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The influence of waste collection infrastructures on the quality of life in public places. A case study: Examining littering patterns in Groningen

Abstract:

Together with the increasing number of people living on the planet, the amount of waste is growing fast. This rapid growth results into the need for a well-structured waste collection infrastructure. This study explores the possible influence of the waste collection infrastructure on the quality of life of public places in Groningen. To address this research objective, a mixed method study was conducted. The data is based on primary and secondary data, including a questionnaire, analysing maps in ArcGIS and a literature review. The key findings of this research reveal: 'Lack in waste collection infrastructure does negatively impact the quality of life' and 'Low maintenance of a good waste disposal infrastructure does impact quality of life positively and negatively'. These findings contribute to the research and municipality by creating insight into the public places well-being. This is relevant to the spatial and urban planners of the municipality.

Keywords: Waste collection, Infrastructure, Street litter, Quality of life, Spatial inequality

Colophon

Title: The influence of waste collection infrastructures on the quality of life in public places. A case study: Examining littering patterns in Groningen

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Table of contents

Colophon	2
Introduction.....	4
Research Problem	4
Research Structure	5
Theoretical Framework	5
Littering patterns.....	5
Waste collection infrastructure.....	7
Quality of life	7
Spatial Inequality	7
Conceptual Model	8
Introduction to the cases	9
Expectations/Hypothesis.....	10
Methodology	10
Research strategy	10
Data collection.....	11
Sub question 1	12
Sub question 2	12
Sub question 3	12
Data analysis.....	13
Ethical Considerations.....	14
Results	14
Waste collection infrastructure.....	14
Littering patterns.....	15
Quality of life	18
Spatial inequality	19
Discussion	19
Conclusion	20
References.....	22
Appendix.....	24

Introduction

Every six months, the municipality of Groningen organises a Clean Up Day. The municipality provides the average of 30 shown up volunteers with equipment to clean public space. Volunteers are indispensable in the battle against street litter, especially in the case of achieving the goal to be litter free in 2030 (Groningen. Haal alles uit je afval, 2023). As told by Kars Ottens, who is an environmental steward for the municipality, Groningen is working towards a litter free environment by the assistance of disciplined volunteers and campaigns. There is, nowadays, a clear gap between inhabitants with a drive to clear the environment and inhabitants who litter creating spatial inequality. Besides inhabitants playing a crucial role in waste separation and reducing littering patterns, optimization and expansion of facilities from the municipality is as important (Groningen. Minder afval meer grondstoffen, op weg naar een circulair Groningen. 2020).

The availability of waste collecting attributes influences the littering phenomena in open public space (Sprague et al., 2022). Previous studies have shown that the amount of street litter is in relation with available collecting points in a public place. Unequal waste collection infrastructure across different geographical areas creates disparity in the ability to properly dispose waste within different places (Guo et al., 2016). The requirement of thoughtful urban planning for community development needs to be researched to ensure that every public place has equitable access to essential services like waste collecting attributes. By creating spatial equality within resources, it is important to equitably divide waste disposal attributes to work towards a litter free environment for everyone (Guo et al., 2016).

Besides the influence that uncollected litter has on the environment of public space, there are consequences for the living communities as well. There is a research gap between littering patterns and the improvement or reduction of quality of life. Within the key aspects of quality of life, there is inclusion of environmental factors referring to a clean environment and well-maintained infrastructure (Martinez, Mikkelsen and Phillips, 2021). The difference in communities overall wellbeing as a result of street litter, is a complex spatial planning inquisition.

Research Problem

This research is focused on bringing more insight into the spatial inequality between communities in public places regarding the amount of street litter due to differences in littering patterns created by unequal distribution of waste collecting attributes. Urbanisation and population growth increase pressure on urban infrastructure in cities and oppress the provision of basic urban services such as waste collection attributions, resulting in uncollected and uncontrolled street litter posing risks (UN Habitat, 2022). The possible posed risks are connected to human health and overall quality of the environment. Quality of life, being a measurable variable that reflects overall well-being, encompasses perceived risks and disadvantages as a reaction to elements in the living environment of everyday life. Human health and quality of the environment are components of quality of life (Van Shoelandt, Gaus, 2018). It is to be understood that spatial distribution across open public spaces varies, questioning whether the differences reflect processes that lead to disadvantages of particular communities in quality of life (Lobao, Hooks and Tickamyer, 2007).

Within this study, the aim is to provide the influence of street litter as a result of littering patterns in combination with the absence of waste collecting attributes on the quality of life of public spaces within the municipality of Groningen. In this study, the relationship between spatial inequality and quality of life is of importance, defined by the investigation of equitable distribution of waste collection infrastructure and will be explained with insights in both dynamics.

The main question of this research is: *'How does the waste collection infrastructure influence the littering pattern and quality of life of communities within public places in the city of Groningen?'*

To answer this main question, the support of sub questions are of importance. The sub questions are formulated as followed:

- What is the effect of available waste collection attributes in a neighbourhood?
- What can spatial planning do to reduce littering patterns?
- How can the difference between high quality of life and low quality of life be defined?

Research Structure

The research begins with the introduction of the theoretical perspective of waste collection infrastructures, littering patterns, quality of life and spatial inequality. Following this, the conceptual model and the hypothesis is presented. Thereafter the cases of this research are introduced, followed by the methodology. This section encompasses the data analysis and the coding process. After this, the results are presented. The final section starts with a discussing the research, where after the research question will be answered in the conclusion.

Theoretical Framework

Investigating the research problem, it is important to elaborate on the main concepts of this study to reach a comprehensive understanding. To answer the main question and its sub questions, it is necessary to clarify what is understood by 'littering patterns', 'waste collection infrastructure', 'quality of life' and 'spatial inequality', together with their relationship. Thereafter, it will be introduced which cases are chosen to represent this study, providing clarification of the concepts and its factors. The conceptual model will show the relationship between the different introduced and explained variables.

Littering patterns

Spatial processes are inherently social. Spatial expressions and processes play a significant role in social arrangements in the form of behavioural patterns (Casal, 2018). Individual behaviours are due to the experience of environmental stimulation together with social interactions. Previous behavioural studies have proven that the qualitative way behind behavioural pattern appearance is focused on the present or absence of opportunities (Pertoldi, Pagh and Bach, 2020). The start of creating a littering pattern is to be seen in the qualitative way of behavioural patterns. A littering pattern is defined as a behavioural pattern in which an individual improperly disposes waste in public spaces repeatedly (Schultz et al., 2013). Understanding these patterns, it is essential to recognize the

factors creating this type of behaviour. The most influential components are considered: 'Knowledge and Awareness', 'The accessibility of waste collection attributes' and 'Urban Planning' (Sprague et al., 2022). Addressing these factors requires a comprehensive approach that combines the expression and development of the individual components towards the creation of a pattern.

Litter is referred to as any piece of solid waste that is misplaced in an unacceptable location within public space (Geller, 1980). It takes various forms encompassing all discarded items that are disposed improperly in public spaces. Narrowing this down, in this research the focus is on street litter. The differences can be found within the emphasized impact on the environment and the perceived situation in public places (Sprague et al., 2022). Street litter is created by an expression of repeated behaviour, resulting in littering patterns possible manageable by a working waste collection infrastructure.

Littering patterns diversify around cultures and countries. The situation within this case study refers to Dutch culture, examined within the city Groningen located in the Netherlands. Figure 1 and 2 give an example of a situation which reflects the definition of street litter whereas this study is based upon.



Figure 1. Street litter in Noorderplantsoen, Groningen (Source: Dierenbescherming)



Figure 2. Litter centred within the grass of a public place, Groningen (Source: FOTO HISSINK)

Waste collection infrastructure

Collecting litter, which hereafter is referred to as 'waste', is one of the most critical parts of an integrated waste management system. It ensures controlled improvement of quality of life and reduction of environmental risks (Pires et al., 2019). The collection of waste is a highly visible municipal service, involving operational control. The essential components ensuring waste collection are waste collection attributes, forming a contact point between users of public places and the waste management system (Petersen and Berg, 2004). Proper implementation of waste collection attributes is established by adequate street litter information and feedback of everyday users of public places, forming a well-maintained waste collection infrastructure (Sprague et al., 2022). For this research, the focus is on public waste collection attributes involving public litter bins together with street litter collection teams.

Public litter bins are operating as waste collection points with a fixed location in a public place, ensuring the possibility for each user to deposit their remains in a correct manner, minimizing the opportunity of creating littering patterns. The success of these waste collection attributes depends on the participation rate of public place users, determined by their littering behaviour in combination with accessibility (Barr, 2007). Social and political support stimulates the psychosocial aspect of correct behaviour, adding value to a clean environment resulting in communities willing to clean up public places (Pires et al., 2019). Street litter collection teams are flexible features adding value to the waste management infrastructure by regularly cleaning up public places voluntarily.

Quality of life

Quality of life is a multidimensional concept that refers to an individual's well-being (Martinez, Mikkelsen and Phillips, 2021). The factors influencing this multidimensional concept vary significantly among cultures, communities and researchers. As Veenhoven (2008) stated: 'Quality of life can be understood as the quality of the environment in which we live, together with a subjective enjoyment of life.' The most common factors of quality of life in qualitative research are based upon multi-levelled well-being (Martinez, Mikkelsen and Phillips, 2021). In this research, the focus is on psychological well-being, social well-being, environmental well-being and leisure and recreation, relating to littering patterns and waste collection infrastructure as quality of life being a reflection of the perceived living environment. Within politics, these factors are standardized measures of quality of life to discuss spatial inequality (Veenhoven, 2008).

Spatial Inequality

Spatial inequality is a term that indicates inequity in social space, among the community that is using the place as public. It is a call to justice demanding for reducing inequality and providing equal opportunities (Casal, 2018). Spatial inequality concerns the unequal distribution of fragments and deficiencies within infrastructure (Aurer et al., 2018). Spatial equality includes equitable and fair distribution in space of valuable resources and opportunities for everyday public to use it (Soja, 2010). Both concepts are evolved as a reflection of spatial conditions within the institutional context

and are related to the waste management infrastructure and the possible subsequent evolution of littering patterns. This research is investigating the equality of spatial conditions within public space in combination with the quality of life of the community. Justifying the surroundings of all communities, it is important to provide everyone with the same spatial conditions, resources and opportunities.

Conceptual Model

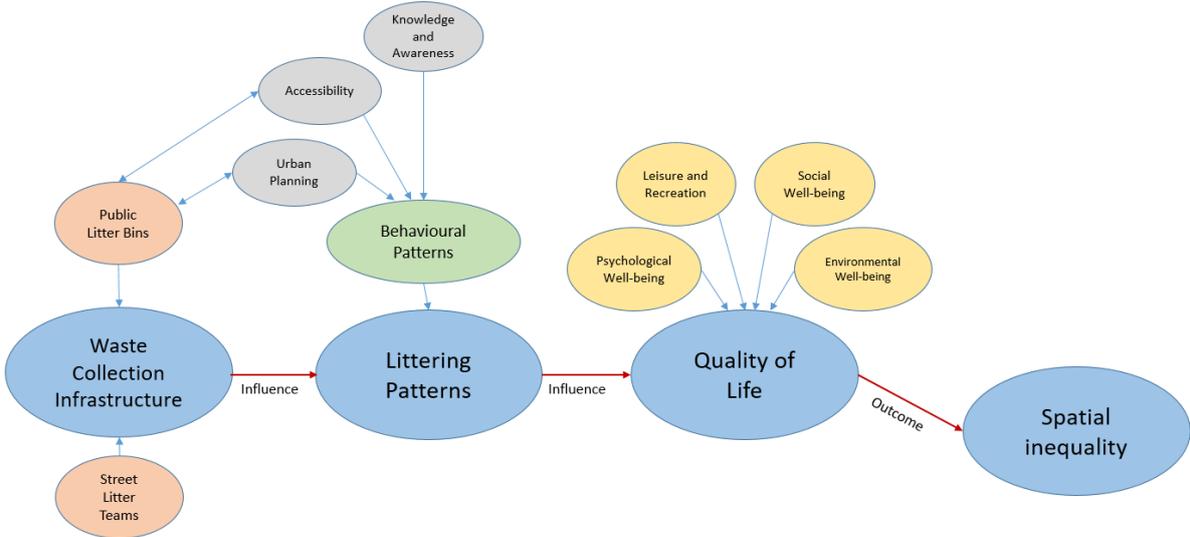


Figure 3. Conceptual model (Source: Author)

This study is investigating the influence of ‘littering patterns’ on ‘quality of life’, caused by differences in ‘waste collection infrastructure’ based upon the distribution of ‘public litter bins’ and ‘street litter teams’. In this model, ‘littering patterns’ are established on ‘behavioural patterns’. The variables affecting ‘behavioural patterns’ are ‘knowledge and awareness’, ‘accessibility’ and ‘urban planning’, of which ‘accessibility’ and ‘urban planning’ are interfering with the distribution of ‘public litter bins’ of the ‘waste collection infrastructure’. The variables of ‘quality of life’ in this model are ‘psychological well-being’, ‘social well-being’, ‘environmental well-being’ and ‘leisure and recreation’. ‘Quality of life’ in this model is the decisive factor for the outcome, resulting in spatial equality or spatial inequality.

Introduction to the cases

The selected cases are the public places and communities of the neighbourhoods 'Reitdiep' and 'De Hoogte', both located within the city of Groningen.

De Hoogte was built within the early 20s as part of the concept 'Garden Town', which is a section of Ebenezer Howards revolutionary 'Garden City movement' (Kijk in de Vegte et al., 2006). It was built to create a place for single families to form a society outside, but close to, the industrial city (Kijk in de Vegte et al., 2006) Today, the neighbourhood covers an area of 57 km² of which is 40% public space and 23% housing. The housing property of the neighbourhood is with 92% dominantly owned by housing corporations and rented as social housing (CBS, 2023) The overall socioeconomic score of De Hoogte has a statistic of -0.595, which is beneath the overall socioeconomic score of the city of Groningen (CBS, 2023).

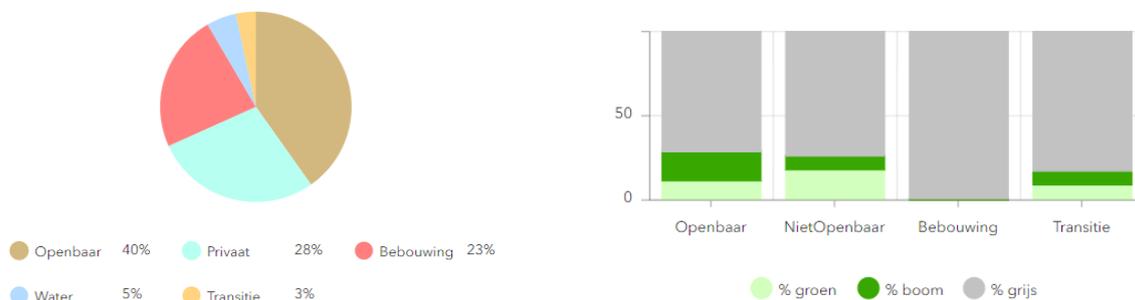


Figure 4. Statistics of De Hoogte (ArcGIS, 2023)

The neighbourhood Reitdiep is still in development. The construction started around the 00s, with the two themes of 'Living close to and on water' and 'Living in the scenery'. A family-friendly creation of property was the intention beyond the built environment (Provincie Groningen, 1996). Today, the neighbourhood covers an area of 97 km² of which 38% is public space and 12% housing. The housing property is 55% owner-occupied and 45% private rental (CBS, 2023). The overall socioeconomic score of Reitdiep is 0.577, which is above the overall socioeconomic score of Groningen (CBS, 2023).

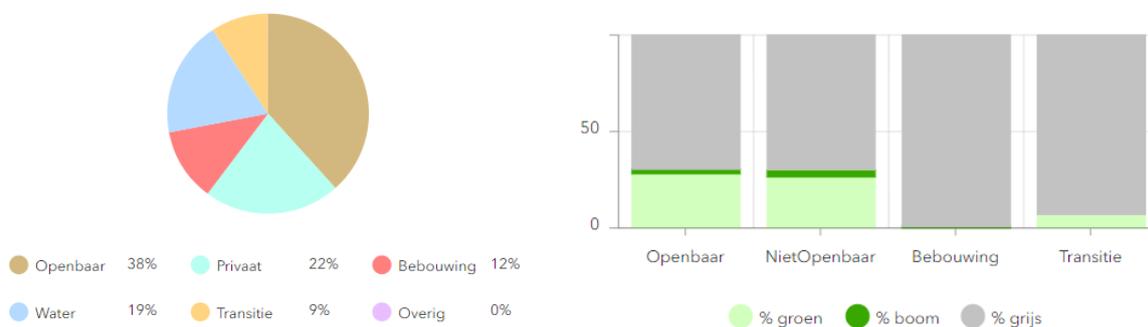


Figure 5. Statistics of Reitdiep (ArcGIS, 2023)

Relevant to this study, the neighbourhoods are comparable in the percentage of public space. The communities living in the areas are, contrary to the public space, unlike each other. The housing property is differently distributed, together with a differentiating socioeconomic score creating a different community in both places. This situation creates an opportunity for comparison between 'De Hoogte' and 'Reitdiep' in terms of studying the differences in inequality in public space between the both places.

Expectations/Hypothesis

The distribution of waste disposal is expected to be the factor influencing littering patterns. The perceived littering patterns are expected to be impacting the quality of life. The combination of the influencing variables are visualised in the conceptual model. It is expected that this process influences the outcome in making a distinction between spatial equality and spatial inequality. The hypothesis relating to this research is: 'Within the communities of the public places in the city of Groningen, there is a relationship between waste collection infrastructure and littering patterns influencing the quality of life.'

Methodology

Research strategy

The research consists of primary and secondary data collection to answer the research question: *'How does the availability of waste collection attributes influence the littering pattern and quality of life of communities within public places in the city of Groningen?'* Primary data was collected by a structured questionnaire among the communities living around the public places of the neighbourhoods which were chosen to be part of the case study and by an interview with the senior environmental steward of the city of Groningen. The secondary data is provided by literature review, governmental documents review and maps analysis. This qualitative approach has a normative and theoretical perspective, together with a subjective contextual perspective. The aim is to provide an understanding of the situation by analysing current topographic maps of the infrastructure and governmental documents, supported by the focus on the key aspects of the outcomes of the questionnaires and the interview. The research design provides background knowledge on waste collection infrastructure, littering patterns, quality of life and spatial (in)equality by literature review.

The multi-method approach is chosen since it fits the research aim together with it strengthening the findings. Multiple methods and different sources of information maximize the understanding of the research question and the sub questions (Clifford, 2010).

Data collection

To clarify the case study, it is important to visualise the infrastructural network in relation to waste disposal in the public places of the chosen neighbourhoods. An ArcGIS map is needed to provide an overview of the locations of waste collection attributes and to understand the pattern of the network structure. The ArcGIS map is created with secondary data including three GIS layers to provide a comprehensive perspective. The underlying layer is the ESRI World Topographic Map, serving as a basemap layer provided by ArcGIS. On top of the ESRI World Topographic Map, is located a downloaded layer from the ESRI database providing the boundaries of the areas of the case study. The third layer is created by adding features to the locations of the current waste collection attribute locations. This information is based upon observation combined with governmental information and observation, captured in September 2023.

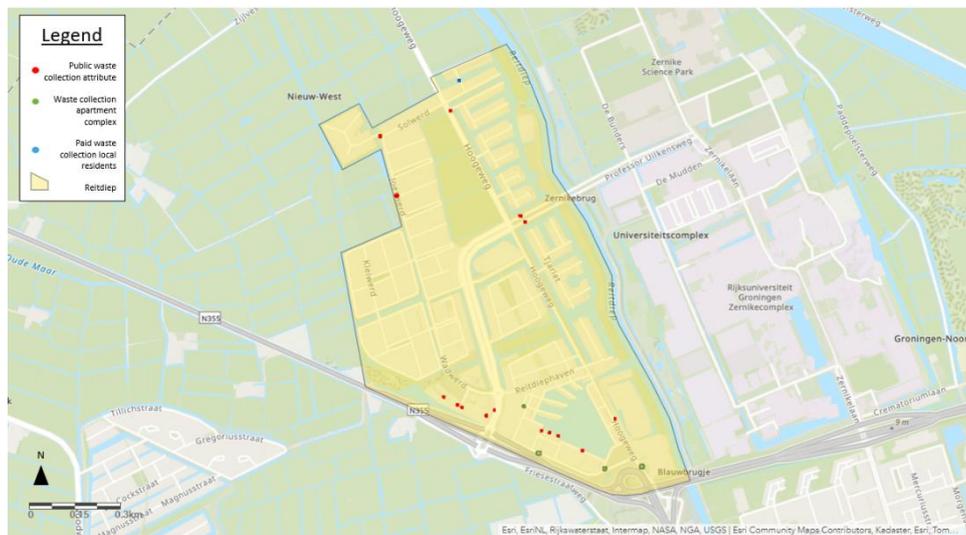


Figure 6. The waste collection attributes located in the neighbourhood Reitdiep (Source: Author)

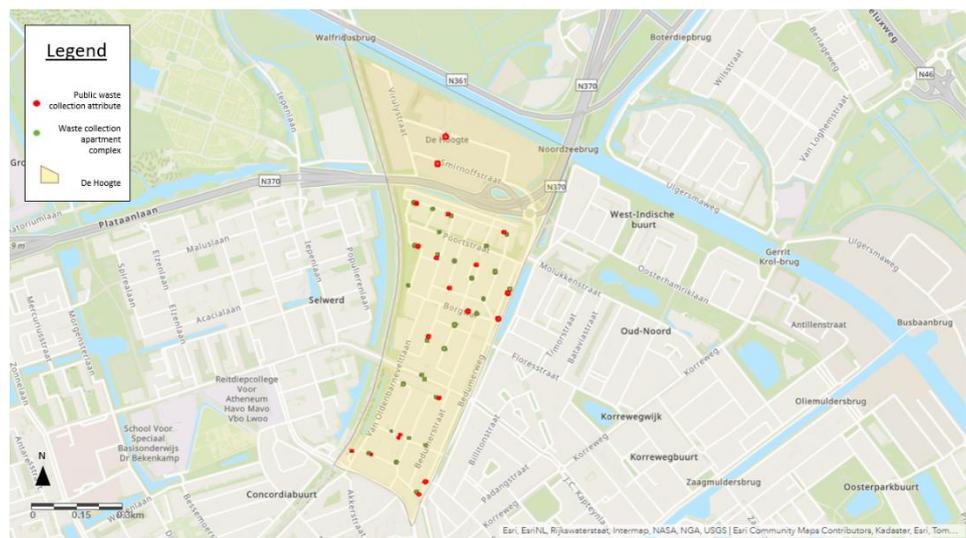


Figure 7. The waste collections attributed located in the neighbourhood De Hoogte (Source: Author)

Sub question 1

To answer the first sub question: *'What is the effect of available waste collection attributes in a neighbourhood?'* it is important to have a visualization of the street litter combined with the waste collection infrastructure. The amount of street litter is primary data, which is collected by observation. To create reliable data, the observation has been done twice in the public places of both neighbourhoods of the case study. This data is gathered and translated to a layer in ArcGIS to create an overview of where street litter is clustered.

Besides the analysis of the waste collection infrastructure and the amount of street litter, there is primary data collected by a questionnaire with participants living around the public places within the boundaries of the neighbourhoods of the case. The questionnaire is made in the program Qualtrics and was researchable for participants by a QR-code. The questionnaire which is participated by the inhabitants is meant to give insight into ideas of inhabitants and is structured by qualitative questions. The questions of the questionnaire are in relation to the effect of street litter on the well-being of the participants and are regarding the experiences of circumstances of the neighbourhood. The primary data collected from the questionnaire is useful to gain knowledge about the effect of available waste collection attributes and the effect of the amount of street litter. The questionnaire can be found in the appendix.

At last, the senior environmental steward of the municipality of Groningen provided primary data by clarifying current policy measures and defining the effort of street litter teams. The operation range of street litter teams is not visualized due to the area being closely related to the neighbourhood boundaries.

Sub question 2

The information and visualisation of the waste collection attributes in combination with the location of the street litter and the community feedback, gives insight into which public places are in need of spatial improvement. To answer the second research question: *'What can spatial planning do to reduce littering patterns?'* primary and secondary data will give an understanding. Secondary data is gathered by the information provided in ArcGIS and by information found in literature reviewing. The literature review in this study consists of policy documents and scientific articles. It is necessary to gain knowledge about the intended spatial plans towards reducing littering patterns which are written in governmental documents. Primary data relating to this sub question is provided by interviewing the senior environmental steward of the city of Groningen and by the questionnaire to which inhabitants living in the neighbourhoods of the case studies participated. The combination of primary and secondary data collection creates a mixed method to answer the second sub question.

Sub question 3

To form a definition towards the last sub question: *'How can the difference between high quality of life and low quality of life be defined?'* secondary data is used. The secondary data that is used

consists of literature reviewing to get insight into the definition of the concept 'Quality of life'. After defining the concept, sociological literature is reviewed to create a clear insight into the distinction between high and low quality of life based on different factors such as well-being and community engagement. After the reviewing, it is to be clear on what basis the distinction between high and low quality of life is made. The literature review is supported by primary data received from the questionnaire.

Data analysis

The literature review, the questionnaire and the interview were coded based on the coding tree prior to the analysis. The tree was developed based on the conceptual model and assisted the data analysis using 'Atlas.Ti'. The considered parts of the literature review and the transcripts of the questionnaires and interview, were analysed and uploaded into the coding program.

Atlas.Ti served as a tool to process and interpret the gathered data. It functioned as a database containing the literature review and the questionnaire transcript. Besides, the coding program was utilized to manage the coding, facilitating the identification of the relationships and patterns with individual codes and coding groups. The final results were led by analysing and interpreting the observations.

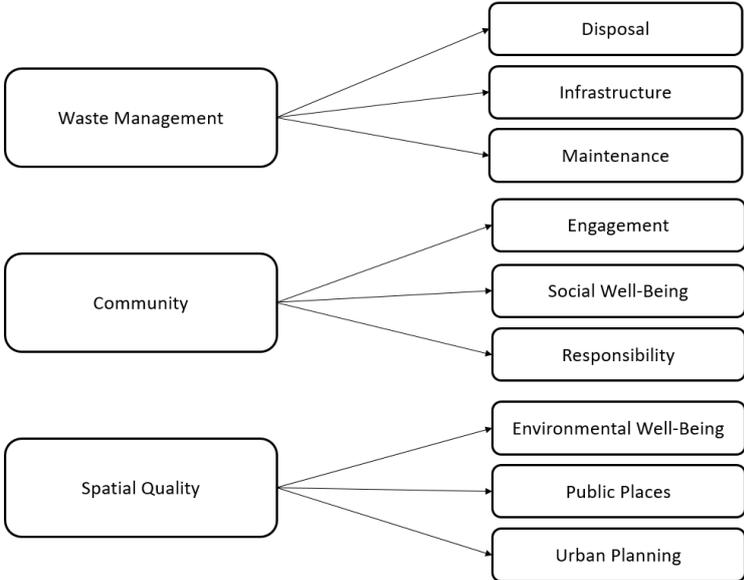


Figure 8. Coding tree (Source: Author)

Ethical Considerations

As the interview concerns, there are no difficulties between the relation of bachelor researcher and civil servant. There was no personal connection and therefore was the interaction professionally. The information shared by the senior environmental steward was confirmed to be used in this research.

The structured questionnaire is directly linked to the theory used in this study. To ensure the privacy of the participants, there is no name and address requested. In addition to this, the participant was informed on the forehand that the questionnaire was completely voluntary and that there was a possibility to quit at any moment. The collected data is stored and analysed in Qualtrics, the program that was used to make the questionnaire, and is only accessible to the researcher. After generalizing and analysing, the collected data is disguised shown in the research.

There is done the best that could be done to strive for academic objectivity.

Results

Waste collection infrastructure

As illustrated in figures 6 and 7, it was found that there is a major difference in the distribution of waste collection infrastructure between the public places of the neighbourhoods which are serving as cases for this study. The neighbourhood of Reitdiep has a surface of 97 km², with an allocation of 15 public waste collection attributes. To bring this in perspective, the amount of public attributes is divided by the amount of square meters of the surface. In the current situation, there is 1 public waste collection attribute found at a surface of 6.47 km². Besides public waste collection attributes, the neighbourhood offers 4 waste collection attributes for apartment complexes and one paid waste collection attribute for local residents of a particular street. The distribution of the waste collection attributes is unequal. As this distribution is visualized in figure 5, it is shown that 9 out of the 15 public waste collection attributes are located around the shopping/service area of the neighbourhood. Next to that, 2 of the 15 attributes are located at a bus stop. This analysis results in concluding that, at the moment, 3 out of the 15 attributes are located around a public space that is not serving as a service area.

The neighbourhood of De Hoogte has a surface of 57 km², with an allocation of 20 public waste collection attributes. To bring this in the same perspective for comparison with the neighbourhood of Reitdiep, the amount of public attributes is divided by the amount of square meters of the surface. In the current situation, there is 1 public waste collection attribute found at a surface of 2.85 km². Other than that, the area offers 27 waste collection attributes for apartment complexes. After analysing the distribution of the public waste collection attributes, it is to be seen in figure 6 that the distribution is not systematic. It turns out that 1 of the attributes is located at a bus stop, the other 19 attributes are randomly divided among crossing of streets within the public space.

Within the case of Reitdiep, it has been found that there is awareness towards street litter teams and their function. At the moment, there is no intention to establish a street litter team that is focused on cleaning up the environment around public places within the neighbourhood. On the contrary, the community located within the case of De Hoogte has started a street litter team which is supervised by the municipality. The team is increasingly committed to cleaning up public places.

Littering patterns

To relate the waste collection infrastructure to the amount of street litter that is found in the neighbourhoods it is to be clear that, along with the different distribution in waste collection infrastructure, the distribution of street litter is additionally different. As can be seen after analysing figure 9, it is noticeable that the amount of street litter in the public places of Reitdiep is mostly centred in places where there is no available waste collection attribute. The waste in public places is mostly centred around gathering places such as a small skate park, a playground and some green space (figure 10). At those places, it is shown in the waste collection infrastructure that there is no opportunity to discard the waste into an attribute. The littering pattern shows that to reduce the amount of street litter, there is need for an improved waste collection infrastructure within the public places of the neighbourhood.



Figure 9. The centred waste in the neighbourhood Reitdiep (Source: Author)



Figure 10. Waste located at the skate park of Reitdiep (Source: Author)

As can be seen at figure 11, the littering pattern of De Hoogte has other dynamics as the littering patterns of Reitdiep. After analysis, it was found that street litter located in the public places of De Hoogte is more centred around the waste disposal attributes. There are multiple spots within the public places where street litter has centred in a location where there is no attribute for waste disposal, but it is to be clear that mostly the street litter is found around the collection attributes such as seen in figure 11. Figure 12 shows an example of a situation as described, together with its location.

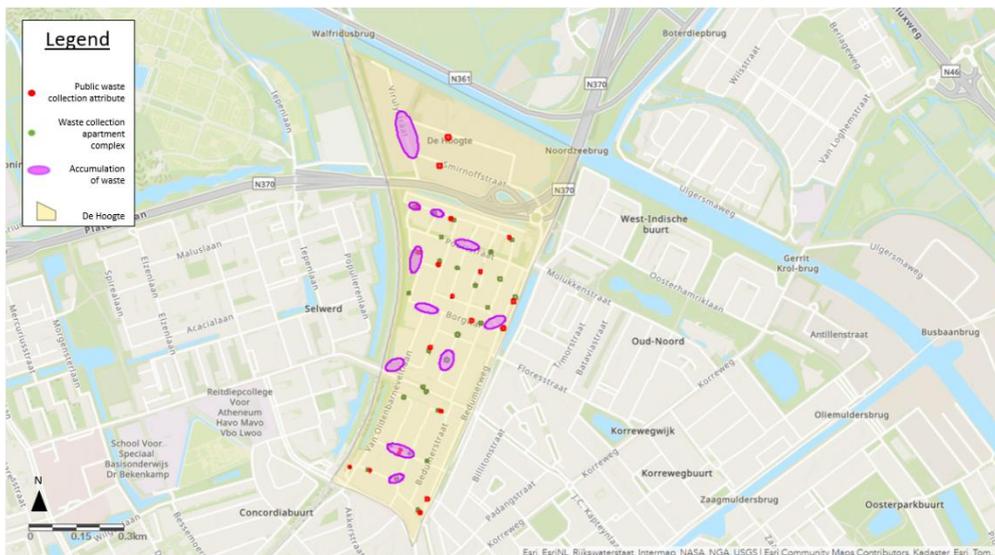


Figure 11. The centred waste in the neighbourhood De Hoogte (Source: Author)

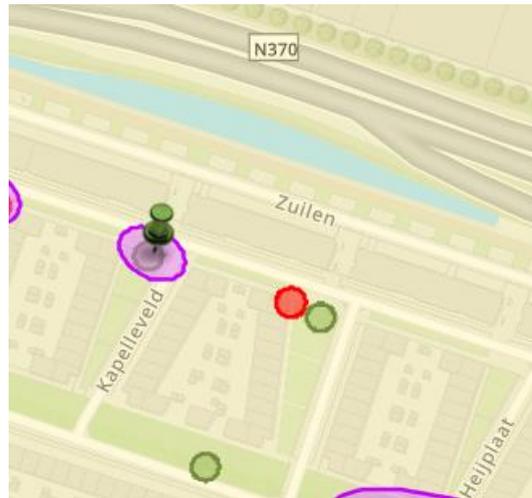


Figure 12. Over-used litter bin located at Zuilen 189 in De Hoogte (Source: Author)

Reflecting on this situation, the questionnaire entailed questions and statements regarding the effect of the available waste collection attributes on the public places within the participants' neighbourhood. The number of respondents to the questionnaire is 66, of which 32 are living in Reitdiep and 34 are living in De Hoogte. The respondents were asked if, in their opinion, there are enough opportunities to dispose waste in the public space of the neighbourhood. Out of the respondents living in De Hoogte, 71% of the respondents answered with 'yes'. Contrary to De Hoogte, 79% of the respondents of Reitdiep answered with 'no'. Regarding the statements '*There is little street litter in my neighbourhood*' and '*I experience the public places in my neighbourhood as clean*', it turned out that respondents living in both neighbourhoods experience much street litter and an unclean environment.

To reflect on the fact that there is a noticed difference in waste collection infrastructure, it is remarkable that respondents living in both neighbourhoods experience street litter and an unclean environment. Relating to this, the questionnaire asked '*Are the waste disposal attributes well maintained?*'. Here, it is found that 96% of the respondents living in De Hoogte are of the opinion that badly maintained waste disposal attributes are the reason for street litter, while the respondents of Reitdiep are with 71% in the opinion that the waste disposal attributes are well maintained.

Quality of life

High and low quality of life can be considered due to various circumstances and situations, based on psychological well-being, happiness and feelings of belonging that are impacting quality of life (Martinez, Mikkelsen and Phillips, 2021). Additionally, social well-being is considered an essential part of quality of life and is referred to in this research in the form of social connection to the neighbourhood. Environmental well-being can be understood by the perceived living environment, where environmental challenges are related to waste disposal limiting opportunities (Martinez, Mikkelsen and Phillips, 2021). Last, quality of life has a dimension of leisure and recreation, in which it is important to consider the stability of conditions of the environment of the public space (Martinez, Mikkelsen and Phillips, 2021). To get an insight into quality of life, the most important factors in this situation were psychological well-being, social well-being, environmental well-being and leisure and recreation opportunities.

To relate to psychological well-being, the questionnaire presented the following statements: *'I feel happy'*, *'I feel mentally well'* and *'I matter'*. The possible answers were scale based with a range from strongly disagree to strongly agree, of all the respondents 91% answered with agree or strongly agree. Next to that, in relation to psychological well-being, there were questions asked about the feeling of safety. It turned out that 52% of the participants living around public places in Reitdiep feel safe in the streets during the day, along with 49% of the participants feeling safe in the streets at night. Remarkable to this, is that it has turned out that 91% of the participants living around public places in De Hoogte feel safe in the streets during the day, along with 87% of the participants also feeling safe at night.

To get an understanding of social well-being in relation with the living environment and therefore the public places of the neighbourhoods that are cases in this study, the participants were asked about social cohesion of the neighbourhood. The questions were pointing towards social connection, knowing your neighbours and willingness to help each other. It turned out that participants living in De Hoogte rated their social well-being sufficiently, in comparison to Reitdiep where participants are dissatisfied with their social well-being in relation to their living environment.

For environmental well-being impacting quality of life, the study explicitly refers to the amount of street litter in combination with the experienced impact from this. The impact of littering patterns resulting into street litter is featured by multiple concepts. Starting off with the fact that not collected litter attracts pests that trigger allergic reactions and illnesses (Knols & Smallegange, 2009). The spread of street litter caused by lack of waste disposal attributes therefore contributes to the spread of pests. This, together with the spread of harmful artificial material causing damage to the flora and fauna, decreases environmental health (Pickett et al., 2001). In relation to the case study, the inhabitants of Reitdiep and De Hoogte were asked in the questionnaire to respond on how they perceive the environmental well-being in their neighbourhood. It turned out that 67% of all participants are worried about the possible decrease in environmental well-being of their neighbourhood due to an unmaintained waste collection infrastructure together with its subsequent street litter.

Last, there is found a link between increase in littering patterns and the decrease of use of public space and physical activity (Sprague et al., 2022). To relate this to the case study, the questionnaire asked the participants to elaborate on their feelings towards using the public space in their neighbourhood. It became clear that 61% of the participants living in De Hoogte feel at ease by enjoying the public space. The other 39% respond with the answer of being outside in the

neighbourhood occasionally due to the lack of green and experienced criminality. As found by LaGrange et al. (1992), increased street litter in a public place is associated with feelings of fear and crime among inhabitants. Relating to this, 52% of the respondents living in Reitdiep declared to feel at ease outside, while the remaining 48% mentioned that due to deterioration in maintenance, the use of public space decreases.

Spatial inequality

The situation clearly indicates spatial inequality. The waste collection infrastructure is not in relation to one another, since the waste collection distribution widely differs. For the public places of the case study Reitdiep, there is found spatial injustice in the infrastructure of waste disposal attributes. The spatial distribution of attributes is unequal, which translates in unequal access to accessibilities for the inhabitants and users of public places. The unequal access to accessibilities is due to an unequal distributed waste collection infrastructure and it clearly results in more extensive littering patterns. In the current policy, there are no plans to install new waste disposal attributes. The policy recalls that individual inhabitants are in the ability to request an adoption of a waste disposal attribute, which includes maintaining the attribute themselves. Besides, there is a possibility to adopt a surrounding as a society and arrange the cleaning of the environment of the public space within the neighbourhood themselves. To reflect on this situation, the questionnaire asked the participants: *'What should be changed in the public places of the neighbourhood to reduce street litter?'* and *'When are users, do you think, more willing to recycle litter?'*, whereas 85% of the responds was based on 'adding more waste collection attributes.'

For the case of De Hoogte, there is found a different waste collection infrastructure. The spatial distribution of waste collection attributes is not structured, but there is access to by most inhabitants and users of public places. The maintenance of the waste collection infrastructure has room for improvement, due to littering patterns arising from the situation. The waste collection attributes are exhaustively over-used and therefore resulting in street litter. The street litter team that is created in De Hoogte is showing the neighbourhoods willingness to create a cleaner environment and to reduce intensive littering patterns.

Discussion

By investigating the current influential factors towards how spatial planning is reducing litter, it has turned out that the municipality of Groningen is aware of the current situation and working hard towards a street litter free city in 2030. As been told by the senior environmental steward and confirmed in multiple policy documents, Groningen has an unique approach towards reaching this goal. Remarkable to this approach is the fact that the municipality is not planning on improving the waste collection infrastructure by placing waste collection attributes.

This research has found that within the cases of Reitdiep and De Hoogte, there is need for infrastructural improvement to raise the quality of life within public places of the neighbourhoods.

Evaluating on the results, spatial planning can reduce street litter by managing the maintenance of the infrastructure by a more regular distribution of disposal attributes, which is in relation to the study of Sprague et al. (2022). Regulating the distribution of waste disposal attributes is a call to spatial equality, providing every daily user of the public space with equal opportunities to properly dispose of waste resulting in less extensive littering patterns as confirmed by the study of Casal (2018). Decrease in extensive littering patterns will increase the quality of life based on social and environment well-being.

The most common factors of quality of life, stated by Martinez, Mikkelsen and Philips (2022), refer to an individual's well-being. The study found that the quality of the environment which inhabitants are using as public, relates to the quality of experienced wellbeing. Improving the quality of the public environment, increases opportunities for behavioural improvement as confirmed by Pertoldi, Pagh and Bach (2020).

Contrary to the study of Martinez, Mikkelsen and Philips (2022), this research has not found a relationship between psychological well-being and waste collection infrastructure together with littering patterns and quality of life. The weakness of this study is that there is not enough knowledge about psychology and that there are not enough resources to sufficiently test psychological well-being. Besides, it is necessary to take into account that quality of life was not tested on all possible factors and that the concept of quality of life is highly subjective.

Conclusion

In conclusion, the issue of waste collection infrastructure, littering patterns, quality of life and spatial inequality are interconnected in a complex relationship. The unequal spatial distribution of waste collection attributes is the foundation of a distinction between littering patterns influencing quality of life. The cases in this study represented each a different spatial infrastructure, whereas the investigation resulted in the notice of various explanations.

Answering the research question, it was found that the existing waste collection infrastructure influences littering patterns. The influential factor of public litter bins plays a crucial role in this, by the means of distribution and maintenance. The quality of life is influenced by littering patterns, regarding social well-being, environmental well-being and leisure and recreation. Psychological well-being turned out not to be influenced by littering patterns in this case study. Social well-being is influenced positively regarding more extensive littering patterns, by means of increasing social cohesion. Environmental well-being decreases by the increase of littering patterns, due to inaccurate waste collection infrastructures, together with leisure and recreation which also is negatively influenced. The process influences spatial inequality based on decreased quality of life by lack of accessibility to resources within the spatial surrounding. Therefore, the hypothesis regarding the research question is partly confirmed.

Towards the sub questions, there is a noticed difference between the situations of the cases. The effect of available waste collection attributes in a neighbourhood is depending on multiple factors, with differing elaboration in both cases. There is a noticed effect of decreasing littering patterns, when there are accessible waste collection attributes located in public places. In contrast to this, it appeared that the maintenance of the waste collection attributes was as influential as accessibility. The task of spatial planning therefore is to maintain and intensify waste collection infrastructures by structuring waste disposal attributes and its maintenance. To decrease over-use, it is advised to

research further in how to prevent this appearing. Derived from this situation, the difference in high and low quality of life can be made, based on the influential factors increasing social well-being and decreasing environmental well-being and leisure and recreation. High quality of life is related to positive associations with the social community and a clean living environment. Low quality of life is considered when social contact is low combined with experienced environmental issues.

For spatial planners, it is necessary to pay attention to the influence brought by changes in waste collection infrastructure to quality of life relating to spatial inequality, which is investigated in this research. In moving forward, it is important to properly research how to enhance the waste collection infrastructure of the city of Groningen with the focus on unequal distribution of attributes and over-use of existing infrastructure. To create a litter free city by the year 2030, the advice concluding from this research is to reinvestigate and expand the current waste collection infrastructure to reduce its effects.

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Appendix

Interview Guide

Beste deelnemer,

Voor mijn bachelorscriptie aan de Rijksuniversiteit Groningen doe ik, Ivette Los, namens de opleiding Spatial Planning & Design onderzoek naar de effecten van (straat)afval op de kwaliteit van leven van wijken in Groningen. Voor mijn onderzoek ben ik op zoek naar reacties en ervaringen van inwonende.

Deze vragenlijst bevat vragen die gaan over de ervaringen van U, als bewoner, richting de omstandigheden van de wijk waarin U woont. De reacties worden volledig anoniem verwerkt en het invullen van de vragenlijst duurt maximaal 10 minuten. U zou mij enorm helpen door de vragenlijst in te vullen. Deelname aan mijn onderzoek is geheel vrijwillig. U kunt op ieder moment tijdens de vragenlijst besluiten toch niet deel te nemen of uw antwoorden niet in te leveren. De gegevens worden zorgvuldig bewaard en zullen alleen gebruikt worden voor mijn onderzoek. De geanalyseerde data zal anoniem verschijnen in de resultaten van het onderzoeksrapport. De onbewerkte data wordt, buiten mij en mijn onderzoeksbegeleider om, niet gedeeld of door anderen bekeken. De data zal worden bewaard volgens de EU GDPR richtlijnen, data voor onderzoeksdoeleinden: <https://gdpr-info.eu/>.

Een aantal vragen in deze vragenlijst gaan over de effecten van een onaangename leefomgeving op uw mentale gezondheid. Als onderzoeker en mens begrijp ik dat gegevens delen over uw mentale gezondheid een moeilijk onderwerp kan zijn. Uiteraard word ook met deze gegevens zorgvuldig omgegaan. Graag wil ik nogmaals expliciet benadrukken dat de gegevens anoniem zijn en dat antwoorden geheel vrijwillig is.

Hiermee wil ik U vragen om hieronder toestemming te geven voor het analyseren, verwerken en opslaan van de door U ingevulde antwoorden in deze vragenlijst. Bij voorbaat dank aan het deelnemen en daarmee mijn onderzoek verder te helpen.

Heeft u vragen naar aanleiding van deze vragenlijst? Stuur U gerust een mailtje naar: i.los@student.rug.nl

Hiermee geef ik mijn toestemming voor deelname aan het onderzoek;

Ja, ik ga akkoord

Achtergrondgegevens

1. In welke wijk van Groningen bent U woonachtig?

2. Wat is uw leeftijdscategorie?

Jonger dan 18

Tussen de 18 en 21

Tussen de 22 en 25

Tussen de 26 en 55

55+

3. Wat is uw hoogst afgeronde opleiding?

Middelbare school VMBO/HAVO/VWO

MBO

HBO

Universiteit

Geen van bovenstaande

4. Wat is op dit moment uw werkstatus?

Ik ben niet werkzaam

Ik heb een bijbaan

Ik werk parttime/fulltime

5. Hoe zou U op dit moment uw inkomen omschrijven? (Het modale inkomen van de gemiddelde Nederlander in 2023 ligt op 40.000 eu per jaar)

Ik heb geen inkomen

Ik heb een uitkering/ik krijg studiefinanciering

Ik verdien onder modaal

Ik verdien rond modaal

Ik verdien boven modaal

De stellingen hieronder reflecteren uw mening over de omstandigheden in de wijk.

6. Ik ervaar mijn wijk als netjes

X Eens

X Niet mee eens, niet mee oneens

X Oneens

7. In mijn wijk is weinig zwerfaval

X Eens

X Niet mee eens, niet mee oneens

X Oneens

8. In mijn wijk zijn er voldoende mogelijkheden om afval te recyclen (denk aan openbare prullenbakken enz.)

X Eens

X Niet mee eens, niet mee oneens

X Oneens

9. In mijn wijk gaan wij zwerfafval actief tegen

X Eens

X Niet eens, niet oneens

X Oneens

10. In mijn wijk voel ik mij overdag veilig op straat

X Eens

X Niet mee eens, niet mee oneens

X Oneens

11. In mijn wijk loop ik, ook in het donker, met een fijn gevoel over straat

Eens

Niet mee eens, niet mee oneens

Oneens

12. In mijn wijk heerst sociale cohesie (Bewoners zijn onderling verbonden, je kent elkaar)

Eens

Niet eens, niet oneens

Oneens

De volgende vragen treffen leefomgeving en recreatie

13. Bij het onderhouden van wijken spelen verschillende belangenorganisaties een rol. Denk aan de gemeente, buurtverenigingen, etc. Hoe zou U uw leefomgeving buitenshuis omschrijven?

Schoon en goed onderhouden

Schoon, maar niet goed onderhouden

Niet schoon niet vuil, maar wel goed onderhouden

Niet schoon niet vuil, en niet goed onderhouden

Vuil en slecht onderhouden

14. Wat zou uw wijk in positieve zin veranderen?

15. Houd u zich bezig met de hoeveelheid zwerfafval in uw wijk?

Ja, ik ben er zelf actief mee bezig

Ik vind het wel belangrijk, maar ben er niet actief mee bezig

Nee, ik ben er niet mee bezig

16. Bent U zich bewust van de invloed van zwerfafval op het milieu?

Ja, daar ben ik bewust van

Nee, ik houd mij daar niet mee bezig

Een beetje

17. Voelt U zich vrij om te recreëren (wandelen/fietsen) in de wijk

Ja, ik ben graag buiten in mijn wijk

Ik ben soms buiten in de wijk

Nee, ik kom liever niet buiten in de wijk

18. Wat is de reden dat U wel/niet graag buiten te vinden bent?

19. Kunt U het gevoel omschrijven dat U krijgt bij het recreëren in een vervuilde omgeving? Denk aan een omgeving met overvolle prullenbakken of veel straatafval

Volgend onderdeel gaat over de recycle mogelijkheden in de buurt

20. Vindt U dat de hoeveelheid prullenbakken voor klein afval (denk aan snoeppapiertjes, koffiebekertjes, etc.) voldoende is in uw wijk?

Ja, er zijn genoeg prullenbakken te vinden in mijn wijk

Nee, er zijn te weinig openbare prullenbakken te vinden in mijn wijk

Ik heb geen idee waar ik een openbare prullenbak voor klein afval kan vinden

21. Bevinden zich in uw wijk gezamenlijke afval containers? Denk aan containers voor glas etc.

Ja

Nee

Geen idee

22. Worden deze containers goed onderhouden?

Ja

Nee, deze containers veroorzaken zwerfafval

N.v.t.

23. Weet U van het bestaan en de werkzaamheden van zwerfafvalteams binnen de stad Groningen af?

X Ja, ik ben hierbij actief

X Ja, ik weet van het bestaan

X Nee, ik heb geen idee

24. Wat zou er in de wijk moeten veranderen zodat er minder straatafval te vinden is?

25. Wanneer, denkt U, dat inwoners sneller hun afval in de daarvoor bedoelde afvalbak gooien?

De laatste stellingen gaan over mentale gezondheid

26. Ik voel mij gelukkig

X Helemaal mee eens

X Mee eens

X Niet mee eens, niet mee oneens

X Mee oneens

X Helemaal mee oneens

27. Ik voel mij mentaal gezond

X Helemaal mee eens

X Mee eens

X Niet mee eens, niet mee oneens

X Mee oneens

X Helemaal mee oneens

28. Ik heb het gevoel dat ik er toe doe

X Helemaal mee eens

X Mee eens

X Niet mee eens, niet mee oneens

X Mee oneens

X Helemaal mee oneens

Bedankt voor de tijd die u heeft genomen om aan deze enquête deel te nemen.

Uw antwoord is geregistreerd.

Heeft U vragen? Laat het mij vooral weten via: i.los@student.rug.nl