveness (Themes identified based on Cho et al., 2012 Urban Space Framework).

Themes (Cho et al., 2012)	Traditional street design	Shared-space street design
<u>Accessibility & safety</u> A. Visual: observation before entering the street-space B. Physical: inclusion & exclusion in terms of perceived comfort or hinderance	A. Functional signage is provided with street elements to increase safety, such as kerbs, road markings, traffic signs and barriers(Hammond & Musselwhite, 2013). B. Provision of safe/direct pedestrian access, but higher traffic speeds, controlled comfort	A. Reducing width of carriageway and applying different colour pavement may inform users that they are entering shared space (Jayakody et al. 2018). B. Lower traffic speed within a high-density environment, and at the same time high perceived hindrance (Cho et al., 2015).

<p>C. Symbolic: perceptual clues for aesthetical place-feeling (inviting or threatening notion)</p>	<p>(Karndacharuk et al., 2014)</p> <p>C. The dominance of motor-vehicles reduces aesthetical place value by discouraging local liveability and social interaction (Jayakody et al., 2018).</p>	<p>C. Aesthetical enhancement to the public realm (Hamilton & Bailie, 2008), however risk reduction in shared spaces seems to be largely achieved through the creation of anxiety or 'unease' among non-pedestrians and pedestrians to cross (Moody & Melia, 2012; Karndacharuk et al., 2014).</p>
<p><u>Connectivity & mobility</u></p> <p>A. Movement patterns</p> <p>B. Way-finding</p> <p>C. Node-connectivity</p>	<p>A. Freedom of movement limited by designated sections, dependent on street user type (Cho et al., 2015).</p> <p>B. A high degree of segregation between soft modes and general traffic (Moody & Melia, 2012).</p> <p>C. Defined access points per user group with direct node-connectivity (Cho et al., 2015).</p>	<p>A. Giving people freedom of movement rather than instruction and control (Moody & Melia, 2012).</p> <p>B. Efficient traffic circulation in terms of time advantage (Hamilton-Baillie, 2008), accompanied with way-finding confusion (Jayakody et al., 2018).</p> <p>C. The provision of varied node-connectivity, resulting in increased permeability (Cho et al., 2015).</p>
<p><u>Spatial Legibility</u></p> <p>A. Spatial layout</p> <p>B. Spatial adaptability</p> <p>C. Focal points of activity</p>	<p>A. A clear hierarchy of the spatial layout and signage between users (Moody & Melia, 2012).</p> <p>B. It is likely that traffic-calming measures might be applied in face of change, such as pedestrian crossings, speed bumps, safety islands etc. (Cho et al., 2015).</p> <p>C. The overall spatial environment is perceived as less attractive to stay within the retail area (Moody & Melia, 2012).</p>	<p>A. There is little demarcation between carriageway and footpath as the entire width is often constructed in a continuous surface with same-colour pavers (Karndacharuk et al., 2014).</p> <p>B. The encouragement of walking and engagement with the spaces indirectly contributes to social security (Jayakody et al., 2018).</p> <p>C. Streetscape elements are added to encourage users to stay within the space and increase the local (retail) activity (Jayakody et al., 2018).</p>

Accessibility

Accessibility in this context refers to the user's ability to access the public space, therefore it is considered as a physical attribute to space, whilst contributing to the operational and socio-perceptual activities of urban space (Cho et al., 2015). For instance, Cho et al. (2012) emphasized the importance of applying certain design principles in order for the public space to become pedestrianized; namely, the

protection of pedestrian space from vehicular and other modes of mobility, such as cycling. It was suggested to provide direct access points to the core of the urban space, whilst drawing attention to the distinction for pedestrian underpasses and the enhancement of the visual comfort, by employing good quality and functional signage and flooring materials (Cho et al., 2015).

Connectivity

Well supported by Moody & Melia (2012) and Jayakody et al. (2018), key factors affecting pedestrian movement comfort appear to be volume, type and speed of traffic, or in other words, the convenience of pedestrian movement and the ease to negotiate movement throughout streets. Inconveniences might be caused by placing overwhelming pedestrian crossings with safety islands, therefore restricting pedestrian flow (Cho et al., 2012). For shared spaces it is the opposite of control and given instructions; in fact, it is considered that more conventional arterial road street design with a direct node-connectivity lacks permeability, as it discourages the freedom of movement for pedestrians (Cho et al., 2012). On the other hand, permeable networks encourage non-motorized modes to take place, depending on the spatial street layout (Jayakody et al., 2018).

Spatial legibility

Compared to traditional street design, shared space comprises the abolishment of common street characteristics such as curbs, road markings, traffic signs and barriers (Hammond & Musselwhite, 2013). Therefore, it suggests adjusting street user behaviour by non-verbal negotiation and social synergy, with the aim to increase public road safety with eye contact and mutual street user cooperation (Imrie, 2012; Hammond & Musselwhite, 2013). Furthermore, research by Hammond & Musselwhite (2013) discusses the effectiveness of shared space, indicating that previous studies advocate the importance of street design transformations giving priority over to pedestrians. As such, the removal of kerbs or reducing

colour contrast encourages pedestrians to share the space and non-pedestrians to give way (Karndacharuk et al., 2014). As a matter of fact, street users tend to achieve satisfaction by experiencing adaptable changes in physical characteristics of the surrounding environment (Hammond & Musselwhite, 2013). Place adaptability refers to how effectively the place's spatial and temporal pattern matches the collective behaviour of its inhabitants, achieved by modification of place, or behaviour, or both (Lynch, 1981). For example, streetscape elements are not only added for aesthetic value but also used as a functional transformation as part of the urban negotiation to encourage visitors to stick around the area (Jayakody et al., 2018).

Street design strategies for pedestrian-cyclist coexistence in shared-space context

Pedestrian-cycling coexistence on shared paths is increasingly becoming a prevalent practice for inner-city mobility plans, despite evidence of both concrete and perceived safety issues (Hatfield & Prabhakaran, 2016). For example, Gerlach et al. (2008) analyzed a case study of Drachten showcasing a mixed-model design, where the pedestrian and cycling zones are not separated from the road surface. The transformation also eliminated the majority of signing, and no speed restrictions were implemented, apart from the already existing inner city 50km/h speed limitation (Gerlach et al., 2018). In fact, due to safety concerns upon the request of local residents, marking strips were added afterwards for crossing the high street (Gerlach et al., 2018). The results indicated more frequent conflicts, especially between pedestrians and cyclists. The key criticism with regards to pedestrian hindrance in shared spaces relates to the perception of risk, involving not only an individual's own risk but also how their behaviour starts impacting other street users (Hammond & Musselwhite, 2013). Additionally Hammond & Musselwhite (2013) suggested, if risk is unequally spread and the shared space complexity becomes greater, this may lead to an unbalanced situation. There comes a point when planners have to consider, if a shared space design fails to prioritize pedestrians (as space

becomes cycling dominant), should it still continue functioning as a shared space (Moody & Melia, 2012)?

Within inner cities, the application of shared space design poses a noteworthy challenge for mobility and road safety authorities, especially when removing traditional traffic management measures (Kardacharuk et al., 2014). If compared to shared spaces designed in quieter residential streets, the mix-use shared spaces of the inner city embody a higher demand, which results in more conflicting situations not only from mobile users but also stationary users (Karndacharuk et al. 2014). A key objection regards people with disabilities, especially those of the visually impaired, as they do not feel safe to navigate through the shared space, particularly when sharing with cyclists (Jayakody et al., 2018). Yet, due to relatively slow travel speeds for cyclists and pedestrians, there is an opportunity to implement safer frameworks through non-motorized shared spaces (Beitel et al., 2018). Gerlach et al. (2008) discussed the way shared space operates through social rules rather than traffic-control measures, emphasizing that human politeness comes into effect in case the right of way becomes unclear. Therefore the actual street design elements, such as the choice of materials, including the colour of paving and blind paths, become the reinforcement of environmental qualities (Gerlach et al., 2008). The transformation to shared space in inner cities requires reducing non-pedestrian dominance through a slow-paced stage process with a goal of enhancing pedestrian priority (Karndacharuk et al., 2014). Successful shared space street design factors were investigated by Jayakody et al. (2018), pointing out to main design elements that focus on setting up freedom and increased comfort for pedestrian movement (See also Figure 3):

- Low mobility speed with visually narrowing road section;
- Application of raised crossing;
- Streetscape design of transitional areas;
- Level of surface with no level differentiation to divide the carriage, pedestrian and cycle way;
- Comfort spaces applying street furniture & design elements;

- A space for parking and loading activities should be allocated without interrupting pedestrian movement and activities.

R. R. J. C. Jayakody et al. Design factors for a successful Shared Space Street (SSS) design

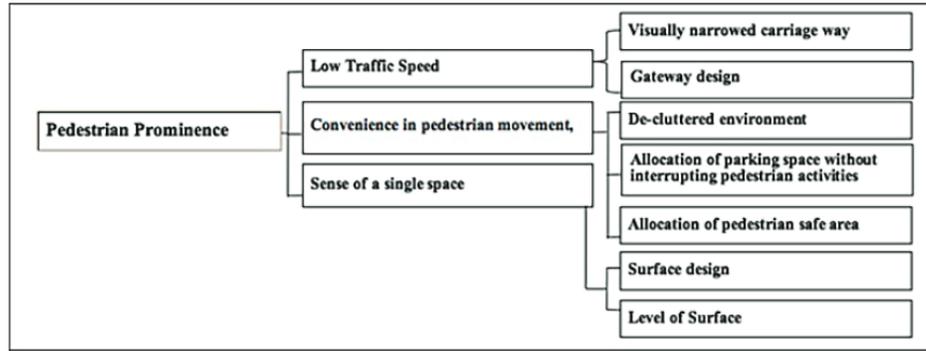


Figure 3. Successful Shared Space Street design factors (Jayakody et al., 2018).

Conceptual Model

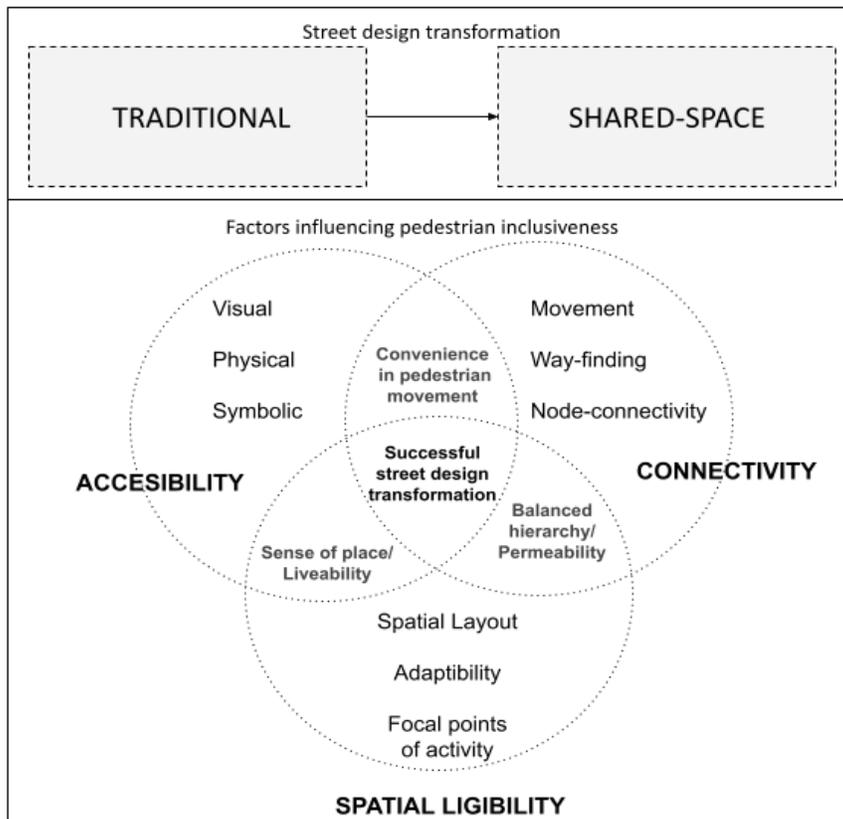


Figure 4. Conceptual model made by Hamish Mardell, inspired by the Urban Space Framework of (Cho et al., 2012)

The conceptual model seen in Figure 4 reflects how street design transformations may influence pedestrian inclusiveness. Various factors were identified based on The Urban Space Framework by Cho et al. (2012), which explained relevant urban design conditions for emerging hybrid and high-density conditions. Namely accessibility, connectivity and spatial legibility influence the way street design affects the livability of place and convenience of pedestrian movement. As such, a balance of order in these different factors results in successful street design transformation.

Hypothesis

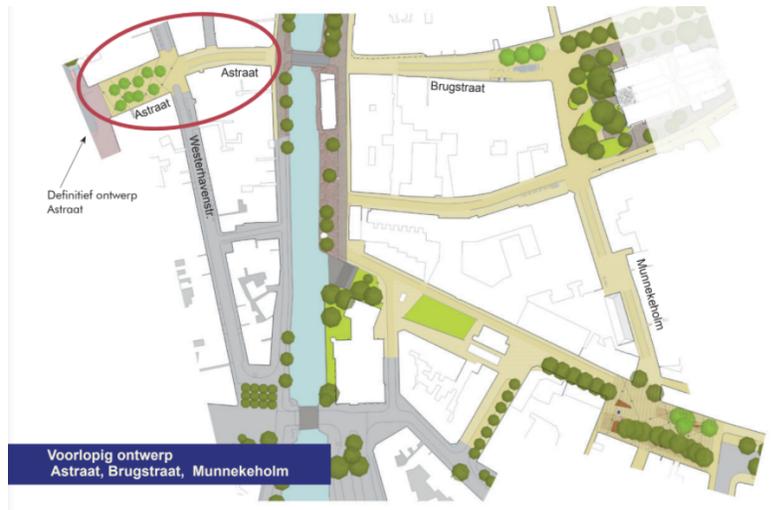
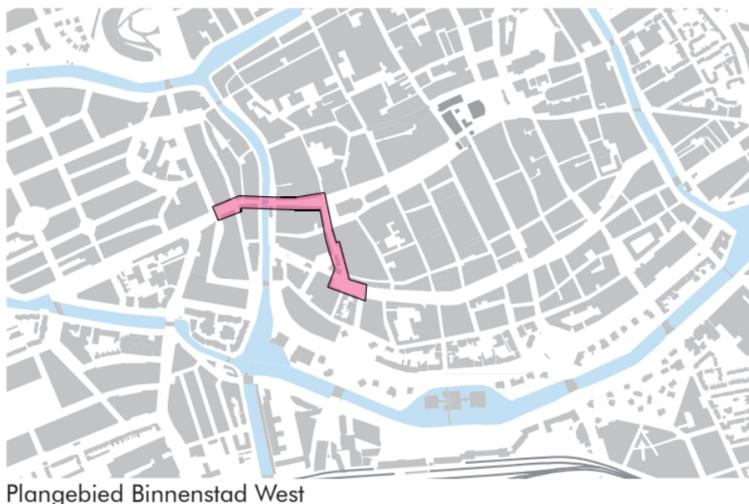
Finding order in street user hierarchy requires balancing the influential factors that define the success of public space negotiation. It can be hypothesized that by improving pedestrian accessibility and connectivity through appropriate (situation-specific) methods of spatial legibility, it increases the likelihood of a successful street design transformation with respect to pedestrians. This hypothesis will be verified by conducting a study into an existing shared space transformation (which in this case study is *Astraat* in the city of Groningen, with further description given in chapter 3.1.).

3. Methodology

Case study area - Astraat, Groningen

The Astraat, leading to A-Brug, provides the inner-city of Groningen with a main entrance/throughway on the Western side. Astraat is not only a connective entrance to the city, but has a flourishing number of consumer-based businesses on either side of the street (Gemeente Groningen, 2017).

The shared space transformation of Astraat commenced in 2017 (Gemeente Groningen (2017)). Before the transformation, the Astraat could be considered to be representative of a traditional layout. Cars and buses were allowed to use the road, there was no dedicated bicycle path, and there were raised pedestrian pavements on either side of the road. Figures 5 and 6 identify the location of the western inner city transformation proposal and illustrate the new situation giving pedestrians and cyclists more space with additional streetscape elements (Gemeente Groningen, 2017).



Figures 5 (left) and 6 (right). The plan of 'Ruimte voor jou' identifies redevelopment of the wester inner city transformation - Astraat (Gemeente Groningen, 2017).

Primary data collection - Survey

To emphasize the experiences and attitudes towards shared space transformation in the city of Groningen, a survey has been created to target daily street users of Astraat. Clifford et al. (2016) and McLafferty (p130, 2016) explained that:

“Survey design is particularly useful for eliciting people’s attitudes and opinions about social, political and environmental issues such as neighbourhood quality of live, or environmental problems and risks.”

Additionally, conducting surveys are also valuable for finding information on people’s experiences that are not available from published sources (Clifford et al., 2016). Acting as the core of this research, the questionnaire aims at answering the first empirical sub-question: How have pedestrians experienced shared-space transformation in Groningen?

The data collection instrument used is ‘Google Forms’. This method provides an accessible, online and realistic way of gathering primary data in the time of the coronavirus pandemic. The questionnaire available in English consists of fixed response and open-ended questions that allow to gain both quantitative and qualitative information and in-depth insights. For an overview of questionnaire design, see Appendix 3. The following methods were applied to recruit participants:

- On-street poster with a QR code to take part in the survey.
- Snowballing technique: invitation sent to targeted audiences through Facebook and other social media platforms.

Secondary data collection - Policy, plan, media content analyses

To strengthen research findings retrieved from primary data, qualitative analysis is conducted by a research tool Atlas.ti, intended to analyze policy plans, as well as media content to review secondary data sources. The selected policy plan overview is seen in Appendix 1 and the documents are translated to English. The same intent is applied for media content (Appendix 2) and manually added to Atlas.ti according to the coding book.

Data analysis scheme

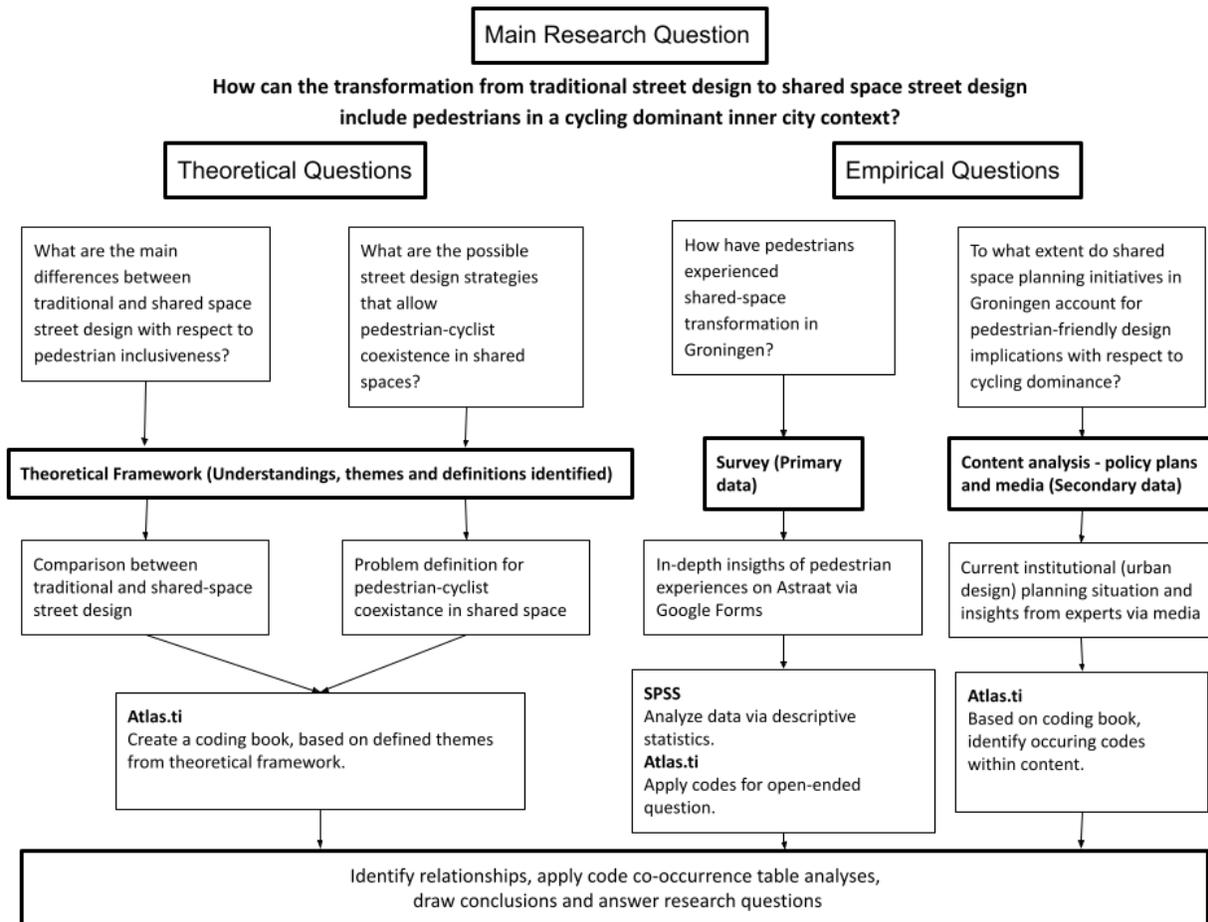


Figure 7. Data analysis scheme.

Figure 7 gives an overview of how data will be collected, analyzed and interpreted in order to answer the main and sub research questions.

Ethical considerations

Both the data collection methods of the on-street QR poster and snowballing technique leave it up to the respondent as to whether they wish to respond to the survey. A clear consent form, appendix 4, was provided at the beginning of the survey. All necessary information that the respondents need are included on the consent form, with a direct contact to the researcher in case of any questions. However, it should be noted that those who respond to the survey could have particularly strong views regarding the shared space transformation, and those that chose not to participate may have done so due to an indifference concerning the research. As such, sampling bias cannot be ruled out.

4. Results

This chapter will introduce the research findings, following a structure that allows a move closer to a hypothesis acceptance or a rejection. Different sub-questions employed several methods to answer the main research question, and this section tries to link findings from theoretical insights and empirical qualitative methodology retrieved from secondary and primary data sources.

4.1. Pedestrian experience of the shared-space transformation (Astraat, Groningen)

To gain insights into how pedestrians experience Astraat transformation from a traditional street design to a shared-space with respect to pedestrian-cyclist coexistence, a survey questioned a total of 50 daily street users (who live in Groningen). To be able to make comparisons, the survey firstly identified how many participants are familiar with such transformation, and whether they are familiar with the previous layout, by providing reference images seen in Figure 8. The majority or 78 % of respondents (respectively, 39 persons) know both street design layouts of Astraat, and 22 % are familiar only with the current layout (see table 2 below). In case, there was no familiarity with either street layouts, the data in that particular case was considered as not valid, therefore it was not used for this research.



Figure 8. Astraat representation before and after street design transformation, in relation to the respondent familiarity. 'Previous' (Gemeente Groningen, 2017); 'Current' (Hamish Mardell, 2021).

Table 2. Familiarity with Astraat street layouts (data from the survey).

Which street layouts of the Astraat are you familiar with?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Both the previous and current layouts	39	78,0	78,0	78,0
	The current layout only	11	22,0	22,0	100,0
	Total	50	100,0	100,0	

Findings indicate that at least 54 percent of respondents are concerned about sharing space with cyclists on Astraat (Seen in Table 3 and the representative graph in Figure 9 below). Whilst 6 % of participants were not sure about the situation. In order to find indications of what influences this, specific survey questions were constructed (based on theoretical findings). For instance, the main themes were identified for pedestrian inclusiveness in street design transformations relevant to densely populated inner cities, namely, 1) Accessibility, 2) Connectivity and 3) Spatial legibility (after Cho et al., 2012 the Urban Space Framework).

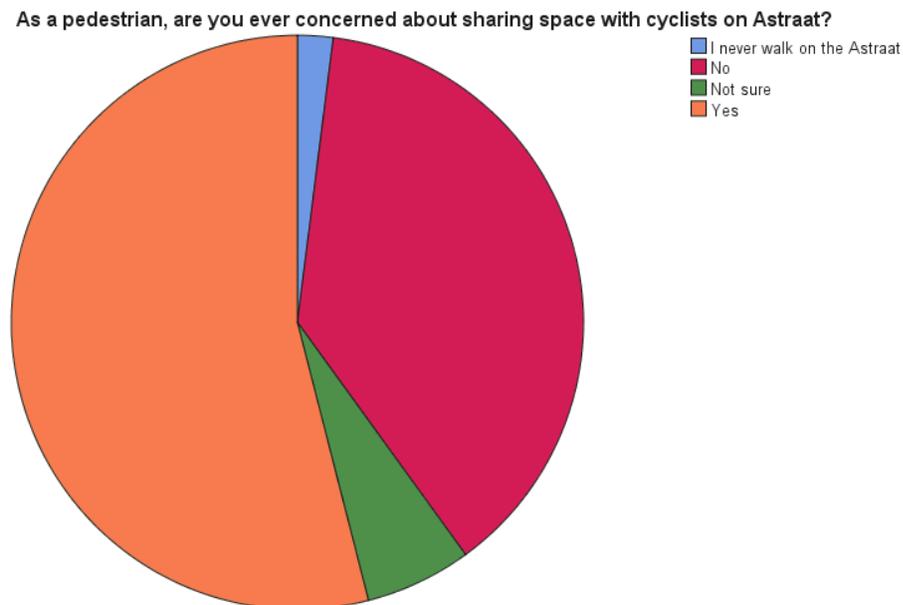


Figure 9. Pedestrians sharing space with cyclists on Astraat.

Table 3.

As a pedestrian, are you ever concerned about sharing space with cyclists on Astraat?					
Possible answers		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I never walk on the Astraat	1	2,0	2,0	2,0
	No	19	38,0	38,0	40,0
	Not sure	3	6,0	6,0	46,0
	Yes	27	54,0	54,0	100,0
	Total	50	100,0	100,0	

Accessibility

The following survey questions aimed to understand how accessible Astraat is to pedestrians visually, physically and symbolically:

Code: Visual Accessibility

As a pedestrian entering Astraat, is the change to a shared space street layout visually clear?

Code: Physical Accessibility

As a pedestrian, do you feel like the Astraat is a place where you can comfortably stop and socialise?

Code: Symbolic Accessibility

As a pedestrian, how do you perceive your priority over cyclists on Astraat?

Overall, the results indicate that pedestrians experience Astraat differently in terms of accessibility (See Appendix 5 for survey results). For instance, less than a half of participants agree with the fact that Astraat, as a shared space, is visually clear. At the same time, the change to a shared-space layout is not clear for 20 persons, with 5 persons being indifferent about their opinion. Interestingly, surveyed pedestrians perceive both the success of visual accessibility and physical accessibility on the Astraat similarly. Table 4 highlights that 40% of respondents find the change of layout to not be visually clear. Table 5 highlights that just over half of respondents perceive their priority as less than cyclists.

Table 4.

As a pedestrian entering Astraat, is the change to a shared space street layout visually clear?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I never walk on the Astraat	1	2,0	2,0	2,0
	No	20	40,0	40,0	42,0
	Not sure	5	10,0	10,0	52,0
	Yes	24	48,0	48,0	100,0
	Total	50	100,0	100,0	

Table 5.

As a pedestrian, how do you perceive your priority over cyclists on Astraat?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Equal priority	13	26,0	26,0	26,0
	I never walk on the Astraat	1	2,0	2,0	28,0
	Less priority	26	52,0	52,0	80,0
	More priority	5	10,0	10,0	90,0
	Not sure	5	10,0	10,0	100,0
	Total	50	100,0	100,0	

Connectivity

It was hypothesized that connectivity also influences accessibility when experiencing transformations in spatial street design. From the additional literature review, Moody & Melia (2012) explained that connectivity is related to the convenience of pedestrian movement and the ease to negotiate the movement throughout streets. To gain pedestrian insights for connectivity aspects of the Astraat, the survey asked: As a pedestrian, do you feel comfortable crossing the street without a designated pedestrian crossing?

Table 6 highlights that over a third of respondents do not feel comfortable crossing the street without a designated pedestrian crossing. A lack of traditional rules clearly negatively impacts this group of respondents, to a point where they do not feel comfortable in the current situation.

Table 6.

As a pedestrian, do you feel comfortable crossing the street without a designated pedestrian crossing?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I never walk on the Astraat	1	2,0	2,0	2,0
	No	18	36,0	36,0	38,0
	Not sure	3	6,0	6,0	44,0
	Yes	28	56,0	56,0	100,0
	Total	50	100,0	100,0	

Within the survey, an open-question was also given to find clearer indications on Astraat street user satisfaction, and whether there are suggestions for improvements. From a total of 50 respondents at least 40 open-answers were considered as valid and coded according to the coding book. Figure 10 below shows a code co-occurrence analysis, indicating that the most grounded themes from surveyed pedestrian experiences suggest improvements to be made within spatial adaptability and layout, and also physical and symbolic accessibility.

Figure 10. Open-ended question co occurrence table, indicating groundness and co-occurrence coefficients for code themes.

	◇ Adaptability 12	◇ Focal points... 5	◇ Movement 7	◇ Node-conn... 4	◇ Physical Acc... 9	◇ Spatial Layo... 11	◇ Symbolic A... 9	◇ Visual Acces... 6	◇ Way-finding 6
◇ Are you satisfied with the shared space design of Astraat... 50	0.02	0.04	0.08	0.04	0.02	0.05	0.04	0.04	0.08

The c-coefficient indicates the strength of the relation between two codes (Atlas.ti, 2014). Given the possibility to work with survey data to analyze open-ended questions, it is a valuable addition to the

more qualitative oriented analysis tools that ATLAS.ti provides (Atlas.ti, 2014). The c-coefficient tends to vary between 0 and 1, meaning that higher values indicate more co-occurrence between the two codes (Atlas.ti, 2014).

Although the coefficients within Figure 10 appear to be close to zero, it still shows different patterns for co-occurring themes. For instance, Case 18 gave an opinion on how the transformation of Astraat improves the overall movement. Specifically, permeability for pedestrians and cyclists as cars are no longer sharing this space, but it is also acknowledged how important is the convenience to reach focal points of activity:

"I really like that the municipality is taking the initiative to change more of the city's streets into being walkable and really make cars seem out of place. I get the sense that when I'm walking or cycling on Astraat, the cars are truly the guests on the road. This makes the street seem a lot more friendly for pedestrians and cyclists and additionally might help by pushing some car drivers to avoid these areas. It also provides a great walking connection between Westerhaven and the Vismarkt, which seems almost essential considering all the shops located in Westerhaven."

In addition, Case 3 indicated that not only cars should be the guests on Astraat, but also non-pedestrians like cyclists by adding additional safety measures to the spatial layout:

'The priority could be set more on pedestrians. Just like cars are "guests" on that street, cyclists should be as well. Most cyclists and scooters speed down that road leaving pedestrians scared/frustrated and/or feeling unsafe when walking on it, especially since there is no separation between sidewalk and street. Speed bumps at the beginning, the middle and the end could be an option to reduce the speed and thus increase safety for pedestrians and cyclists (e.g. less accidents/collisions).'

Spatial legibility

In order to research how spatial legibility of the Astraat corresponds for pedestrians inclusiveness , the survey asked: "As a pedestrian, in the current street layout of Astraat, how has your priority over cyclists changed compared to the previous layout?"

Table 7.

As a pedestrian, in the current street layout of Astraat, how has your priority over cyclists changed compared to the previous layout?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Decreased	17	34,0	34,0	34,0
	I never walk on the Astraat	1	2,0	2,0	36,0
	Increased	17	34,0	34,0	70,0
	Not sure	8	16,0	16,0	86,0
	Stayed the same	7	14,0	14,0	100,0
	Total	50	100,0	100,0	

Interestingly, table 7 shows that there is an equal split between those that perceived their priority over cyclists has increased or decreased compared to the previous layout. This suggests that the spatial legibility and pedestrian priority hasn't improved with the shared-space transformation.

Finding relationships, linking survey data with content analysis

The Sankey diagram (seen in Figure 11) was used for finding relevant patterns for the open-ended Q : 'Are you satisfied with the shared space transformation of Astraat? Do you have any suggestions?'. It showed the co-occurrence for *Adaptability* and *Physical Accessibility*, interlinked with spatial layout, focal points of activity, and others.

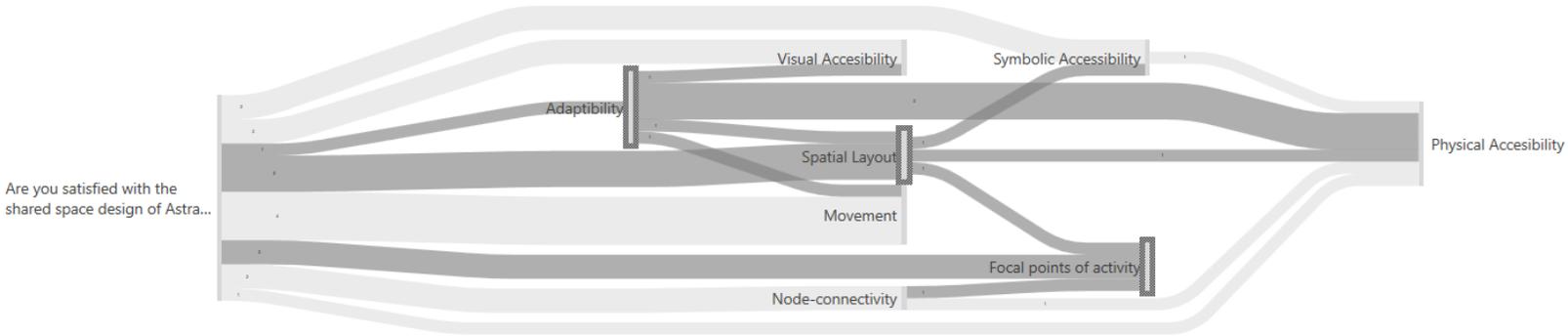


Figure 11. Sankey Diagram.

To investigate this further, a co-occurrence table analysis via Atlas.ti was conducted for all of the sub-themes of accessibility, against other relevant themes in relation to connectivity and spatial legibility (See Table 8). This includes codes from the open-ended question, but also codes applied within selected policy documents and media content (See Appendix 1 and 2).

Table 8.

Co-Occurrence	○ Physical Accessibility Gr=9	○ Symbolic Accessibility Gr=9	○ Visual Accessibility Gr=6
○ Adaptability Gr=12	0.17	0.00	0.06
○ Node-connectivity Gr=4	0.08	0.00	0.00
○ Spatial Layout Gr=11	0.05	0.05	0.00
○ Way-finding Gr=6	0.07	0.00	0.09

Analyses showed that specifically Physical Accessibility has linkages to many sub themes, with the strongest relation having Adaptability. Previous literature explained that place adaptability refers to how effectively the place's spatial and temporal pattern matches the collective behaviour of its inhabitants (Lynch, 1981). For example, streetscape elements are not only added for aesthetic value but also used as a functional change to improve physical accessibility to local activities (Jayakody et al., 2018). Detailed quotations on how this relation co-occurs within this research is visualised in Appendix 7.

Overall, not everyone has the same preferences, wishes and experiences. When asked for the opinion on certain street design elements of the Astraat, there was a mixed response. When asked about the same colour brick across the whole street, just less than half of the respondents liked it (appendix 5). Quite surprisingly, only 22% of respondents liked the lack of signage and traditional rules (appendix 5). This clear dissatisfaction in general at the lack of rules demonstrates the large gap between the pedestrian and the aims of the shared-space transformation. (Albers, 2020) mirrors this finding where it is recognised that when there are a lack of rules not all users choose to use and common sense and show respect to other road users

5. Conclusions, Limitations and Recommendations

With regards to the main research question, “How can the transformation from traditional street design to shared space street design include pedestrians in a cycling dominant inner city context?”, the study cannot give a strongly reliable answer. However, the results suggest that there are various issues that pedestrians experience when using shared space in a cycling dominant inner city.

It is clear that pedestrians do not currently carry an equal amount of safety and accessibility as other road users in the shared-space transformation on Astraat. With the vast majority of respondents presenting either a lack of accessibility, connectivity or spatial legibility, it is clear that improvements on Astraat are required on each of these pedestrian domains. It is difficult to ascertain whether these results represent a problem with the case study, or shared-space transformations overall. However, the most important area to work on is visual accessibility. With only 22% liking the lack of signage and traditional rules, work is needed in this domain in order to properly and equally include pedestrians.

Limitations:

There are a number of limitations to the research that strongly limit the strength of results and the ability to make generic conclusions. Firstly, the age of respondents is extremely skewed toward the 20-29 age group, and there were no respondents in the 40+ age range. This could be due to the accessibility and technological understanding and willingness to scan the QR code on the survey poster. In addition, English was used as the language of the survey in a Dutch context, which could have presented a language barrier to some of the population. With just fifty respondents, the sample size is relatively very small compared to the population of Groningen. This, in conjunction with the lack of diversity regarding age group, it is difficult to come to general conclusions

Recommendations:

The Astraat represents the most similar street in the inner city of Groningen in terms of traffic, width and function to what could be implemented in bike modal transitioning inner cities across the world. However, with just one example studied, this case study represents an insight into shared space in a cycling context as opposed to generic, wide sweeping conclusions for a cycling transitioning inner cities.

The study is clear, that in the instance of Astraat, the current transformation is not including pedestrians as it should be. Greater comparative research internationally is needed to ascertain the exact elements and 'rules' that when implemented in shared space, fully include pedestrians on an equal playing field with cyclists and other road users.

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Appendices

Appendix 1 - Selected policy plan overview

Appendix 1. Selected policy plan overview

Document title	Issued by	Relevance
Actieplan Toegankelijke Stad Groningen 2017/2021	Gemeente Groningen (2017)	Street Design - shared space of Astraat - Brugstraat, detailed design measures and policies (p13, 2017).
Bestemming Binnenstad	Gemeente Groningen (2016)	Shared space future vision, inner city transformations, separation of cyclists and pedestrians by maps (p 48 and 54, 2016)
Concept inrichtingsplan Astraat-Brugstraat-Munnekeholm	Ruimte voor jou (2017)	Layout plan of the Astraat-Brugstraat-Munnekeholm
Impressies en ontwerp 'Aanpak koppen Folkingestraat'	Ruimte voor jou (2017)	An official document in form of a letter, explaining the need of redesigning the Folkingestraat to ease the tension between cyclists and pedestrians

Appendix 2 - Selected media (content) analysis overview

Source	Main interviewees/ person of importance	Relevance	Main themes (codes)
Fietsers, auto's en voetgangers in één gebied: werkt dat wel? (Minnema, 2018)	<ul style="list-style-type: none"> - Femke Niekerk - Herman Lubbers - Sjoerd Nota 	Represents different points of view from various experts in the spatial planning field. Debate regarding whether a through-route like Astraat can still be used as a shared space. Blind and partially sighted people struggle without being able to sense physical separation.	<ul style="list-style-type: none"> - Visual accessibility - Spatial Layout - Way-finding - Focal points of activity - Adaptability
Space for people, not cars (van de Vliet, 2013)	<ul style="list-style-type: none"> - Hans Monderman 	Discusses the historical development of shared space and further emphasis is given to the dilemma if shared space actually increases safety but is perceived as less safe.	<ul style="list-style-type: none"> - Accessibility (Safety) - Spatial layout - Movement patterns - Spatial adaptability
The city at eye level (Kalfsbeek and	<ul style="list-style-type: none"> - Jaco Kalfsbeek & 	Urban planner Jaco Kalfsbeek	<ul style="list-style-type: none"> - Spatial adaptability

van Osnabrugge, 2016)	Gavin van Osnabrugge (Municipality of Groningen)	and programme manager Gavin van Osnabrugge of the – who both work for the municipality of Groningen – explain how flexibility is the central theme in the new design guide and in the city centre itself. They go in-depth in explaining the principles applied for the redevelopment of Astraat/Brugstraat.	<ul style="list-style-type: none"> - Way-finding - Spatial layout - Visual accessibility - Movement patterns
Verborgen gebreken – hoe toegankelijk is de Groninger binnenstad? (Albers, 2020)	- Jorrit Albers	Represents the challenges of finding a balance between aesthetics and functionality, applied in a case of shared spaces in Groningen, where visually impaired are missing guidelines.	<ul style="list-style-type: none"> - Aesthetics - Spatial layout - Visual accessibility - Way-finding
Stoepen verdwijnen gedeeltelijk uit Folkingerstraat: fietsers en voetgangers zoek het maar uit (Sikkom, 2017)		The focus has been given to the Folkingerstraat transformation, explaining how the shared space transformation within the city started.	<ul style="list-style-type: none"> - Spatial layout - Focal points of activity - Physical and symbolic accessibility - Spatial Legibility

Appendix 3 - Survey design:

Question	Possible Answers	Measurement Scale	Theme
Do you consent?	<ul style="list-style-type: none"> • Yes • No 	Nominal	NA
How old are you?	<ul style="list-style-type: none"> • 0-9 • 10-19 • 20-29 • 30-39 • 40-49 • 50-59 • 60-69 • 70-79 • 80+ 	Ordinal	NA
Please select the country of your primary nationality	<ul style="list-style-type: none"> • All countries possible. 	Nominal	NA
Gender: How do you identify?	<ul style="list-style-type: none"> • Male • Female Non-binary 	Nominal	NA

Do you live in Groningen or the surrounding area?	<ul style="list-style-type: none"> • Yes • No 	Nominal	NA
What is your employment status?	<ul style="list-style-type: none"> • Employed Full-Time • Employed Part-Time • Unemployed • Student • Student and Employed • Retired • Prefer not to say 	Nominal	NA
Which street layouts of the Astraat are you familiar with?	<ul style="list-style-type: none"> • Both the previous and current layouts • The current layout only • Neither 	Nominal	
How do you use the Astraat? (please select all the modes that you use)	<ul style="list-style-type: none"> • Walking • Cycling • Wheelchair/Mobility Vehicle • Moped/Bromfiets/Scooter • Car • Other 	Nominal	
As a pedestrian, are you ever concerned about sharing space with cyclists on Astraat?	<ul style="list-style-type: none"> • Yes • No • Not sure • I never walk on Astraat 	Nominal	Various factors (themes) might be relevant
As a pedestrian entering Astraat, is the change to a shared space street layout visually clear?	<ul style="list-style-type: none"> • Yes • No • Not sure • I never walk on Astraat 	Nominal	Visual Accessibility
As a pedestrian, how do you perceive your priority over cyclists on Astraat?	<ul style="list-style-type: none"> • More priority • Equal Priority • Less Priority • Not sure • I never walk on the Astraat 	Nominal	Symbolic accessibility
As a pedestrian, in the current street layout of Astraat, how has your priority	<ul style="list-style-type: none"> • Increased • Stayed the same 	Nominal	Spatial legibility (spatial layout,

over cyclists changed compared to the previous layout?	<ul style="list-style-type: none"> ● Decreased ● Not sure ● I never walk on Astraat 		adaptability,
As a pedestrian, do you feel like the Astraat is a place where you can comfortably stop and socialise?	<ul style="list-style-type: none"> ● Yes ● No ● Not sure ● I never walk on Astraat 	Nominal	Physical Accessibility
As a pedestrian, do you feel comfortable crossing the street without a designated pedestrian crossing?	<ul style="list-style-type: none"> ● Yes ● No ● Not sure ● I never walk on Astraat 	Nominal	Connectivity (movement, way-finding,
As a pedestrian, which street layout of the Astraat do you prefer?	<ul style="list-style-type: none"> ● The current layout ● The previous layout ● Not sure ● I never walk on Astraat 	Nominal	Various factors (themes) might be influential
Please indicate how you feel about the following shared space elements present on the Astraat (<i>Both the road and sidewalk are the same colour paving/brick</i>)	<ul style="list-style-type: none"> ● I like it ● I don't like it ● I don't have an opinion or feel indifferent 	Nominal	Spatial legibility (spatial layout, adaptability,
Please indicate how you feel about the following shared space elements present on the Astraat (<i>Trees and greenery are built within the fabric of the road</i>)	<ul style="list-style-type: none"> ● I like it ● I don't like it ● I don't have an opinion or feel indifferent 	Nominal	Spatial legibility (spatial layout, adaptability,
Please indicate how you feel about the following shared space elements present on the Astraat [<i>The sidewalk is the same height as road (no raised sidewalk)</i>]	<ul style="list-style-type: none"> ● I like it ● I don't like it ● I don't have an opinion or feel indifferent 	Nominal	Spatial legibility (spatial layout, adaptability,
Please indicate how you feel about the following shared space elements present on the Astraat (<i>A lack of signage/traditional rules</i>)	<ul style="list-style-type: none"> ● I like it ● I don't like it ● I don't have an opinion or feel indifferent 	Nominal	Spatial legibility (spatial layout, adaptability,
Please indicate how you feel about the following shared space elements present on the Astraat (<i>No allocated parking space for non-pedestrians</i>)	<ul style="list-style-type: none"> ● I like it ● I don't like it ● I don't have an opinion or feel indifferent 	Nominal	Spatial legibility (spatial layout, adaptability,
Please indicate how you feel about the following shared space elements present on the Astraat (<i>Seating elements are built into the fabric of the street</i>)	<ul style="list-style-type: none"> ● I like it ● I don't like it ● I don't have an opinion or feel indifferent 	Nominal	Spatial legibility (spatial layout, adaptability,

<p>Please indicate how you feel about the following shared space elements present on the Astraat (<i>No clear pedestrian crossing</i>)</p>	<ul style="list-style-type: none"> ● I like it ● I don't like it ● I don't have an opinion or feel indifferent 	<p>Nominal</p>	<p>Spatial legibility (spatial layout, adaptability,</p>
<p>Are you satisfied with the shared space design of Astraat? Do you have any suggestions for improvement?</p>	<p>Open Question</p>	<p>Open Question</p>	<p>All themes</p>

Appendix 4 - Survey consent form

Study of the shared space transformation of Astraat, Groningen.

Shared space transformation Groningen:

You have been invited to participate in a research study on pedestrian experiences in relation to shared space street transformation of the Astraat, Groningen. Before you decide to participate it is important that you understand why the research is being done and what it will involve. Please read the following information carefully.

Purpose of this study:

The purpose of this study is to understand how shared space street transformation affects pedestrian road users in a bicycle dominant city context. To investigate this, we are asking residents of Groningen to participate.

Study procedures:

This study consists of three sections. The first section below will ask for your considered consent. The second section will ask you some general demographic questions. The third and final section will ask you questions regarding your experiences and use of Astraat, Groningen.

The total expected time commitment for this study is approximately five minutes.

Participating in this study:

You must be a resident of Groningen or the surrounding province. Participation is voluntary and you can decide to stop participating in the study at any time. There will be neither benefits or risks to participating in this study.

How will your data will be used:

Any data that is collected is done so anonymously. Collected data will only be used for the purpose of a bachelor thesis.

Further questions?:

If you have any further questions about this study, please contact the lead researcher, Hamish Mardell, at h.w.mardell@student.rug.nl

*Required



university of
 groningen

faculty of spatial sciences

Informed Consent

I understand the information provided about the study. I understand that my participation is voluntary and that I can stop participating at any moment in time, without explanation or consequence. I understand that the data I provide is anonymous and will be used for the purpose of a Bachelor thesis.

Do you consent? *

- Yes, I consent
- No, I do not consent

Next

Never submit passwords through Google Forms.

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Google Forms

Appendix 5 - Survey results

Do you consent?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, I consent	50	100,0	100,0	100,0

How old are you?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10-19 Years Old	2	4,0	4,0	4,0
	20-29 Years Old	45	90,0	90,0	94,0
	30-39 Years Old	3	6,0	6,0	100,0
	Total	50	100,0	100,0	

Please select the country of your primary nationality					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bulgaria	3	6,0	6,0	6,0
	Croatia	1	2,0	2,0	8,0
	Gambia	1	2,0	2,0	10,0
	Germany	2	4,0	4,0	14,0
	Ireland	2	4,0	4,0	18,0
	Italy	1	2,0	2,0	20,0
	Kenya	1	2,0	2,0	22,0
	Latvia	2	4,0	4,0	26,0
	Luxembourg	1	2,0	2,0	28,0
	Netherlands	30	60,0	60,0	88,0
	United Kingdom	5	10,0	10,0	98,0
	United States (USA)	1	2,0	2,0	100,0
	Total	50	100,0	100,0	

Gender: How do you identify?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	21	42,0	42,0	42,0
	Male	29	58,0	58,0	100,0
	Total	50	100,0	100,0	

Do you live in Groningen or the surrounding area?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	50	100,0	100,0	100,0

What is your employment status?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Employed Full-Time	8	16,0	16,0	16,0
	Employed Part-Time	8	16,0	16,0	32,0
	Prefer not to say	1	2,0	2,0	34,0
	Student	12	24,0	24,0	58,0
	Student and Employed	20	40,0	40,0	98,0
	Unemployed	1	2,0	2,0	100,0
	Total	50	100,0	100,0	

Which street layouts of the Astraat are you familiar with?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Both the previous and current layouts	39	78,0	78,0	78,0
	The current layout only	11	22,0	22,0	100,0
	Total	50	100,0	100,0	

How do you use the Astraat? (please select all the modes that you use)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Cycling	3	6,0	6,0	6,0
	Moped/Bromfiets/Scooter	1	2,0	2,0	8,0
	Walking	1	2,0	2,0	10,0
	Walking, Cycling	42	84,0	84,0	94,0
	Walking, Cycling, Car	2	4,0	4,0	98,0
	Walking, Cycling, Pogo stick	1	2,0	2,0	100,0
	Total	50	100,0	100,0	

As a pedestrian, are you ever concerned about sharing space with cyclists on Astraat?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I never walk on the Astraat	1	2,0	2,0	2,0
	No	19	38,0	38,0	40,0
	Not sure	3	6,0	6,0	46,0
	Yes	27	54,0	54,0	100,0
	Total	50	100,0	100,0	

As a pedestrian entering Astraat, is the change to a shared space street layout visually clear?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I never walk on the Astraat	1	2,0	2,0	2,0
	No	20	40,0	40,0	42,0
	Not sure	5	10,0	10,0	52,0
	Yes	24	48,0	48,0	100,0
	Total	50	100,0	100,0	

As a pedestrian, how do you perceive your priority over cyclists on Astraat?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Equal priority	13	26,0	26,0	26,0
	I never walk on the Astraat	1	2,0	2,0	28,0
	Less priority	26	52,0	52,0	80,0
	More priority	5	10,0	10,0	90,0
	Not sure	5	10,0	10,0	100,0
	Total	50	100,0	100,0	

As a pedestrian, in the current street layout of Astraat, how has your priority over cyclists changed compared to the previous layout?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Decreased	17	34,0	34,0	34,0
	I never walk on the Astraat	1	2,0	2,0	36,0
	Increased	17	34,0	34,0	70,0
	Not sure	8	16,0	16,0	86,0
	Stayed the same	7	14,0	14,0	100,0

	Total	50	100,0	100,0	
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As a pedestrian, do you feel like the Astraat is a place where you can comfortably stop and socialise?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I never walk on the Astraat	1	2,0	2,0	2,0
	No	26	52,0	52,0	54,0
	Not sure	7	14,0	14,0	68,0
	Yes	16	32,0	32,0	100,0
	Total	50	100,0	100,0	

As a pedestrian, do you feel comfortable crossing the street without a designated pedestrian crossing?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I never walk on the Astraat	1	2,0	2,0	2,0
	No	18	36,0	36,0	38,0
	Not sure	3	6,0	6,0	44,0
	Yes	28	56,0	56,0	100,0
	Total	50	100,0	100,0	

As a pedestrian, which street layout of the Astraat do you prefer?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I never walk on the Astraat	1	2,0	2,0	2,0
	Not sure	10	20,0	20,0	22,0
	The current layout	27	54,0	54,0	76,0
	The previous layout	12	24,0	24,0	100,0
	Total	50	100,0	100,0	

Please indicate how you feel about the following shared space elements present on the Astraat [Both the road and sidewalk are the same colour paving/brick]					
		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	I don't have an opinion or feel indifferent	5	10,0	10,0	10,0
	I don't like it	21	42,0	42,0	52,0
	I like it	24	48,0	48,0	100,0
	Total	50	100,0	100,0	

Please indicate how you feel about the following shared space elements present on the Astraat [Trees and greenery are built within the fabric of the road]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't have an opinion or feel indifferent	4	8,0	8,0	8,0
	I don't like it	6	12,0	12,0	20,0
	I like it	40	80,0	80,0	100,0
	Total	50	100,0	100,0	

Please indicate how you feel about the following shared space elements present on the Astraat [The sidewalk is the same height as road (no raised sidewalk)]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't have an opinion or feel indifferent	4	8,0	8,0	8,0
	I don't like it	19	38,0	38,0	46,0
	I like it	27	54,0	54,0	100,0
	Total	50	100,0	100,0	

Please indicate how you feel about the following shared space elements present on the Astraat [A lack of signage/traditional rules]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't have an opinion or feel indifferent	16	32,0	32,0	32,0
	I don't like it	23	46,0	46,0	78,0
	I like it	11	22,0	22,0	100,0
	Total	50	100,0	100,0	

Please indicate how you feel about the following shared space elements present on the Astraat [No allocated parking space for non-pedestrians]					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't have an opinion or feel indifferent	11	22,0	22,0	22,0
	I don't like it	19	38,0	38,0	60,0
	I like it	20	40,0	40,0	100,0
	Total	50	100,0	100,0	

Please indicate how you feel about the following shared space elements present on the Astraat [Seating elements are built into the fabric of the street]					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't have an opinion or feel indifferent	9	18,0	18,0	18,0
	I don't like it	4	8,0	8,0	26,0
	I like it	37	74,0	74,0	100,0
	Total	50	100,0	100,0	

Please indicate how you feel about the following shared space elements present on the Astraat [No clear pedestrian crossing]					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't have an opinion or feel indifferent	11	22,0	22,0	22,0
	I don't like it	23	46,0	46,0	68,0
	I like it	16	32,0	32,0	100,0
	Total	50	100,0	100,0	

Are you satisfied with the shared space design of Astraat? Do you have any suggestions for improvement?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-	1	2,0	2,0	2,0
	.	1	2,0	2,0	4,0
	don't know if it is there already but a sign stating it is shared space would be	1	2,0	2,0	6,0

nice. I know it defeats the purpose of confusion thus eye contact of shared space, but the first time I almost got hit by a cyclist because I didn't understand what was going on					
Especially the intersection is chaotic and dangerous. Traffic coming from all directions with Almost nothing to guide them. Bring back zebra crossings and raised sidewalk. Pederstrieans seem to think cyclists should not be there.	1	2,0	2,0	8,0	
Fine because pedestrians still walk on the side	1	2,0	2,0	10,0	
I am pretty satisfied, although the junction just after astraat, heading towards westerhaven is abysmal and needs to be redesigned	1	2,0	2,0	12,0	
I am satisfied with the shared space design of the Astraat.	1	2,0	2,0	14,0	
I am satisfied with the shared space. Though I feel like lots of people are not really aware of the shared space, and thus get irritated towards pedestrians/cyclists	1	2,0	2,0	16,0	
I do like the look of the street. But as a result of all the changes made it seems to me that pedestrians feel like they own the whole road which can be VERY anoying when i am trying to cycle there. The whole traffic situation can be very hectic and confusing because it is a very busy place in the city and all the clear traffic rule	1	2,0	2,0	18,0	

	indicators have been removed				
	I feel as if cyclists move far too quickly through this street for the situation where pedestrians can just move around freely. I'm surprised for accidents don't happen.	1	2,0	2,0	20,0
	I like the design, but I feel it's not being used to full potential because most people aren't familiar with the concept. That makes it so you again walk on the side of the streets as a pedestrian. That makes me less satisfied then I would be otherwise	1	2,0	2,0	22,0
	I really like that the municipality is taking the initiative to changing more of the city's streets into being walkable and really make cars seem out of place. I get the sense that when I'm walking or cycling on Astraat, the cars are truly the guest on the road. This makes the street seem a lot more friendly for pedestrians and cyclist and additionally might help by pushing some car drivers to avoid these areas. It also provides a great walking connection between Westerhaven and the Vismarkt, which seems almost essential considering all the shops located in Westerhaven.	1	2,0	2,0	24,0
	I really like the new layout of the a straat although it is a bit chaotic especially for tourists and it is really annoying when people stop walking in the middle of the	1	2,0	2,0	26,0

<p>street if you're trying to pass them on your bike. Moreover I feel like tourists don't realise it is also allowed to cycle on the street so they don't pay sufficient attention to their surroundings, so maybe a sign with a little explanation on the shared space principle could be added to the layout of the street.</p>				
<p>I think it is an interesting transformation, and especially the seating and greenery elements are beneficial to just enjoy the city (or to have your lunch outdoors after doing some shopping in Westerhaven). However, often it seems very busy, and when all users are sharing that space, it becomes chaotic. I have also seen especially the elderly struggling to cross by the Aastraat entrance. Whilst having sidewalk the same height as road seems to solve the issue with inaccessibility, at the same time I would like to suggest an improvement to be made in terms of traffic speed. Cyclists often are very fast and don't seem to give a way to pedestrians.</p>	1	2,0	2,0	28,0
<p>I think it is rather dangerous for pedestrians and cyclists. It would be helpful to make a clear distinction between cyclists and pedestrians, could be with different colour of bricks. The old situation wasn't ideal either, because of the frequency of buses.</p>	1	2,0	2,0	30,0

	<p>I think it looks much better, and I like the concept. However, I feel like both cyclists and pedestrians in Groningen do not pay enough attention as is - this shared space layout exacerbates that in my opinion. As there is no crosswalk, pedestrians sometimes randomly cross the road in front of cyclists, and cyclists are ducking and weaving through the mess that sometimes ensues. While I like the look and feel of it, I think it comes with it's own set of problems. It might help if pedestrians were somehow encouraged to stick more to the sides somehow in a subtle manner (no signs - that defeats the purpose in my view).</p>	1	2,0	2,0	32,0
	<p>I think it's find but it's clearly not a pedestrian place.</p>	1	2,0	2,0	34,0
	<p>I'm not sure if it's due to the design, signs or something else, but in my experience, many cyclists just 'take' their priority over pedestrians, which does not increase the safety of the pedestrians in that area.</p>	1	2,0	2,0	36,0
	<p>It makes no sense to have pedestrians and cyclists share a space like that (same with folkingerstraat) it creates a lot of confusion and dangerous situations.</p>	1	2,0	2,0	38,0
	<p>It works well for wheelchair users in terms of it being all the same level. However, for blind people there is no clear delineage between road and pavement.</p>	1	2,0	2,0	40,0

	Jo	1	2,0	2,0	42,0
	Kinda, if everybody knew it was a shared street it would be better. Not everybody knows it	1	2,0	2,0	44,0
	Let a street be a street, nobody really cares anyways.	1	2,0	2,0	46,0
	Make a clearer cycle path on it and a pedestrian part on the floor through white markings	1	2,0	2,0	48,0
	Make clearer the zones for cycling and walking so that pedestrians are safer. They should also draw a line to separate lanes for cyclists coming from both directions rather than one big blurred space	1	2,0	2,0	50,0
	More clarity where pedestrians need to walk, as they're walking often on the road. They don't care about giving priority and it's quite unclear. Often, pedestrians are walking on the road and causing dangerous situations	1	2,0	2,0	52,0
	More clear difference	2	4,0	4,0	56,0
	mostly i guess. it's not a very wide street so therefore you cannot expect bigger gatherings.	1	2,0	2,0	58,0
	N/A	1	2,0	2,0	60,0
	Nee, ik vind het vervelend dat je niet duidelijk kunt zien wie waar hoort en dat iedereen eigenlijk overal op de weg kan rijden, als voetganger is dat vervelend want je moet constant kijken of er fietsers aankomen bij het oversteken en het lopen op zich ook al, en als fietser is het vervelend dat	1	2,0	2,0	62,0

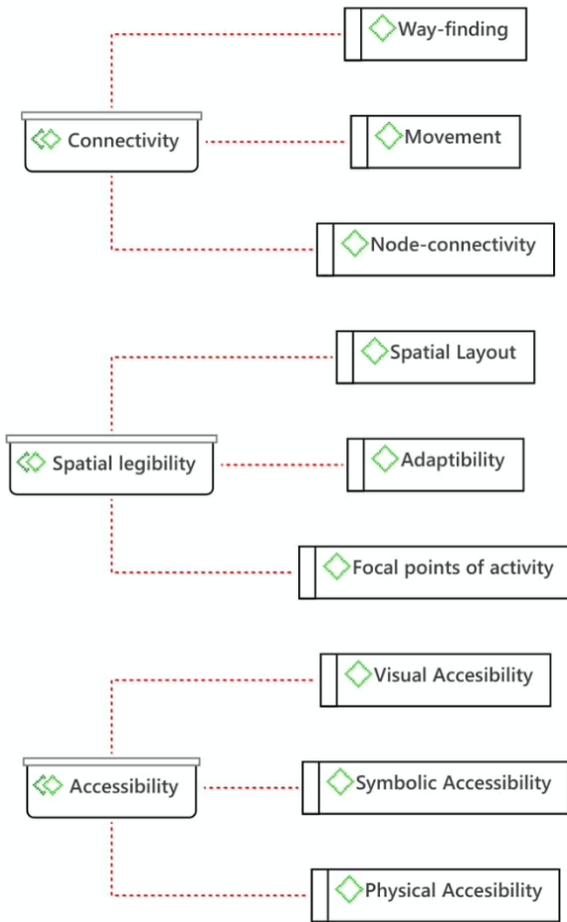
	voetgangers je in de weg lopen.				
	No I think it can be improved to be safer for everyone, I think cars especially should big be allowed	1	2,0	2,0	64,0
	Pedestrians are always in the way.	1	2,0	2,0	66,0
	Somehow make sure the street wont be another Folkingestraat, where getting through with a bike is horrid and pedestrians take up all space without considering cyclists	1	2,0	2,0	68,0
	Start all over again honestly	1	2,0	2,0	70,0
	The mentioned above	1	2,0	2,0	72,0
	The priority could be set more on pedestrians. Just like cars are "guests" on that street, cyclists should be as well. Most cyclists and scooters speed down that road leaving pedestrians scared/frustrated and/or feeling unsafe when walking on it, especially since there is no separation between sidewalk and street. Speedbumps at the beginning, the middle and the end could be an option to reduce the speed and thus increase safety for pedestrians and cyclists (e.g. less accidents/collisions).	1	2,0	2,0	74,0
	The street layout is visually improved but functionally worse, apart from the removal of the bus route that previously used to use the road makes it more comfortable for pedestrians and cyclists.	1	2,0	2,0	76,0

when crossing the astraat as a cyclist, my opinion is completely the opposite. As a cyclist, i treat it as a street, however pedestrians treat it as a narrow square	1	2,0	2,0	78,0
Would be handy if pedestrians were not as prone to walk on the street. It's very annoying if you are in a rush and on a bike.	1	2,0	2,0	80,0
X	1	2,0	2,0	82,0
Yeah it's not the worst	1	2,0	2,0	84,0
Yes	1	2,0	2,0	86,0
Yes im satisfied	1	2,0	2,0	88,0
Yes, but for pedestrians who don't live here it is not always clear that it is also a road for cyclists	1	2,0	2,0	90,0
Yes, but I never knew the previous design. Maybe a way to channel the traffic of cyclist closer to the bridge	1	2,0	2,0	92,0
Yes, I think it's fine the way it is. Just teach people to use these roads well!	1	2,0	2,0	94,0
Yes. However, the bricks are slippery when it rains.	1	2,0	2,0	96,0
Yes. No.	1	2,0	2,0	98,0
Yes. When I was 17, it was still the old situation and it wasn't great. Got threatened by a man with a huge knife there, stole my brand new samsung galaxy s7. Fun times, worked for half a year to get that thing. But in the current situation, even at night, I wouldn't expect such a situation to occur anymore.	1	2,0	2,0	100,0
Total	50	100,0	100,0	

Appendix 6 - (Atlas Coding)

Show codes in **any** of the groups **Accessibility**, **Connectivity** or **Spatial legibility**

	Name	▲	Grounded	Density	Groups
<input type="radio"/>	◇ Adaptability		■	12	0 [Spatial legibility]
<input type="radio"/>	◇ Focal points of activ...		■	5	0 [Spatial legibility]
<input type="radio"/>	◇ Movement		■	7	0 [Connectivity]
<input type="radio"/>	◇ Node-connectivity		■	4	0 [Connectivity]
<input type="radio"/>	◇ Physical Accesibility		■	9	0 [Accessibility]
<input type="radio"/>	◇ Spatial Layout		■	11	0 [Spatial legibility]
<input type="radio"/>	◇ Symbolic Accessibility		■	9	0 [Accessibility]
<input type="radio"/>	◇ Visual Accesibility		■	6	0 [Accessibility]
<input type="radio"/>	◇ Way-finding		■	6	0 [Connectivity]



10:27 ¶ 48, However, often it seems very busy, and when all users are sharing that... in Case 4

Way-finding

57:2 p 3, When it's busy, the cyclist will wonder: "hey, where's my space?" And... in DOING IT TOGETHER SIMPLY RESULTS IN A BETTER PLAN - The City at Eye Level

39:25 ¶ 48, The whole traffic situation can be very hectic and confusing because i... in Case 33

56:25 ¶ 48, I feel like both cyclists and pedestrians in Groningen do not pay enou... in Case 50

18:25 ¶ 48, It makes no sense to have pedestrians and cyclists share a space like... in Case 12

61:5 p 3, s. The city centre is bursting at the seams in terms of cyclists and... in Fietsers, auto's en voetgangers in één gebied_ werkt dat wel_ - RTV Noord

Appendix 7. - Co-Occurrence for themes: Spatial layout and Adaptability with Physical accessibility.

ID	Quotation Name	Quotation Content	Codes	Reference
8:25	Positive notion, relationship between physical accessibility and adaptability.	<i>“It works well for wheelchair users in terms of it being all the same level.”</i>	<i>Spatial Layout and Adaptability</i> <i>Physical Accessibility</i>	48 - 48
60:3	Physical measures through adaptability by creating changes in the spatial layout may influence physical accessibility.	<i>“Earlier I wrote about the bicycle parking problem in the Brugstraat, which is a good example of this. Entrepreneurs put terraces outside to prevent bicycle parking. It causes the pressure on the space to only increase, while moving the problem to another place in the street.”</i>	<i>Spatial Layout and Adaptability</i> <i>Physical Accessibility</i> <i>Focal points of Activity</i>	2 - 2
61:5	Pedestrian-cyclist coexistence. Limits to physical accessibility, influenced by spatial layout and movement.	<i>“The city centre is bursting with cyclists and pedestrians. At some point you will come to your limits whether you can start mixing foot and bicycle traffic.”</i>	<i>Spatial Layout and Adaptability</i> <i>Physical Accessibility</i> <i>Movement</i>	3 - 3