Master Thesis Population Studies

From Numbers to Experience: Investigating the influence of socioeconomic, demographic, and residential factors on perceived liveability shifts in the province of Groningen

Colophon

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Abstract

Perceived liveability is an important concept in urban planning used to measure the quality of life of individuals, cities, and neighbourhoods. The province of Groningen exhibits a lower level of well-being compared to the rest of the Netherlands; therefore, this is an important topic for research. This paper examines the relationship between socioeconomic, demographic, and residential characteristics and changes in perceived liveability between 2018 and 2022 in Groningen. The variables used in this research are selected based on the literature review and theoretical framework surrounding perceived liveability theory and social production function. The research uses a multinomial logistic regression model on data from the Groninger panel. The results show that income level, changes in social capital, labour market status, age category, the urbanity of the living environment, and living in an earthquake zone significantly influence change in perceived liveability. However, change in income level, education level, sex, household composition, and homeownership do not significantly affect changes in perceived liveability. These findings only partially correspond with the expectations derived from the literature review. These results are helpful for policymakers and suggest that interventions aimed at improving liveability should focus on enhancing social capital, catering to the needs of different life stages, managing urban and rural living conditions, and addressing the issues related to living in earthquake zones.

Keywords:

Perceived liveability, social production function, longitudinal research, multinomial logistic regression, socioeconomic characteristics, demographic characteristics, residential characteristics

Content

List of abbreviations:

BWI	Broad well-being indicator
SPG	Sociaal Planbureau Groningen
SPF	Social production function
AIC	Akaike Information Criterion

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1. Introduction

Liveability is an important concept used to determine the quality of life and standard of living of individuals, cities, regions and neighbourhoods (Bandarabad & Shahcheraghi, 2012; Okulicz-Kozaryn, 2013). Liveability is used in urban planning to measure living conditions (Baig et al., 2019). Liveability has become a significant focus for urban planners and governments at all levels to plan and design neighbourhoods that offer comfortable spaces for residents (Pandey et al., 2013, 2014a).

The effects of liveability are broad, with positive consequences for individuals, businesses, and communities. When neighbourhoods are designed to be pleasant, they become more liveable, contributing to residents' happiness. This is because when objective improvements are made to a city's conditions, people's subjective well-being improves, as Veenhoven and Ehrhardt (1995) noted. Furthermore, happiness is contagious, as happy individuals tend to make other individuals happy as well (Fowler & Christakis, 2008). Not only does liveability impact individuals, but it also affects businesses; happy employees tend to be more productive (Lyubomirsky et al., 2005). Therefore, companies located in liveable cities have a competitive edge when it comes to attracting and retaining the best talent. For city governments, promoting liveability is essential for economic development. By creating liveable cities, they can attract talented workers and businesses, which are crucial for the growth of the local economy. In summary, the effects of liveability are positive and diverse, and investing in it can lead to a better quality of life for everyone involved.

However, the value of liveability can be limited without considering residents' perceptions and experiences. Therefore, perceived liveability is a crucial factor, as it reflects individuals' subjective evaluations of their living conditions, which can differ from objective liveability measures. Recognizing the importance of perceived liveability can lead to more effective urban planning and policy decisions that prioritize the needs and preferences of residents, ultimately contributing to their overall well-being and satisfaction.

1.1 Societal relevance

As mentioned above, residents need to perceive their environment as liveable, as this increases their happiness and quality of life. The province of Groningen aims to improve the liveability in the province through their liveability programme (leefbaarheidsprogramma); in this programme, they use the Broad well-being indicator (BWI) created by Aalders et al. (2019) to measure the liveability of the province (Provincie Groningen, 2020). The BWI uses the COROP regions to divide the Netherlands into 40 regions. All 40 regions are ranked according to their overall BWI score, based on eleven indicators such as subjective well-being, health, education, safety, income and social capital (Aalders et al., 2019). The province of Groningen is divided into three regions in this index, namely ‘Overig Groningen', ‘Oost-Groningen', and 'Delfzijl en omgeving’. The Groningen regions score poorly, ranking 33, 35, and 37 out of 40 (Aalders et al., 2019). The regions in the province of Groningen score especially low on the indicators: employment, income, health, and education. However, the three regions score high on the indicator environment, which could be attributed to the rural character of the province of Groningen. The wellbeing standards in Groningen are noticeably lower than in the rest of the Netherlands, emphasizing the importance of further research into this matter. By studying the factors that contribute to the low levels of well-being in certain regions of Groningen, policymakers and urban planners can identify specific areas for improvement. This information can then be used to design targeted interventions and policies that address the most pressing needs of these communities.

Regarding the perceived liveability of the province of Groningen, this has been rated more than sufficient, with a 7.5 out of 10 in the most recent measurement of 2022 (Sociaal Planbureau Groningen, 2023a). However, there was a slight decrease from the previous measurement in 2018, where the

score was 7.7 (Sociaal Planbureau Groningen et al., 2018). The research of Sociaal Planbureau Groningen (2023) has measured a geographical variation in perceived liveability. Municipalities in the north-east of the province, such as Oldambt, Eemsdelta and Het Hogeland, have a lower perceived liveability compared to municipalities in the South, such as Stadskanaal, Westerkwartier and Groningen, having a higher perceived liveability (Sociaal Planbureau Groningen, 2023a). Furthermore, different age groups reported different ratings of perceived liveability; older individuals reported a higher perceived liveability than younger individuals. This is interesting, as the municipality of Groningen has a high perceived liveability while the population of the municipality is relatively young. The differences between individuals from different age groups and regions make this an interesting research topic.

1.2 Academic relevance

Much research has been done into what influences the perceived liveability of individuals, primarily how the environment influences perceived liveability. Most authors agree that perceived liveability is shaped by personal needs and wishes about the environment and to what extent these needs and wishes are met, which results in a certain level of satisfaction with the liveability of the environment (Conger, 2015; Shafer et al., 2000; Zivanovic et al., 2020). The needs and wishes differ based on personal characteristics such as gender, education level, financial possibilities and health (De Haas, 2021). However, little research has been done on how demographic and economic characteristics shape perceived liveability (Pandey et al., 2014b). Especially how changes in personal characteristics influence perceived liveability, so what happens with the perceived liveability of an individual when their income increases or does perceived liveability change based on social capital? This research will try to add to this body of literature and hopefully narrow the research gap.

1.3 Study aim and research questions

As was mentioned before, the liveability in the province of Groningen is under pressure. Overall, the liveability has decreased in the last few years. Furthermore, liveability is not equally distributed among the Dutch population and within the province of Groningen there are inequalities. This study aims to determine if socioeconomic, demographic, and residential characteristics cause changes in perceived liveability and how these changes are related to each other. The research will identify the factors associated with decline, increase or no change in perceived liveability, providing insights into the potential drivers of changed perceived liveability over time. This investigation will contribute to a better understanding of the complex interplay between individual characteristics and changes in perceived liveability, which can inform more effective urban planning and policy decisions. This relationship will be studied quantitatively using data from the liveability monitor (Dutch: leefbaarheidsmonitor) of multiple years of the Sociaal Planbureau Groningen (SPG). A representative sample of the province of Groningen has filled in the same survey in 2018 and 2022; it will be used to identify three groups, those who experienced a decline, increase or no change in perceived liveability between the two moments of measurement. The following research question has been formulated to achieve the research aim stated above:

How do socioeconomic, demographic, and residential characteristics influence changes in perceived liveability between 2018 and 2022 in the province of Groningen?

The sub-questions are:

(1) How did perceived liveability in Groningen change between 2018 and 2022?
(2) What are the socioeconomic, demographic, and residential characteristics of the residents of the province of Groningen?

2. Theoretical framework

This chapter aims to critically evaluate and assess the topics and concepts related to the research question. This chapter will examine the current academic literature to establish a clear definition of the key concepts to be used in the study. This evaluation and analysis of the literature will enable the researcher to develop a theoretical framework that will guide the research, contextualize the research question within the broader academic discourse, and identify any gaps or inconsistencies in the existing literature. Ultimately, this chapter will serve as the foundation for the subsequent thesis chapters.

2.1 Literature review

2.1.1 Liveability and change in liveability

The ambiguity of the concept of liveability is one of the main issues of the concept in academic literature (De Haas, 2021). According to the research of Leidelmeijer & Van Kamp (2003), the term liveability is frequently substituted for similar notions such as quality of life and standard of living, despite these concepts not sharing the exact definitions. This either arises from or contributes to the vagueness of the liveability concept. Among authors, the definition of liveability differs, van Kamp et al. (2003) have extensively reviewed different definitions of liveability, environmental quality, quality of life and sustainability. It was found that most academic literature only provides an implicit definition of concepts (van Kamp et al., 2003). Therefore, the meaning attributed to these concepts in the literature must be inferred from either the context or the selection of indicators used. Almost all definitions of liveability are based on the relationship between the individual and their environment (Conger, 2015; Shafer et al., 2000; Zivanovic et al., 2020). In their conceptualization of liveability, Antognelli & Vizzari (2017) differentiate between a subjective element, attributed to personal characteristics, and an objective element, linked to landscape qualities. Notably, their definition does not imply a directional link between these subjective and objective components (Antognelli & Vizzari, 2017). Baig et al. (2019) explain the complexity of liveability very well; it means many things to different people and professionals. Liveability is a complex concept acknowledged by many but challenging to express in a universally comprehensible way (Balsas, 2004). Nonetheless, Badland & Pearce (2019) and Leidelmeijer & Van Kamp (2003), suggest that enhancing liveability is more effectively achieved by examining how individuals engage with and appreciate their surroundings based on personal traits, rather than solely focusing on the characteristics of the environment. According to Leidelmeijer & van Kamp (2003), the definition of liveability combines how people view and value their daily living environments with how well those environments meet their requirements and needs. However, because requirements and needs can alter over time, different people have different perspectives on liveability, which lead to a different perceived liveability for each individual. Therefore, this study will use the definition of liveability as stated by Leidelmeijer & van Kamp (2003, p. 59):

"Liveability is an assessment of the environment, whether the living environment meets the wishes and needs that are set by the residents and if so, to what extent these wishes and needs are met."

Understanding liveability as a concept is essential, as it directly impacts the quality of life that individuals and communities experience. However, it is equally, if not more, important to research the change in perceived liveability, a topic that currently remains mainly unexplored in existing academic literature. Perceptions of liveability are not static; they evolve with ageing, population composition, and changing cultural norms. Therefore, understanding these is essential to maintaining and improving liveability standards.

Leidelmeijer et al. (2011) explored various factors that influence changes in liveability over time in neighbourhoods, with a particular focus on population composition. It identifies unemployment, the share of non-Western immigrants, nuisance, and the high-income level of city populations as negative influences on change in liveability. In contrast, the proportion of highly educated individuals and elderly people is found to positively influence change in liveability. These findings are supported by the earlier findings of Leidelmeijer et al. (2009), which provide a comprehensive analysis of the factors influencing liveability in the Netherlands. Furthermore, it identified that neighbourhoods with a high proportion of single-parent families and young people aged 10-19 years had seen a decline in liveability between 1998 and 2008. On the other hand, pre-war neighbourhoods showed an improvement during the same period. This was also the case for neighbourhoods with a high number of highly educated and self-employed individuals (Leidelmeijer et al., 2009).

2.1.2 Factors determining perceived liveability

One factor which adds to the complexity of the concept of perceived liveability is the difficulty of determining what contributes to perceived liveability (Badland & Pearce, 2019). As was mentioned before, liveability is based on the needs and wishes of the residents; these differ based on personal characteristics such as financial possibilities, gender, education level and health (Badland et al., 2014; Badland & Pearce, 2019; Leidelmeijer & Van Kamp, 2003; Namazi-Rad et al., 2012). Based on these personal characteristics, individuals interact differently with their environment. Therefore, the socioeconomic, demographic, and residential factors determining perceived liveability will be discussed in the following sections.

Socioeconomic status

In this section, the relationship between socioeconomic status and perceived liveability will be discussed based on findings in academic literature. Subjective well-being and psychological well-being are often seen as components of (perceived) liveability and are positively related. Earlier research into the relationship between socioeconomic and demographic characteristics of individuals on the perceived liveability has been done by Pandey et al. (2014b). The objective of their paper is to explore the inhabitant's perception of identified liveability attributes in the Indian context across various socioeconomic and demographic parameters. The study revealed that religion and education level did not impact perceived liveability. On the other hand, the results showed that certain liveability attributes were associated with sex, age, marital status, and life cycle group. Overall, the study suggests that socioeconomic factors play a crucial role in determining how individuals perceive the liveability of their surroundings (Pandey et al., 2014b).

Education and income level

Research from other authors has found that social factors such as socioeconomic status, education and income have a positive relationship with subjective well-being (Diener, 2012) and psychological well-being (Reyes et al., 2020), contributing to improved perceived liveability. Furthermore, it was found that income is positively related to subjective well-being, and this relationship was stronger in wealthier regions than in less wealthy regions (Ng & Diener, 2014). An individual with a higher income has higher accessibility to facilities and services in the region, which increases the individual's autonomy (Biswas-Diener, 2009; Read et al., 2016).

Marsman & Leidelmeijer (2001) have found contradicting findings in their research. Their research mentions that higher educational attainment is associated with experiencing more annoyance from external noises. Individuals with only primary school or vocational education are less likely to report annoyance when exposed to a specific noise source than households with completed higher education. These results are supported by the findings of (Miedema & Vos, 1999). The higher the level of

education, the more annoyance is reported. It should be noted that lower levels of education (only primary school) are predominantly found among older individuals. It implies that part of the effect of education on annoyance is likely explained by age (or vice versa). In other words, at least one group experiences relatively less annoyance: low-educated older individuals. When re-analysing the effects of education on annoyance while controlling for the effect of age, the strength of the effect diminishes (Marsman & Leidelmeijer, 2001). As mentioned earlier, this is because educational attainment is associated with age, but there remains an effect of education.

Overall, the literature reviewed provides evidence of an existing relationship between education, income level, and perceived liveability. However, the direction of the relationship with education is disputed and unclear. Hopefully, the results of this study can give a direction to this relationship.

Social capital

The research of Marsman & Leidelmeijer (2001) also looked at the influence of social capital on satisfaction with the environment or perceived liveability. The research found a significant positive relationship between both variables; the higher the self-rated social capital, the higher the perceived liveability. These findings are supported by the research of Li and Zhang (2021), who used the American Housing survey to research the relationship between social capital and the perceived liveability of neighbourhoods in cities in the United States. Their research controlled for a diverse set of variables such as household characteristics, actual and perceived neighbourhood characteristics, housing attributes and geographical variables. The research found that the majority of social capital dimensions are significantly and positively related to the perceived liveability of a neighbourhood. The findings suggest that higher perceived neighbourhood liveability is influenced by stronger social capital (Li & Zhang, 2021).

Labour market status

Employment is a crucial social determinant of health and well-being, significantly influencing perceived liveability (Badland et al., 2016). Financial security, personal growth, and social networks can all be improved by working a job that offers a living wage, professional growth opportunities, flexibility, and a work-life balance. Together, these elements support better health as well as a feeling of independence and control. The perceived liveability can be negatively impacted by unemployment or participation in lower-skilled jobs, which can have negative effects on both physical and mental health (Badland et al., 2016).

In essence, the labour market status, which could be interpreted as the availability of jobs, income levels, and job security, plays a significant role in shaping the perceived liveability of a place (Namazi-Rad et al., 2016). A positive labour market status, characterized by high employment rates and good income levels, tends to enhance the perceived liveability of a place. Conversely, a negative labour market status, characterized by high unemployment rates and low-income levels, tends to reduce the perceived liveability of a place (Namazi-Rad et al., 2016).

Demographic characteristics

The wishes and needs of the residents on the environment are partially determined by what people find important. Therefore, sex, age, and household composition are also important differentiators for the 'fit' between people and environments. Not everyone fits equally well into every environment at every stage of life. For that reason, various studies also distinguish between lifestyle groups when looking for the determinants of liveability (Lang et al., 1997; Marsman & Leidelmeijer, 2001; Vlek, 2000).

Sex

The study of Giusta et al. (2011) finds that men and women gain life satisfaction from different activities, which may be due to gendered patterns of socialization resulting in different specializations and expectations. While overall life satisfaction levels are similar for men and women, men tend to have higher satisfaction in almost all components of life satisfaction except for job satisfaction (Giusta et al., 2011). Furthermore, the study reveals that leisure and social activities are the most important factor for both genders, followed by different components for men and women. The results suggest that women's life satisfaction is determined by a different set of factors, and the importance of job satisfaction for women's overall life satisfaction is lower than that for men. The research concludes that gender-specific socialization patterns culminate in distinct perspectives and anticipations for men and women. This, in turn, results in varying specializations and elements of life satisfaction for different genders (Giusta et al., 2011).

Age

Marsman & Leidelmeijer (2001) did a thorough analysis of the causes of perceived liveability and how these differentiate based on personal and household characteristics. Age emerged as a significant factor in shaping the perception of the living environment. The study revealed that as individuals grow older, they tend to hold more positive views regarding liveability. These findings are confirmed in the research by (Leidelmeijer & Marsman, 1999). Age explained the highest amount of variance in the perception of the living environment compared to other factors examined. This suggests that individuals' perspectives on their surroundings become increasingly positive as they age. Interestingly, when examining specific age groups, variations in the strength of relationships between indicators and perception were observed. Therefore, age not only plays a prominent role in determining overall liveability perception but also influences the specific dynamics within different age cohorts. These findings emphasize the importance of considering age as a crucial determinant when assessing the subjective experience of the living environment.

Household composition

On the relationship between household composition and perceived liveability, little research has been done. However, Marsman & Leidelmeijer (2001) researched the relationship between household composition and the level of noise disturbance experienced in the living environment, which has implications and is a predictor for perceived liveability. Estimating the precise relationship between perceived liveability and household composition becomes complex due to contradictory findings. While households with children may experience more annoyance from road traffic noise, indicating a potential negative impact on perceived liveability, the presence of children in a household has also been associated with more positive perceptions of the living environment (Marsman & Leidelmeijer, 2001). Similarly, multi-person households may be more affected by aircraft noise, which could negatively influence their perceived liveability. Therefore, further research is needed to unravel the intricate interactions between household composition, noise disturbance, and the overall perception of liveability (Marsman & Leidelmeijer, 2001).

Residential characteristics

Homeownership

Marsman & Leidelmeijer (2001) researched the relationship between predictors of perceived liveability and homeownership. The research found that the relationship between homeownership and the level of annoyance is not straightforward. Homeowners who hear road traffic or aircraft noise in their dwellings are more bothered by it compared to renters. However, the reverse relationship holds true for noise from industry and neighbours. The research shows that the relationship is complex for one of the predictors of perceived liveability.

Living in an earthquake zone

The impact of earthquakes on the liveability in Groningen has been a significant concern (Busscher et al., 2020). Multiple studies have indicated a decline in liveability as a result of earthquakes in recent years. In 2012, approximately 85% of residents in the affected areas expressed satisfaction with their living environment, aligning with the national average. However, by 2015, the satisfaction level had dropped to 77%, positioning the earthquake-prone region among the lowest-scoring areas in the Netherlands (Busscher et al., 2020). A more recent study conducted by KAW in 2018 revealed that nearly 79% of households in the area were (very) satisfied with their living environment, with approximately 5% expressing dissatisfaction (Heuff et al., 2018). Although this indicates a potential stabilization or slight improvement in overall satisfaction between 2015 and 2018, it remains challenging to estimate the exact relationship between perceived liveability and the composition of households due to varying findings. Furthermore, the level of damage caused by earthquakes has been found to influence perceived liveability. Individuals who have experienced damage to their homes report a decrease in satisfaction with their living environment over time, while those without damage do not report any change in satisfaction (Heuff et al., 2018). The Groninger Panel survey also revealed that residents with severe earthquake damage more frequently experienced a decline in liveability (32%) compared to those with minor damage (22%) or no damage (14%) (Sluiter et al., 2018). These findings highlight the multifaceted nature of the relationship between earthquakes and liveability, encompassing factors such as damage, loss of amenities, uncertainty surrounding home reinforcement, and population decline, all of which contribute to the complex and varied perceptions of liveability in the affected areas.

Urbanity of the living environment

Rural living environments often exhibit unique traits shaped by various demographic, social, and economic factors. The research conducted by the Social and Cultural Planning Bureau highlights an image of a shrinking and ageing rural population, particularly evident in small and remote villages, from which younger generations tend to migrate (Steenbekkers et al., 2017). However, this youth exodus seems to have stagnated since 2010. Despite these challenges, rural areas are characterized by a sense of strong cohesion, particularly in comparison to urban areas, with places like churches serving as important meeting points. In small, remote villages, residents often have more traditional views on societal issues, with less favour towards multicultural societies. Political dissatisfaction tends to rise quicker in these areas. The rural population often engages in volunteer work and self-organization to maintain liveability, although the capacity to do so largely depends on the social and cultural capital of the communities (Gieling & Haartsen, 2016).

On the other hand, urban areas have witnessed significant improvements in liveability in recent years (Kullberg et al., 2015). There's a growing popularity for dynamic urban living environments, and the proportion of highly educated individuals is rising faster in cities than in rural areas (Kullberg et al., 2015). In addition, the political preferences of city dwellers appear to differ significantly from those in rural regions (de Voogd, 2015). Urban areas, particularly cities within the Randstad area such as Amsterdam and Utrecht, are increasingly favoured for their agglomeration advantages, size, employment opportunities, and ability to attract young, highly educated, and creative individuals. However, it is worth noting that not all urban areas are thriving equally, with some neighbourhoods lagging behind others (Planbureau voor de Leefomgeving, 2015).

As mentioned in the introduction, in practice, there are actual differences in the perceived liveability of individuals in urban and rural areas. Urban environments are generally less clean, less safe, and the inhabitants are less healthy, yet they have greater material wealth compared to rural areas (Centraal Bureau voor de Statistiek, 2020). There is a general trend of increasing prosperity in urban areas. This

is evident in the decrease in registered crimes, unemployment, and rise in median disposable income. In contrast, rural areas offer a cleaner, safer environment with more nature, less pollution, and higher women's life expectancy, but amenities such as basic schools are usually farther away (Centraal Bureau voor de Statistiek, 2020).

However, a study by Leidelmeijer et al. (2011), investigated neighbourhood liveability from 2008 to 2010, utilizing the "Leefbaarometer" instrument. It reveals a negative correlation between urbanity, defined as the concentration of human activities, and liveability (Leidelmeijer et al., 2011). While urbanity tends to lower liveability, non-urban regions aren't without challenges. Despite their overall satisfactory liveability, these areas exhibited a minor developmental lag and decreased safety during the study period, although these trends are not yet significant issues.

In conclusion, the liveability of rural and urban environments is subject to different challenges and opportunities. Rural areas are grappling with structural demographic changes and the disappearance of local amenities, potentially impacting the quality of life and perceived liveability. Urban areas, on the other hand, are witnessing an upsurge in their appeal due to various advantages. However, within these broad categories, there's considerable diversity, with some rural and urban areas faring better than others. The academic discourse does not offer a clear-cut agreement on the relationship between perceived liveability and the urbanity of the living environment.

Amenity satisfaction

The relationship between amenity satisfaction and liveability is underscored by the perceived accessibility and quality of public facilities within an urban environment. These facilities—spanning shopping, education, healthcare, culture, and entertainment—are recognized as significant contributors to urban quality of life, directly impacting residents' satisfaction with their surroundings (Tao et al., 2014; Zhan et al., 2018). These findings are supported by the results of a case study on Kuala Lumpur, which suggested the presence of facilities and amenities significantly influences residential satisfaction (Mohit et al., 2010).

2.2 Theoretical background

2.2.1 Liveability theory

The Liveability theory tested by Veenhoven and Ehrhardy (1995, p.2) states:

> *"[…] subjective appreciation of life depends in the first place on the objective quality of life; the better the living conditions in a country, the happier its inhabitants will be."*

It also agrees with the definition mentioned in the earlier literature, that the liveability of society or individual is the degree to which the wishes and needs of society or individual are met. The liveability theory places more emphasis on the absolute quality of life than on relative differences. Even when individuals are aware that others have even better living circumstances, people are assumed to be content in their circumstances (Veenhoven & Ehrhardt, 1995).

The liveability theory is closely tied to the belief in universal human needs. It views societies as systems designed to meet these needs and evaluates societies based on their effectiveness in doing so. However, studies have shown that subjective well-being doesn't always correlate with objective factors such as income, education, age, and gender (Veenhoven & Ehrhardt, 1995). The liveability theory also suggests that happiness levels differ across countries. It posits that nations are equally liveable only if they have converged into a global society. According to the theory, a nation's liveability and average level of happiness are strongly correlated.

However, the liveability theory doesn't claim that either happiness or unhappiness is the norm. It acknowledges that within nations, there are clear relationships between subjective and objective factors. For instance, in less affluent and unequal nations, happiness tends to correlate strongly with income and social class. In Western countries, marital status also has a significant impact, with married individuals typically experiencing greater happiness than single individuals.

The liveability theory assumes that happiness stems from the fulfilment of needs, which can explain phenomena like satiation. For example, in affluent welfare states, the weak correlation between happiness and income can be attributed to the diminished marginal utility of money. In summary, the liveability theory is a robust predictor of happiness patterns and is considered the most realistic theory on (perceived) liveability.

2.2.2 Psychological theories

Within the discipline of psychology, theories on subjective well-being can be classified into two dimensions, the first axis is the bottom-up vs top-down approaches, and the second axis is telic vs autotelic theories (Ormel et al., 1999). The first way of categorizing subjective well-being theories within psychology is based on whether the theory gives more importance to changing life experiences and circumstances or stable individual traits (Brief et al., 1993; Diener, 1984). The bottom-up approach emphasizes the importance of changing life circumstances and experiences in determining one's well-being. The study posits that a person's happiness is determined by experiencing more positive than negative events. Consequently, an individual's well-being is directly tied to the balance between these positive and negative experiences (Bradburn, 1969; Brief et al., 1993). In contrast, the top-down approach emphasizes the significance of stable person characteristics, such as global personality traits like neuroticism, in determining well-being levels (Costa et al., 1981). This approach suggests that some individuals are happier than others regardless of their life circumstances.

On the other axis are telic and autotelic theories, which differ in their sources of subjective well-being (Ormel et al., 1999). Telic theories believe that the accomplishment of desired end states is the source of well-being (Ormel et al., 1999). Autotelic theories, on the other hand, argue that rather than the endpoint itself, the source of well-being is the experiences and activities which are part of the progression towards the endpoint. Although the telic and autotelic approaches may seem very different, they are quite similar. This is because personally chosen goals often reflect individuals' attempts to fulfil their universal needs, whether these goals relate to a few common universal needs or numerous personally chosen ones. Psychologists agree that subjective well-being is associated with positive affect, and the absence of well-being is linked to negative affect. According to the research of Ormel et al. (1999), both approaches mentioned are relevant to real-life behaviour.

To summarize, psychological theories about well-being emphasize the importance of achieving goals and satisfying the needs to experience positive emotions. Yet, these theories diverge when it comes to identifying which needs are universal, often treating needs as discrete entities. This approach overlooks the interdependence of needs, neglecting the possibility that fulfilling one need could compensate for another. While this may be true in extreme cases of deprivation, in everyday life, people may prioritize certain needs over others and make trade-offs between them. For example, someone may sacrifice some sleep and comfort to achieve affection or status.

2.2.3 Social Production function theory

The social production function (SPF) theory argues that individuals strive to achieve universal goals and improve their well-being within the limitations of their resources and constraints (Lindenberg, 1986,

1991; Lindenberg & Frey, 1993). This perspective, which combines psychological and economic theories, depicts people as proactive individuals who make rational choices to improve their well-being. However, due to the limited information of humans, the rational considerations of cost and benefit are constrained.

SPF theory identifies two general goals: social well-being and physical well-being. Within these two universal goals, the theory identifies five individual goals. For physical well-being these individual goals comfort and stimulation, comfort refers to meeting basic needs such as hydration, nourishment, rest, and safety. Feeling pleasant and comfortable is beneficial for physical health. Stimulation involves activities that induce excitement, such as cognitive and sensory experiences, physical exertion, and competitive sports. While most people enjoy some level of activation, excessive stimulation for long periods can be unpleasant and counterproductive. As a result, the link between stimulation and well-being follows an inverted U-shaped curve (Hebb, 1966; Scitovsky, 1976).

According to SPF theory, achieving social well-being involves achieving three main goals: status, behavioural confirmation, and affection, as illustrated in Table 1. Status pertains to an individual's relative position in comparison to others and is largely determined by their control over limited resources. Behavioural confirmation involves feeling a sense of accomplishment in the eyes of others, even in the absence of direct reward. Love, friendship, and support are just a few of the emotions that are included in affection, which is typically given through loving connections, such as those with close friends, family members, or intimate partners.

Table 1: The hierarchy of social production functions. (Source: Ormel et al., 1997)

Top level	Well-being and social production function				
Universal goals	Physical well-being		Social well-being		
First-order instrumental goals	Stimulation/ activation (optimal level of arousal)	Comfort (absence of physiological needs; pleasant and safe environment)	Status (control over scarce resources)	Behavioural confirmation (approval for doing the 'right' things)	Affection (positive inputs from caring others)
Activities and endowments (examples)	Physical and mental activities producing arousal	Absence of pain, fatigue, vitality	Occupation, lifestyle, excellence in sports or work	Compliance with external and internal norms	Intimate ties, offering emotional support
Resources (examples)	Physical and mental efforts	Food, health care, money	Education, social class, unique skills	Social skills, competence	Spouse, empathy, attractiveness

In conclusion, the perceived liveability theory, and the (SPF) theory offer interconnected, complementary perspectives on how human needs and goals fulfilment, influence happiness and well-being. Both theories assert that the extent to which societies and individuals meet their needs and goals shapes subjective happiness and well-being. They diverge in their emphasis—liveability theory prioritizes environmental and societal conditions, positing that the liveability of a society directly impacts the happiness of its inhabitants, while the SPF theory incorporates both environmental and

individual factors and underscores the proactive role individuals play in optimizing their well-being by striving to achieve universal goals within their constraints. The SPF theory offers a more comprehensive framework by considering both physical and social well-being in its definition of happiness and liveability.

The socioeconomic, demographic, and residential characteristics discussed in the literature review influence the five resources of the Social Production Function theory: stimulation, comfort, status, behavioural confirmation, and affection. Education level enhances 'status' and provides 'stimulation' through intellectual enrichment, while a high-income level ensures 'comfort' in terms of material needs and can also enhance 'status.' As individuals age, they may gain 'status' in societies that respect elders but may experience reduced 'stimulation' or 'comfort' due to health issues. Sex, depending on societal gender norms, may influence access to 'status,' 'comfort,' or 'affection.' A rich social capital can boost 'affection' through supportive relationships, add to one's 'status,' and promote 'behavioural confirmation' within social groups. Living in urban or rural environments can provide differential access to 'stimulation' and 'comfort' based on available amenities and lifestyle factors. Homeownership significantly contributes to 'comfort' and is a common symbol of 'status.' Living in an earthquake-prone area, however, could detract from 'comfort' due to persistent insecurity. Household composition affects resources such as 'affection' or 'behavioural confirmation,' depending on the dynamics and relationships within the household. Satisfaction with amenities can elevate one's 'comfort' and provide 'stimulation,' while an individual's labour market status will uniquely shape their focus on all six resources, such as young adults seeking 'stimulation' and older adults possibly prioritizing 'comfort' and 'status.' Each of these characteristics intersects with the five resources in ways that reflect individual priorities, societal norms, and environmental factors.

In the context of the present research, these two theories will serve as guiding frameworks, applying the liveability theory will provide insights into the role of societal and environmental conditions on liveability, while the SPF theory will help understand how individual characteristics and their striving to meet universal goals within their constraints contribute to perceived liveability. Therefore, the intertwined application of both theories will enable a more holistic understanding of the complex dynamics of perceived liveability, its changes over time, and its influencing factors in Groningen.

2.3 Conceptual model

Based on the literature discussed above, a conceptual model has been created, which can be found in Figure 1. It visualizes how socioeconomic, demographic and residential characteristics shape physical and social well-being and the needs and wishes about the environment and consequently, how this shapes perceived liveability. And eventually, when the perceived liveability changes over time, there is a relationship with personal characteristics.

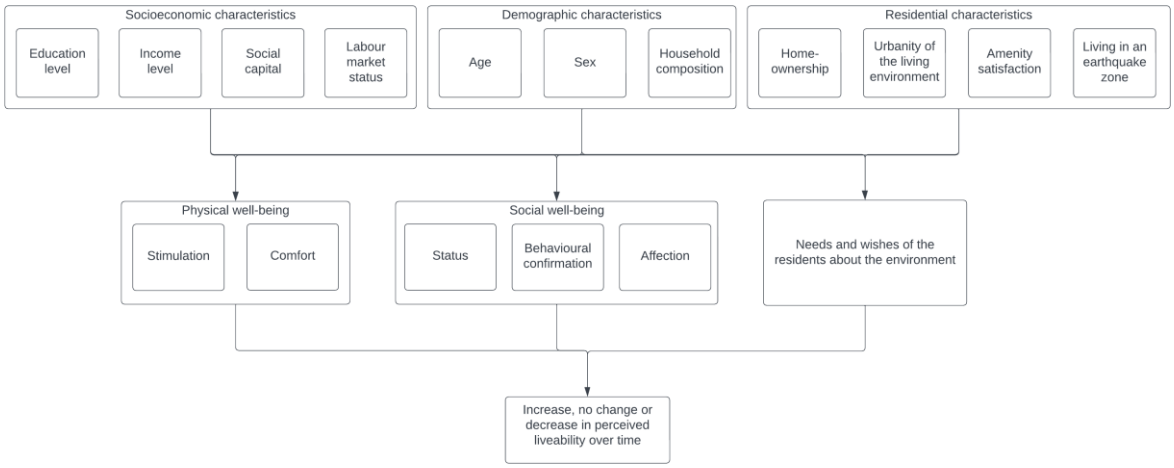


Figure 1: Conceptual model (made by author)

2.4 Hypothesis

The following hypotheses are developed based on the evaluated literature and the conceptual model. These are examined in the study.

Hypothesis 1: It is expected that education level has does not influence change in perceived liveability over time.

Hypothesis 2: It is expected that income level is positively related with change in perceived liveability over time.

Hypothesis 3: It is expected that social capital has a strong positive relationship with change in perceived liveability over time.

Hypothesis 4: It is expected that working is positively related to changes in perceived liveability.

Hypothesis 5: It is expected that age has a positive relationship with change in perceived liveability over time.

Hypothesis 6: It is expected that sex does not have a relationship with change in perceived liveability over time.

Hypothesis 7: It is expected that household composition does not influence change in perceived liveability.

Hypothesis 8: It is expected that homeowners are more likely to experience an increase in perceived liveability.

Hypothesis 9: It is expected that urbanity of the living environment does not influence change in perceived liveability.

Hypothesis 10: It is expected that amenity satisfaction is positively related to change in perceived liveability.

Hypothesis 11: It is expected that living in an earthquake zone negatively influence change in perceived liveability.

3. Methodology

This section will explain and discuss the data collection and analysis methods of this research. It will be used to operationalise the conceptual model explained in the previous chapter. First, the methods of data collection and the dataset will be discussed. Then, the possible panel attrition in the dataset will be analysed and discussed. Subsequently, the socioeconomic, demographic, and residential characteristics will be discussed and operationalised. Lastly, the statistical model used in this research will be discussed and explained.

3.1 Methods of data collection

For this research, a secondary data set of the Sociaal Planbureau Groningen (SPG) will be used, which has been created based on surveys on liveability filled in by the Groninger Panel. The Groninger Panel is an online citizen panel established in 2013 by the SPG. It is a quantitative research instrument used to capture the experiences of the inhabitants of the province of Groningen. This provides the SPG with insights into trends and developments within the province, which can be analysed and interpreted. The Groninger Panel has approximately 6000 members aged 18 and older from diverse backgrounds. The surveys cover various social and societal topics, such as liveability and living environment, effects of earthquakes, changes in healthcare, social connectedness, and resilience (Sociaal Planbureau Groningen, 2023b). The panel is representative of the Groninger population, and participants are selected through invitations and can opt-out at any time (Sociaal Planbureau Groningen, 2023b). They receive approximately ten survey invitations per year, with a total time commitment of approximately 1.5 hours. The panel's results are confidentially treated and publicly reported in publications by SPG. The Groninger Panel has a public function and is managed by SPG, which is part of CMO STAMM and conforms to the regulations for statistics and research (Sociaal Planbureau Groningen, 2023b).

For this research, two surveys of SPG will be combined. These are the surveys Liveability in Groningen (Dutch: Leefbaarheid in Groningen) from 2018 and 2022. The surveys contain data on the perceived liveability in Groningen and the respondent's personal backgrounds, such as age, sex, place of residents, education level, income, and information about the dwelling. The 2018 survey had 2225 responses, while the 2022 survey had 2422 responses, but for the present study, only the respondents who participated in both the 2018 and 2022 surveys of SPG will be selected. Unfortunately, this has reduced the sample size, as only 983 respondents have filled in both surveys. This phenomenon is called panel attrition, where participants who were originally part of a research panel drop out or are lost to follow-up over time. Panel attrition can threaten the sample's representativeness, as it can result in the loss of participants who may be different from those who remain in the study, which can bias the results (Lugtig, 2014). This data limitation will be discussed in more detail later in the chapter.

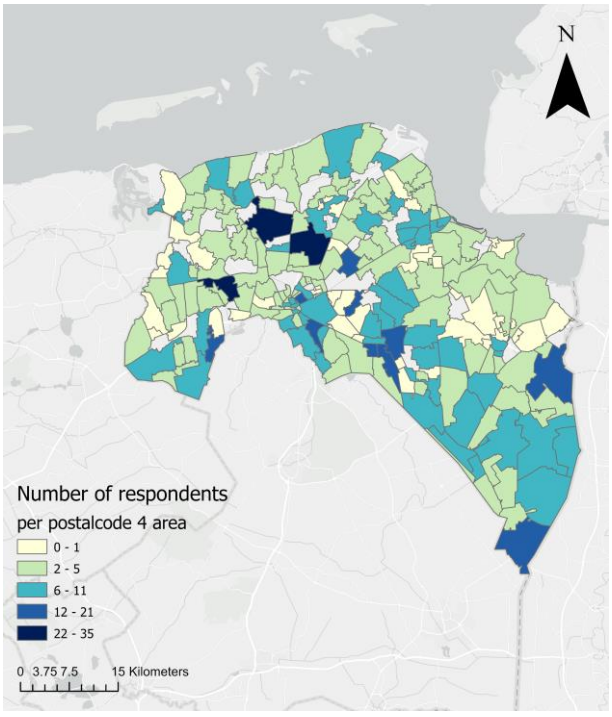


Figure 2: Distribution of the respondent in the sample (made by author).

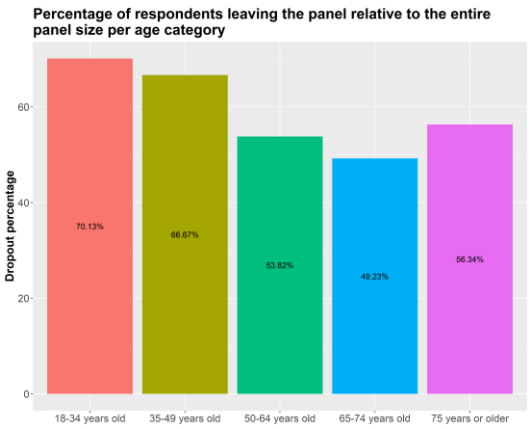
By using the unique identifier of each respondent, it is possible to connect the respondents of the

surveys through multiple years to track their (possible) change in perceived liveability. The perceived liveability in 2018 of each respondent has been compared with their perceived liveability in 2022. Based on the possible difference, each respondent has been categorised as having either a decrease, no change or an increase in perceived liveability. The data editing will be explained in more detail later in the chapter. The geographical distribution of the sample throughout the province of Groningen is visualised in Figure 2.

3.2 Panel attrition

This section will assess the extent of panel attrition in the sample, which can reduce statistical power due to the fewer respondents. When the attrition in the panel is selective, it can lead to biased results, and it is one of the most significant sources of non-sampling errors in panel surveys (Lugtig, 2014). The research of Lugtig (2014) looked at the sociodemographic characteristics of attriters and stayers of panel surveys, and they found that younger individuals are more likely to drop out of a panel compared to older individuals and individuals with lower education levels are more likely to dropout compared to individuals with higher education level. However, males and females are equally likely to be attriter, and urbanicity nor household composition were neither predictors of panel dropout.

As was mentioned before, panel attrition occurred in the Groninger panel between 2018 and 2022. In 2018, the survey on liveability contained 2225 respondents, while only 983 of those respondents also filled in the survey on liveability in 2022. This means that 1228 respondents dropped out of the panel. Descriptive statistics have been made on the group who dropped out between 2018 and 2022 to check the distribution of panel dropout. In Graph 1, the distribution of panel dropout per age category can be found. It shows that as the age categories get older, the panel dropout decreases; it only increases again at the oldest age category. This could be caused by health-related issues which make it difficult to continue participating in the panel. A chi-square test was performed to determine whether panel attrition depends on age categories. By comparing the observed frequencies of panel attrition across age categories with the frequencies that would be expected if panel attrition was independent of age, the test provided a result of a p-value equalling 0.03833, which means that the null hypothesis can be rejected and assumed that there is a significant association between panel attrition and age categories. The results imply that the likelihood of panel attrition varies across different age groups.



Graph 1: Panel attrition per age category.

Furthermore, the chi-square test was also used to examine potential associations between panel attrition and other variables, including sex, education level, perceived liveability grade, social capital, and income category. However, unlike age, these variables did not show a significant association with panel attrition, see Table 2. The results indicate that panel attrition does not significantly differ between sexes, suggesting that male and female participants are equally likely to drop out of the panel. Likewise, education level was not significantly impacting panel attrition rates, indicating that panel dropout was not higher in any particular educational group. Perceived liveability grade was also analysed and was found not to be a determining factor in panel attrition, as was social capital, demonstrating that these aspects did not significantly influence a participant's likelihood of dropout. Lastly, the income category was analysed and found not to have a significant association with panel

attrition, indicating that the propensity for panel attrition was not dependent on a respondent's income level.

These results provide valuable insights into the characteristics of panel attrition in the Groninger panel between 2018 and 2022. Although age was found to be significantly associated with panel attrition, the other factors tested did not show such a relationship. Additionally, it is important to interpret the research findings cautiously when examining the analysis outcomes. Overall, addressing panel attrition in research is crucial for maintaining the validity and reliability of panel surveys and ensuring accurate conclusions can be drawn from the data.

Table 2: Results of the chi-square tests on panel attrition.

Variable	*X-squared*	*Degrees of freedom*	*P-value*
Age category	10,128	4	0,03833
Sex	1,5279	1	0,2164
Education level	1,7585	2	0,4151
Perceived liveability grade	3,8482	9	0,9211
Social capital grade	3,2746	9	0,9524
Income category	1,5124	4	0,8245

3.3 Operationalisation

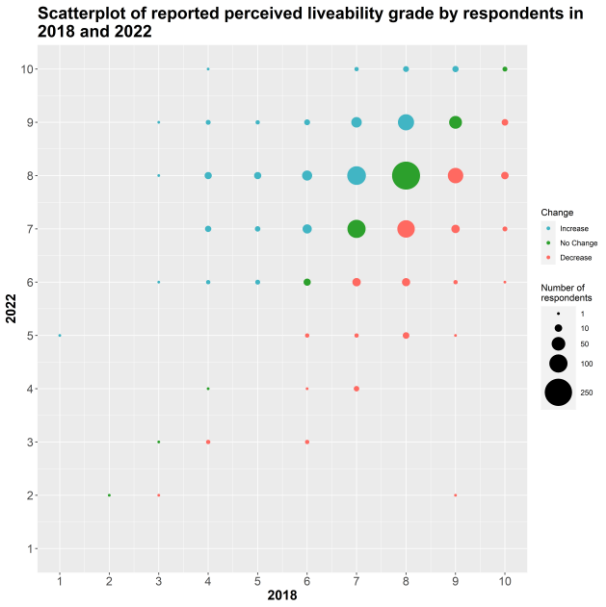
In this section, the operationalisation of the conceptual model will be explained. First, the dependent variable will be explained, change in perceived liveability. Afterwards, the operationalisation of the socioeconomic, demographic, and residential characteristics will be explained respectively.

Dependent variable

The dependent variable used in this research is the change in perceived liveability. This variable will be operationalised using survey data from the SPG. This question is asked in the survey using a rating on a scale from 0-10, 'How satisfied or unsatisfied are you with the liveability in your town or neighbourhood?'. This question was asked in the survey of 2018 and 2022, and based on the answers in both surveys, the dependent variables will be calculated. This will be done by comparing each respondent's perceived liveability in 2018 and 2022. Based on the difference in perceived liveability, the respondent will be categorized into one of three categories, those who experienced an increase, decline or no change in perceived liveability between 2018 and 2022. When categorizing respondents into three distinct categories based on the change in perceived liveability between 2018 and 2022, several consequences arise that need to be considered. Firstly, the categorisation process leads to a loss of granularity, as the specific magnitude of change in perceived liveability is obscured. This can limit the depth of insights gained from the data, potentially overlooking extreme increases or decreases in perceived liveability. Additionally, the categorization masks heterogeneity within each category, hindering the identification of diverse responses. For example, within the 'no change' category, significant differences in liveability ratings may exist, obscuring valuable information about specific subgroups.

With the information provided in Graph 2, sub-question one can be answered. The scatterplot reveals that the largest group of respondents consistently rated their perceived liveability as high in 2018 and

2022. This suggests a stable and positive perception of their town or neighbourhood's liveability over the four-year period. Additionally, the scatterplot highlights the presence of a considerable subgroup that reported relatively low liveability grades in 2018, but significantly higher grades in 2022. This particular group experienced a notable improvement in their perception of liveability over time. The shift from a rating of 6 or lower in 2018 to a higher grade in 2022 indicates a positive change in their assessment. The scatterplot analysis provides valuable visual insights into the distribution and patterns of perceived liveability, shedding light on both the consistently high-rated group and the group experiencing a significant improvement and deterioration in their perception over the studied period.



Graph 2: Scatterplot of perceived liveability in 2018 and 2022.

Due to the nature of the dependent variable, it is prone to regression towards the mean, which is a statistical phenomenon where extreme initial measurements or observations tended to be followed by less extreme ones. Therefore, to control for regression towards the mean, the variable of perceived liveability in 2018 has been included as a control variable in the analysis.

Socioeconomic characteristics

The variables education level, income level, social capital and labour market status are used to operationalise the socioeconomic characteristics. All variables are gathered from the survey Liveability in Groningen and asked in the survey of 2018.

Education level

Regarding the measurement of respondents' highest level of education achieved, the survey posed a question in the 2018 survey. In the survey data, education levels were originally reported in eight categories. However, due to the presence of small categories with a low number of respondents, a decision was made to recategorize the variable into three broader categories: low, intermediate, and high. This recategorization was undertaken to ensure that categories with a small number of respondents would not adversely affect the statistical model's robustness and reliability. The recategorization of the variable can be found in Table 3.

Table 3: Recoding of the variable education level.

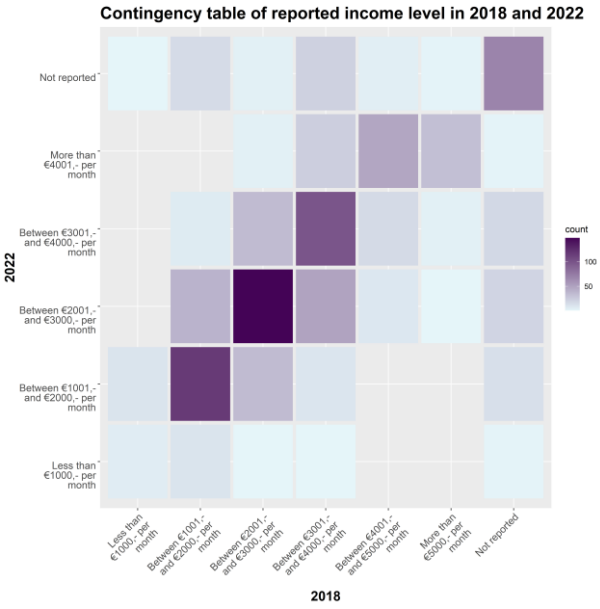
Original category (Dutch)	Original category (English)	New category
Geen opleiding	No education	Low
Basisonderwijs (lagere school)	Basic education (primary school)	
LBO (bv. LTS, LEAO, huishoudschool)	Lower secondary vocational	
VMBO, MAVO (MULO)	Pre-vocational secondary education	
HAVO/VWO (HBS, MULO-B, Lyceum)	Senior general secondary education/pre-university education	Intermediate

MBO (bv. MTS, MEAO, UTS)	Secondary vocational education	
HBO (bv. HTS, HEAO, Sociale Academie, Kweekschool, PABO, HAS, WO-bachelor)	Higher professional education	High
Wetenschappelijk onderwijs (universiteit)	Scientific education (university)	

Income level

When it comes to the variable of income, respondents were requested to report their income within seven distinct categories, spanning from less than €1000 per month to over €5000 per month. The responses have been recoded into three different categories to ensure that all categories have a sufficient number of responses. Respondents who earn less than €2000 per month are coded in the low category, respondents who earn between €2000 and €3000 per month are coded in the intermediate category and respondents who earn more than €3000 per month are coded in the high category. Additionally, it should be noted that a subset of 272 respondents indicated that they either did not know or preferred not to answer the income question in 2018. It is not uncommon to encounter missing values in survey questions concerning income, as many individuals perceive this topic as sensitive and may hesitate to disclose their income information. Nevertheless, these respondents have been categorized as 'Not reported' to ensure their inclusion in the statistical model. Excluding them would diminish the statistical power of the model by reducing the sample size. Therefore, categorizing them as 'Not reported' allows for a comprehensive analysis while acknowledging the presence of missing data points.

Additionally, due to the longitudinal character of the research and of the dependent variable, change in income level also has been added to the model. By utilizing the responses from both the 2018 and 2022 surveys, all participants were categorized into one of three groups based on their income changes: decrease, no change, or increase. A crosstab of the distribution of income in 2018 and 2022 can be found in Graph 3. It can be seen that most respondents stayed in the same income category, however, there is some variation in income between 2018 and 2022. Only few respondents experienced large increase or decrease in income.

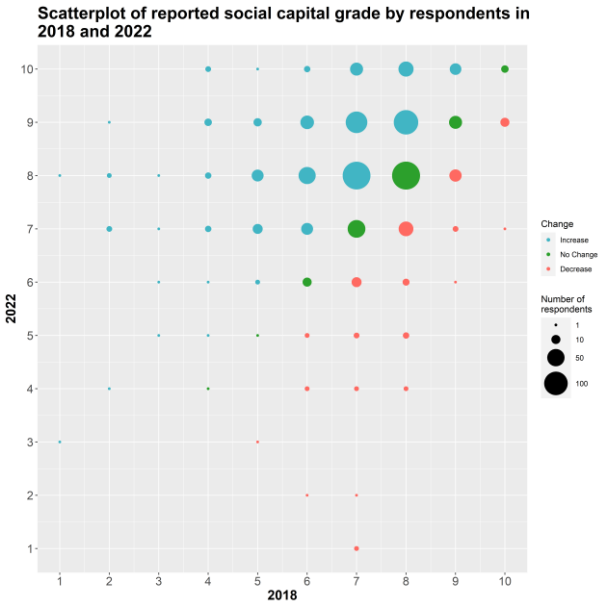


Graph 3: Contingency table of income category in 2018 and 2022.

Social capital

Within the survey, participants were asked to assess their social capital, whereby they were requested to rate their level of satisfaction with their social contacts in their village or neighbourhood on a scale ranging from 1 to 10. For this variable the rating of the social capital of 2018 will be used, and it will be added to the model as a continuous variable.

Additionally, change in social capital between 2018 and 2022 will also be added to the model. By analysing the responses obtained in both 2018 and 2022, the respondents were subsequently classified into one of three categories: decrease, no change, or increase in social capital. This classification process enabled the examination of shifts in social capital over the designated period. A scatterplot of the social capital of the respondents in 2018 and 2022 can be found in Graph 4, the majority of the sample reported their social capital well above average in both 2018 and 2022. However, there exists a notable subgroup within the data, who reported a lower social capital in 2018 but a major increase to a level well above average in 2022. This observed rise in social capital is likely attributable to the lifting of COVID-19 regulations and restrictions, allowing for increased social interactions and heightened appreciation for social connections. The substantial improvement in social capital within this subgroup suggests the significant influence that external circumstances, such as the pandemic, can have on social connections and overall satisfaction with social contacts in a given community or neighbourhood.



Graph 4: Scatterplot of social capital in 2018 and 2022.

Labour market status

In addressing the labour market status of the respondents, a new variable was constructed from two original survey questions: 'Are you currently working?' and 'Are you currently unemployed or retired?'. These two variables were combined to create a single comprehensive variable that represents the labour market status of the participants. The need for recategorization arose due to certain categories having insufficient responses, a situation that could potentially result in unstable estimates and low statistical power of the model (Mehmetoglu & Jakobsen, 2022). Therefore, sparse categories were recoded into broader ones, thus enhancing the precision of the results. A detailed comparison of the original and newly constructed categories is presented in Table 4. For instances where respondents answered 'no' to both initial questions, these were classified as missing data. This classification was done to maintain data integrity and ensure the validity of subsequent analyses.

Table 4: Recoding of the variable labour market status.

Original variable	Original category (Dutch)	Original category (English)	New category
Are you currently employed	Ja, in loondienst	Yes, in employment	Working
	Ja, als zelfstandige	Yes, self-employed	
Are you currently retired or unemployed?	Gepensioneerd, VUT, rentenier	Retired, early retirement or pensioner	Retired, early retirement, pensioner
	(gedeeltelijk) werkloos	(partially) unemployed	Unemployed
	(gedeeltelijk) arbeidsongeschikt/langdurig ziek	(partially) disabled or long-term sick	

Demographic characteristics

Age and sex

In the survey, participants provided their date or year of birth, allowing for the calculation of each respondent's age. Subsequently, by using this variable the age of each respondent has been calculated. These age categories were designed to encompass approximately a 15-year range, starting at 18 years old and extending to 75 years or older. Additionally, during the survey registration process, respondents were also asked to report their sex, providing additional demographic information for analysis. These variables enable a more nuanced examination of the survey findings, allowing for the identification of potential age-related patterns and distinctions based on sex.

Household composition

In the survey, respondents were asked to report their household composition, which refers to the individuals living together and their relationships. It includes family members, relatives, and non-related individuals sharing a common living space. Factors such as the presence of a spouse, children, parents, grandparents, siblings, and other relatives are considered. This information provides insights into household demographics and dynamics, helping to understand the relationships and roles of individuals living together. In the survey the respondents could report in six different categories, however, due to low numbers of respondents in some categories, these six categories have been recoded into three categories. An overview of the recoding can be found in Table 5.

Table 5: Recoding of the variable household composition.

Original category (Dutch)	Original category (English)	New category
Alleenstaand met thuiswonende kinderen	Single with children living at home	Singe with or without children
Alleenstaand zonder (thuiswonende) kinderen	Single without (dependent) children	
Inwonend bij (groot) ouders, familie of verzorgers	Living with (grand)parents, family, or caretakers	
Studentenhuis/woongemeenschap	Student housing/co-living community	
Gehuwd of samenwonend met thuiswonende kinderen	Married or cohabiting with children living at home	Married or cohabiting with children living at home
Gehuwd of samenwonend zonder (thuiswonende) kinderen	Married or cohabiting without (dependent) children	Married or cohabiting without (children) living at home

Residential characteristics

Homeownership

In the survey, participants were asked to indicate whether they are renters or homeowners. The responses were utilized to generate a variable indicating the individual's housing status as either a renter or homeowner. This variable will be employed to examine the potential impact of housing status on changes in perceived liveability. By comparing the experiences of renters and homeowners, it can be explored whether there are any associations or influences between housing status and variations in perceived liveability.

Living in an earthquake zone

During the survey the postal codes of the respondents have been collected. From these postal codes the municipalities of the respondents have been derived, these municipalities have been compared with a list of municipalities qualified as earthquake area by Statistics Netherlands. A municipality is listed as earthquake zone if more than 5% of all dwellings in the municipality are damaged by earthquakes (Centraal Bureau voor de Statistiek, 2016). These municipalities include, according to the municipal arrangement of 2018: Appingedam, Bedum, Delfzijl, Eemsmond, De Marne, Loppersum, Midden-Groningen, Ten Boer and Winsum. A map of the included municipalities can be found in Figure 3.

Figure 3: Municipalities in the province of Groningen marked as earthquake areas in 2018 (made by author).

Urbanity of the living environment

The survey collected respondents' addresses using complete postal codes (PC6). This data was utilized to determine whether participants reside in rural or urban areas. The comparison involved matching the postal codes with address density data from Statistics Netherlands, which classifies areas into different levels of urbanity based on average surrounding address density. Address density refers to the number of addresses within a one-kilometre radius of a given address divided by the area of the circle (Centraal Bureau voor de Statistiek, n.d.). The classification of urbanity is based on the average address density, categorized into five groups or classes for different areas. The average address density of an area is calculated as the mean of the address densities for all addresses within that area. Address density is expressed in addresses per km2, the categorization can be found in Table 6.

Table 6: Categorization of urbanisation level (Source: Centraal Bureau voor de Statistiek, n.d.)

Category	Address density
Very strongly urban	Average of 2500 or more addresses per km2
Strongly urban	Average of 1500 to 2500 addresses per km2
Moderately urban	Average of 1000 to 1500 addresses per km2
Slightly urban	Average of 500 to 1000 addresses per km2
Non-urban	Average of fewer than 500 addresses per km2

Amenities Satisfaction

In the survey, participants were asked to evaluate their satisfaction with local amenities. The question posed was as follows: 'On a scale from 0-10, how would you rate your satisfaction or dissatisfaction with the amenities in your town or neighbourhood?'. This query is intended to operationalise the variable denoted as 'satisfaction with amenities'. For purposes of analysis in the ensuing statistical model, this variable will be incorporated as a continuous variable.

3.4 The model

For the operationalisation of the model, a statistical test is used to determine if there is a relationship between the dependent and independent variables. The strength, direction and significance of the relationship will be determined using the results of the statistical test. In this case, the dependent variable has three unranked categories, and the independent variables consist of nominal, ordinal and ratio variables. In this case, the multinomial logistic regression model is well fit for this application as it allows for an unranked categorical dependent variable with more than two categories (Mehmetoglu & Jakobsen, 2022). An OLS approach is inappropriate because it cannot be assumed that X and Y have a linear relationship, and violation of other OLS regression assumptions would occur. A variation of binary logistic regression that has the advantage of analysing non-binary categorical dependent variables is multinomial logistic regression (Mehmetoglu & Jakobsen, 2022). Various measures have been taken to ensure that all categories have sufficient cases, discussed for each variable in the chapter above. Categories with a small number of respondents can have notable effects on the analysis and interpretation of data. These effects arise due to the limited representation and potential for sampling variability in these categories. When categories have a small sample size, their estimates and statistical results can be more prone to fluctuation, leading to less reliable and robust findings (Mehmetoglu & Jakobsen, 2022). In Table 7, an overview can be found of all variables and their corresponding reference category, which will be used in the statistical model of this research. The selection of reference categories in this study primarily considers two factors: first, the choice of the largest category, and second, the preference for a reference category that enhances the interpretability of the results, especially when all categories possess equal sizes. The number of respondents for each (reference) category can be found in the descriptive statistics in chapter 4.

Table 7: Variables and reference categories of all models.

Category	Variable	Reference category
Dependent variable	Change in perceived liveability	No change
Socioeconomic characteristics	Education level	High
	Income level in 2018	High
	Change in income level	No change
	Social capital in 2018	Not applicable, continuous variable
	Change in social capital	No change
Demographic characteristics	Age	Not applicable, continuous variable
	Sex	Female
	Household composition	Singe with or without children
Residential characteristics	Labour market status	Working
	Homeownership	Homeowner
	Living in an earthquake zone	Not living in an earthquake zone

Urbanity of the living environment	Non-urban
Satisfaction with amenities in the town or neighbourhood	Not applicable, continuous variable

While developing the research methodology for this study, three different statistical models have been used. The first model integrated all variables elaborated in the section Operationalisation, with an added interaction between labour market status and age categories and the perceived liveability grade of 2018. However, the subsequent analyses revealed that the interaction was not statistically significant, suggesting that the effects of labour market status on the dependent variable are consistent across all age categories, and vice versa.

The second model used all the original variables but omitted the interaction identified in the first model, due to its lack of significance. This model provided a simplified version of the first, focusing solely on the direct effects of each variable on the dependent variable. However, after testing the model for multi-collinearity, it appeared that perceived liveability in 2018, social capital in 2018, and satisfaction with amenities in 2018 all scored high on the Variance Inflation Factor (VIF) test, warranting their removal from the model. The results of the VIF test in model 2 can be found in Appendix A. By eliminating these variables, the model was refined to address the issue of multi-collinearity, thereby ensuring more reliable and interpretable results.

The Variance Inflation Factor (VIF) test is a diagnostic tool used to detect the presence of multi-collinearity in regression models (Mehmetoglu & Jakobsen, 2022). Multi-collinearity occurs when two or more predictor variables in the model are highly correlated, which can lead to unstable and unreliable estimates of the regression coefficients. The VIF test quantifies the degree to which a given independent variable is linearly related to the other independent variables. A general rule of thumb is that a VIF value exceeding 5 or 10 indicates severe multi-collinearity that warrants further investigation or action (Mehmetoglu & Jakobsen, 2022). In this study, the high VIF scores of perceived liveability in 2018, social capital in 2018, and satisfaction with amenities in 2018 indicated that these variables were highly correlated with other variables in the model. Consequently, they were excluded to avoid the adverse effects of multi-collinearity, such as inflated standard errors, which can obscure the true relationship between the predictors and the dependent variable. Finally, the third model incorporated all variables, excluding the interaction and the variables with multi-collinearity.

The changes in residual deviance and Akaike Information Criterion (AIC) across the three models provide insights into the models' goodness-of-fit and complexity and can be found in Table 8. Residual deviance is a measure of the lack of fit of a model to the data. A decrease in residual deviance usually indicates a better fit, whereas an increase suggests the model does not fit the data as well. Conversely, AIC takes into account both the goodness-of-fit and the complexity of the model (Mehmetoglu & Jakobsen, 2022). It penalizes adding too many variables to the model. Generally, a lower AIC indicates a better model as it suggests a good trade-off between fit and complexity.

In this case, the increase in residual deviance as the models progressed could indicate that the latter models (2 and 3) may not fit the data as well as model 1. The AIC decreased initially from model 1 to 2, suggesting that the removal of the insignificant interaction in model 2 might have improved the balance between fit and complexity. However, the subsequent increase in AIC for model 3 suggests

that removing the variables due to multicollinearity may have compromised the goodness-of-fit without sufficiently reducing complexity.

Furthermore, two likelihood ratio tests were conducted to compare the goodness of fit between Model 1, Model 2, and Model 3. The comparison between Model 1 and Model 2 yielded a p-value of 0.45, indicating that the addition of parameters in Model 2 did not lead to a significant improvement in model fit compared to Model 1 (Mehmetoglu & Jakobsen, 2022). On the other hand, the comparison between Model 2 and Model 3 resulted in a p-value of 0.001, indicating a highly significant improvement in fit when transitioning from Model 2 to Model 3. These results suggest that the inclusion of additional variables in Model 3 significantly enhances its ability to explain the changes in perceived liveability compared to Model 2. Therefore, Model 3 appears to be a better-fitting model for the given dataset.

That being said, addressing multicollinearity is paramount in ensuring reliable and interpretable results. Multicollinearity can lead to inflated standard errors and unreliable coefficient estimates. Even though model 3 has higher residual deviance and AIC, removing the variables causing multicollinearity is essential to prevent misleading interpretations. The reliability and validity of the conclusions drawn from the model are more important than solely aiming for lower residual deviance and AIC values. It's imperative to achieve a model that is both parsimonious and provides trustworthy estimates for meaningful interpretation and inference.

Table 8: Model specifications.

Model	Residual deviance	AIC
Model 1	1765,994	1900,994
Model 2	1766,609	1890,609
Model 3	1949,260	2061,260

Regression towards the mean

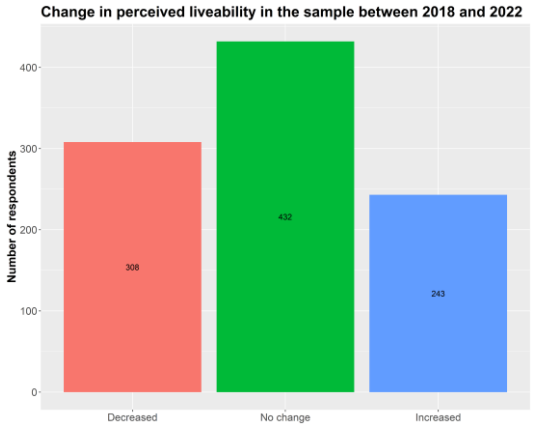
While developing the models discussed above, the variable perceived liveability in 2018 was incorporated into Model 2 to investigate its relationship with changes in liveability over time. The results of Model 2 can be found in Appendix B, this model was not used for the results section as it had severe multicollinearity. The results indicated that individuals with a higher rating of perceived liveability in 2018 were more likely to have experienced a decrease in perceived liveability over time. Conversely, individuals with a lower rating in 2018 were more likely to have experienced increased perceived liveability over time. This pattern of results suggests that regression towards the mean is occurring. Regression towards the mean is a statistical phenomenon where extreme initial measurements are likely followed by measurements closer to the average upon subsequent observations (Barnett et al., 2005). This is not necessarily due to any underlying causal relationship but can be the result of random variation within the data. The implications of these findings are significant. Firstly, it is important to recognize that the changes in liveability might not be due to any inherent changes in the characteristics of the respondents but could instead be a statistical artefact due to regression towards the mean. The interpretation of the results should be done with caution, and the occurrence of regression towards the mean should be kept in mind.

4. Descriptive results

This chapter presents the descriptive statistics of all variables used in Model 3. This means that the descriptive statistics of social capital in 2018, perceived liveability in 2018 and amenity satisfaction in 2018 will not be discussed as they showed multicollinearity and are therefore not included in model 3. The descriptive statistics will add context to the data and more insight into the variables' distribution. Additionally, this chapter will help answer sub-question two as it will provide insight into the socioeconomic, demographic, and residential characteristics of the respondents in the sample.

4.1 Dependent variable

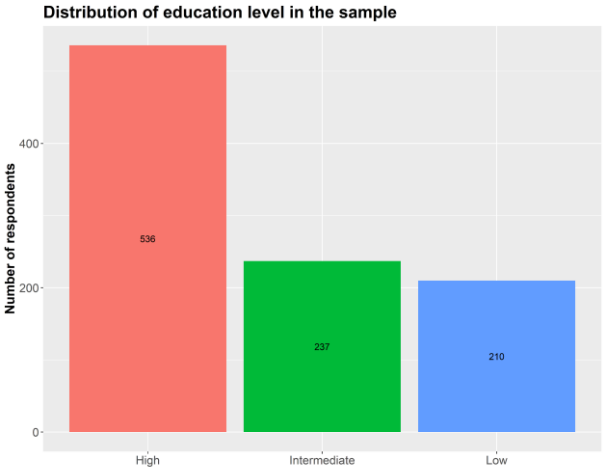
The dependent variable used in this research is the change in perceived liveability. The distribution of this variable can be seen in Graph 5, the categories are relatively equally distributed. The majority of the respondents, 43,95%, did experience no change in perceived liveability, slightly more respondents reported a decrease in perceived liveability compared to an increase in perceived liveability.



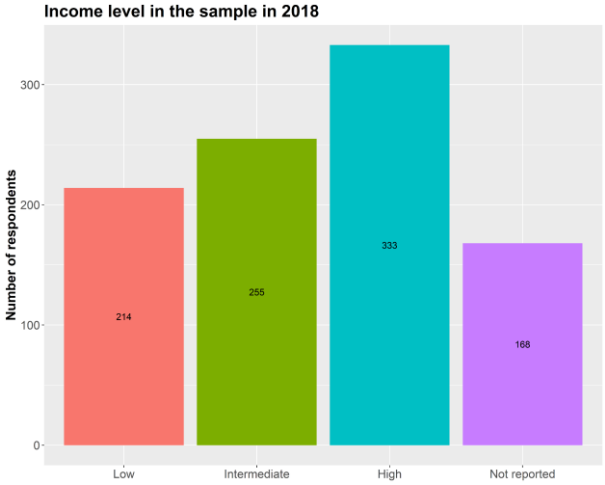
Graph 5: Distribution of change in perceived liveability between 2018 and 2022 in the sample.

4.2 Socioeconomic characteristics

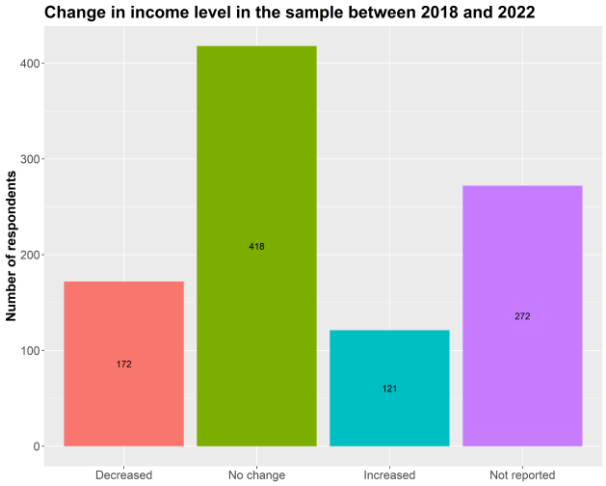
This research uses education level, income level, change in income level, social capital, and labour market status as variables of socioeconomic characteristics to explain their possible relationship to perceived liveability. Graph 6 shows the distribution of the variable education level, it reports the highest achieved education level of the respondent. As can be seen, the majority of the sample has achieved a high education level, around 54,53%, the group of respondents who has achieved an intermediate or lower education level are roughly of equal size. Graph 7 displays the distribution of income level categories in the sample. As can be seen the high-income categories has the largest number of respondents, with the number of respondents decreases as the income categories decrease.



Graph 6: Distribution of education level in the sample.

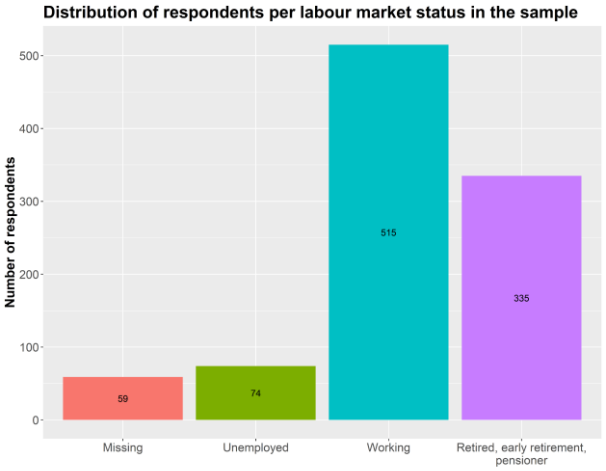


Graph 7: Distribution of income level in the sample.

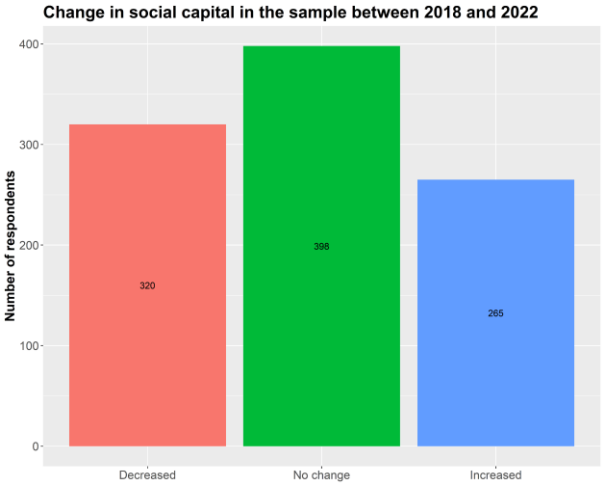


Graph 8: Distribution of change in income level between 2018 and 2022 in the sample.

Graph 8 displays the change in income level between 2018 and 2022. The majority of the respondents, around 42,52% did not experience a change in income level between the two moments of measurement. However, there are slightly more respondents who experienced a decrease compared to an increase in income. The decrease in income is most likely caused by retiring which is very common in the sample. Furthermore, there are 272 respondents who are categorised as missing values because the respondents reported that they did not know or did not want to answer the question in either 2018 or 2022. Therefore, these respondents could not be categorised. A relatively large number of missing values is quite common for survey questions about income, as many people view this as a sensitive topic. The distribution of change in social capital between 2018 and 2022 can be found in Graph 10, the cases are quite equally distributed with a slightly majority of 40,89% who experienced no change in social capital between the two moments of measurement. Meanwhile, Graph 9 focuses on the distribution of respondents according to their labour market status. The majority of the respondents are either working or retired. The number of unemployed respondents and those categorized as 'missing' are approximately the same in the sample.



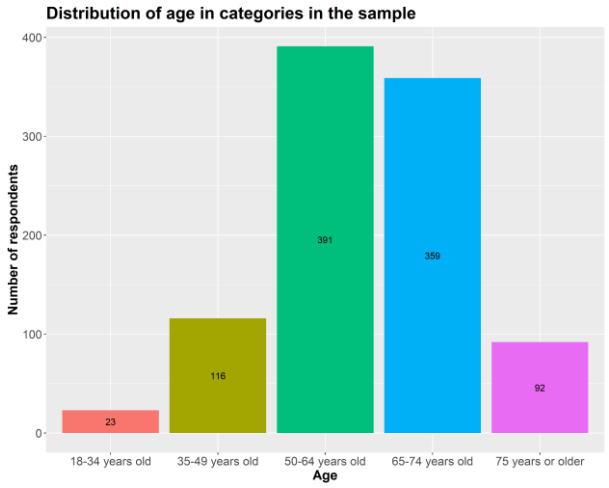
Graph 9: Distribution of labour market status in the sample.



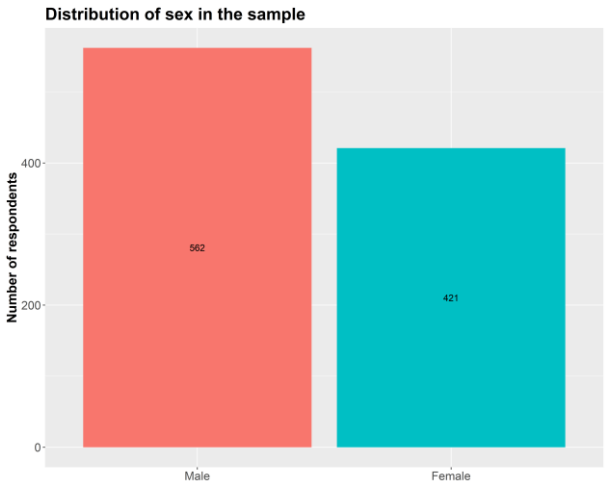
Graph 10: Distribution of change in social capital between 2018 and 2022 in the sample.

4.3 Demographic characteristics

This research uses age category, sex, and household composition as demographic characteristics to try to explain the relationship with perceived liveability. In Graph 11, the distribution of the age categories can be found for the sample in 2018. For this variable the respondents are not equally distributed, the largest age categories are 50-64 and 65-74 years of age. The descriptive statistics of the variable sex can be found in Graph 12, males are slightly overrepresented in the sample.

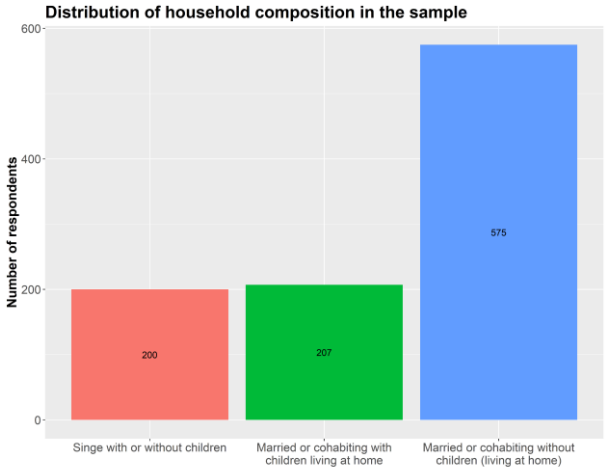


Graph 12: Distribution of age in categories in the sample.



Graph 11: Distribution of sex in the sample.

Graph 13 provides a detailed illustration of the household composition in the sample. Evidently, the graph indicates that a majority of the sample comprises individuals who are either married or cohabiting, regardless of whether they have children residing at home. It's also worth noting that the remaining segments of the sample, which represent two different groups, are of equivalent size.



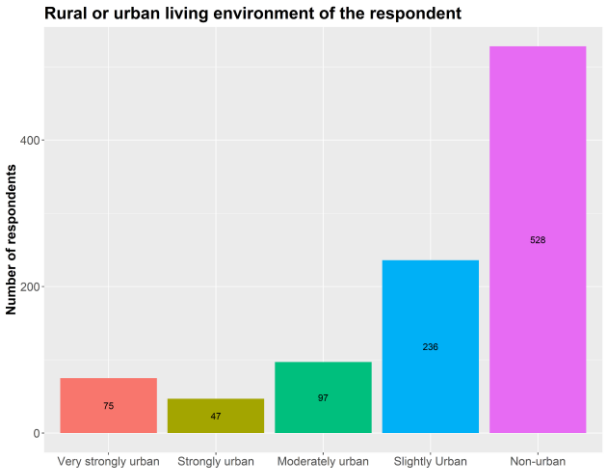
Graph 13: Distribution of household composition in the sample.

4.4 Residential characteristics

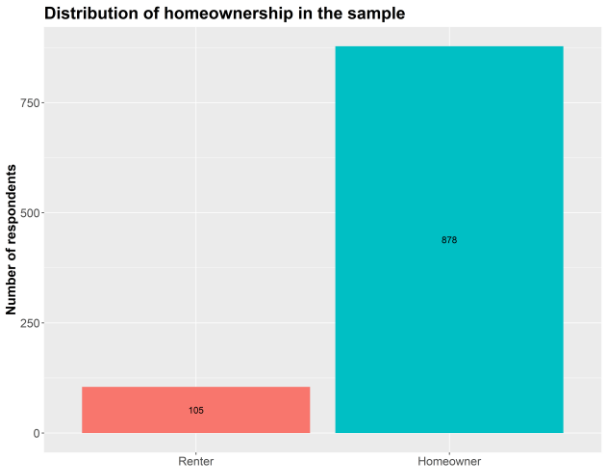
Graph 15 shows the distribution of homeownership in the sample, as can be seen the majority of respondents with 89,32% are homeowners, versus 10,68% of the respondents who are renters. Graph 14 shows the distribution of respondents according to the urbanity of their living environment. The majority of respondents with 53,71% are living in a non-urban area. This is most likely due to the fact that the majority of the research area is qualified as non-urban area, only regions near the city of Groningen, Hogezand, and Veendam are more urban areas (Centraal Bureau voor de Statistiek, 2022). To examine if the distribution of urbanity of the living environment of the respondents in the sample is similar to that of the actual population of the province of Groningen, a comparison has been made which can be found in Table 9, The population of the non-urban and slightly urban areas are overrepresented in sample, while the population in moderately urban, strongly urban, and very strongly urban areas are underrepresented in the sample.

Table 9: Urbanity of the living environment in the sample compared to the target population (source: Centraal Bureau voor de Statistiek, 2022).

Urbanity of the living environment	Number of respondents in the sample	Percentage of the total sample size	Number of residents	Percentage compared to the total province
Non-urban	528	53,37%	197.170	33,82%
Slightly urban	236	24,01%	113.970	19,55%
Moderately urban	97	9,87%	80.520	13,81%
Strongly urban	47	4,78%	64.960	11,14%
Very strongly urban	75	7,63%	126.330	21,67%

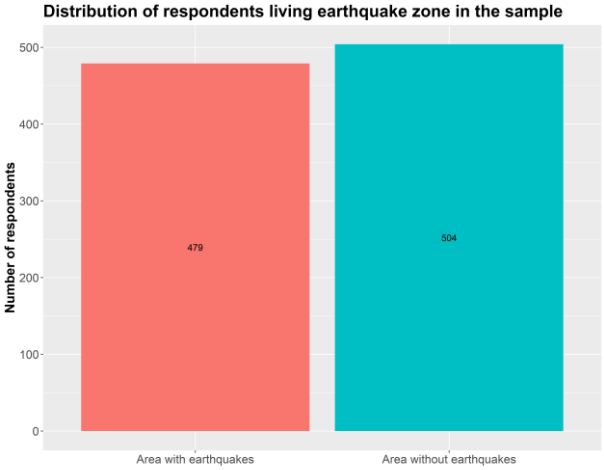


Graph 14: Distribution of urbanity of the living environment in the sample.



Graph 15: Distribution of homeownership in the sample.

The distribution of respondent who live in an earthquake zone are presented in Graph 16, the respondents are quite equally distributed, with a slight majority of 51,27% not living in an earthquake zone.



Graph 16: Distribution of respondents living in an earthquake zone in the sample.

5. Results

In this section, the results of the multinomial logistic regression model, which can be found in Table 10, will be discussed. It will be done in separate sections for socioeconomic, demographic, and residential characteristics.

5.1 Socioeconomic characteristics

Examining the results from the multinomial logistic regression model, it shows that the results are mixed. First of all, education level does not significantly influence change in perceived liveability. This finding confirms Hypothesis 1, which projected that the education level would not be a determining factor in influencing changes in the perception of liveability. This observation implies that the liveability perceptions remain consistent across the different education levels, reinforcing the expectation that these perceptions are not dependent on the educational attainment of individuals. This validates Hypothesis 1 and adds credibility to the broader understanding of factors contributing to perceived liveability over time.

Secondly, static income level appears to significantly influence change in perceived liveability. Individuals in the low-income category have 1.67 higher odds to experience a decrease in perceived liveability than no change compared to individuals in the high-income category. This is also the case for individuals who have not reported their income level; they have 1.85 higher odds of experiencing a decrease in perceived liveability than no change compared to individuals who are in the high-income category. For all other categories, the results are not statistically significant. With these results, Hypothesis 2 can be rejected, as high income is not associated with increases in perceived liveability. Additionally, the results show that changes in income level over time do not significantly impact changes in perceived liveability.

Furthermore, the category decrease in social capital is significant for the decrease in perceived liveability. This means that individuals who have experienced a decrease in social capital have 2.21 higher odds of experiencing a decrease rather than no change in perceived liveability compared to individuals who have experienced no change in social capital. Furthermore, individuals who have experienced an increase in social capital have 1.63 higher odds of experiencing an increase rather than no change in perceived liveability compared with individuals who have experienced no change in social capital. These results confirm the suggestion of Hypothesis 3, that increase in social capital has a positive relationship with change in perceived liveability.

Lastly, the results of labour market status are only significant for one of the categories. The results suggest that retired individuals have 0.64 lower odds of experiencing an increase in perceived liveability rather than no change compared to working individuals. It is important to note that the other categories within labour market status did not show significant results. This might indicate that, apart from retirement, other labour market statuses, such as unemployment, do not substantially affect the change in perceived liveability compared to being employed. These results reject Hypothesis 4, as working does not positively influence change in perceived liveability.

To conclude, socioeconomic characteristics influence perceived liveability. While education level and change in income level do not influence change in perceived liveability, static income level, change in social capital and labour market status significantly influence change in perceived liveability. These findings underscore the value of occupation and social networks on change in perceived liveability. However, these findings will be further discussed in the next chapter.

Table 10: Output multinomial logistic regression model 3.

Reference category dependent variable: no change	Decreased		Increased	
	Odds ratio	p-value	Odds ratio	p-value
(Intercept)	0.55	0.1	0.51	0.085*
Education level (ref. high)				
Intermediate	1.25	0.3	1.01	>0.9
Low	1.02	>0.9	1.09	0.7
Income level in categories 2018 (ref. high)				
Intermediate	1.4	0.13	0.88	0.6
Low	1.67	0.066*	0.92	0.8
Not reported	1.85	0.072*	0.94	0.9
Change income level (ref. no change)				
Decreased	1.17	0.5	1.21	0.4
Increased	1.28	0.3	1.46	0.2
Not reported	0.75	0.3	0.94	0.8
Change Social Capital (ref. no change)				
Decreased	2.21	<0.001*	1.08	0.7
Increased	0.74	0.2	1.63	0.015**
Labour market status (ref. Working)				
Missing	0.71	0.4	0.5	0.14
Retired, early retirement, pensioner	0.85	0.5	0.64	0.09*
Unemployed	1.2	0.6	0.89	0.7
Age category (ref. 50-64 years old)				
18-34 years old	2.26	0.13	1.72	0.4
35-49 years old	1.24	0.4	1.53	0.14
65-74 years old	1.02	>0.9	1.59	0.071*
75 years or older	0.86	0.7	1.12	0.8
Sex (ref. female)				
Male	0.8	0.2	1.08	0.7
Household composition (ref. singe with or without children)				
Married or cohabiting with children living at home	0.78	0.4	0.82	0.5
Married or cohabiting without (children) living at home	0.96	0.9	0.78	0.3
Homeownership				
Renter	1.04	0.9	1.18	0.6
Urbanity of the living environment (ref. non-urban)				
Moderately urban	0.65	0.13	0.94	0.8
Slightly Urban	0.56	0.003***	0.45	<0.001***
Strongly urban	0.99	>0.9	0.33	0.023**
Very strongly urban	0.63	0.2	0.8	0.5
Living in an area with earthquakes (ref. area without earthquakes)				
Area with earthquakes	1.26	0.2	1.48	0.029**

*** p<0.01, **p0.05,* p<0.1

5.2 Demographic characteristics

The results of the demographic characteristics show that the outcomes are predominantly insignificant. Regarding the outcomes of the variable age, this variable is only significant for the category 65-74 years old. This means that individuals 65-74 years old have 1.59 higher odds of experiencing increased perceived liveability rather than no change compared to individuals 50-64 years old.

The findings suggest that age is only a substantial predictor of experiencing change in perceived liveability for one age category. With these results, Hypothesis 5 cannot be accepted, as age does not positively influence change in perceived liveability for all categories. The variable sex has no significant relationship with experiencing change in perceived liveability. The results suggest that males or females are equally likely to have experienced changes in perceived liveability. This confirms hypothesis 6, that sex does not have a relationship with change in perceived liveability over time.

The results revealed no statistically significant relationship between household composition and change in perceived liveability. This suggests that alterations in the structure or size of households do not predict changes in perceived liveability. Rejecting the proposition of Hypothesis 7. This finding informs the understanding of demographic influences, indicating that household composition may not be a key determinant of perceived liveability. These results underline the potential for other factors to play a more substantial role in influencing perceived liveability.

In conclusion, the analysis of demographic characteristics revealed that, in general, they do not play a significant role in predicting changes in perceived liveability, except for the age category of 65-74 years old. Specifically, individuals aged 65-74 are more likely to experience an increase in perceived liveability compared to those aged 50-64. This finding illustrates that age is not uniformly predictive of changes in perceived liveability across all age categories. Additionally, the results highlighted that males and females have similar odds of experiencing changes in perceived liveability. Moreover, household composition was unrelated to changes in perceived liveability, suggesting that family structure or size are not critical determinants. This reinforces the notion that other factors outside the examined demographic characteristics may have a more pronounced influence on perceived liveability.

5.3 Residential characteristics

Looking at the results of residential characteristics, the outcomes are quite varied. Concerning homeownership, this variable appears not to be a significant predictor of change in perceived liveability. This suggests that renters and homeowners are equally likely to experience increase, no change or decrease in perceived liveability. These findings reject Hypothesis 8, as homeownership does not positively influence change in perceived liveability.

Regarding the urbanity of the living environment, the category slightly urban is significant for both categories of the dependent variable with a p-value of 0.003 for decreased and <0.001 for increased. This suggests that individuals who live in a slightly urban environment have 0.56 lower odds of experiencing a decrease compared to no change in perceived liveability compared to individuals who live in non-urban areas. Individuals who live in a slightly urban environment have 0.45 lower odds of experiencing an increase compared to no change in perceived liveability compared to individuals who live in non-urban areas. These findings suggest that individuals living in slightly urban areas are more inclined to experience no change in perceived liveability. Additionally, individuals who live in a strongly urban environment have 0.33 lower odds of experiencing a decrease compared to no change in perceived liveability compared to individuals who live in non-urban areas. The results are insignificant for all other living environments, suggesting that individuals of very strongly urban and moderately

urban areas are equally likely as the reference category to experience increase, no change or decrease in perceived liveability. These results reject Hypothesis 9, as the urbanity of the living environment appears to influence change in perceived liveability.

The variable living in an earthquake zone is a significant predictor with a p-value of 0.029. This suggests that individuals living in an earthquake zone have 1.48 higher odds to have experienced an increase than no change in perceived liveability compared to individuals not living in an earthquake zone. These results reject Hypothesis 11, that living in an earthquake zone negatively influences change in perceived liveability.

These findings underscore the varied effects of residential characteristics on changes in perceived liveability. Specifically, the urbanity of the living environment and living in an earthquake zone demonstrate significant associations with changes in perceived liveability, while homeownership does not emerge as a significant predictor. Considering these results within the broader context of other potential factors influencing perceived liveability changes is essential, facilitating a comprehensive understanding of the interplay between residential characteristics and individuals' perceptions.

6. Discussion

This section will discuss the research results in more detail and compare them with the reviewed literature. Furthermore, the limitations of the research will also be discussed. Firstly, the results of the socioeconomic characteristics are partially in line with the findings in the literature. From the literature, it was expected that income level would have a positive relationship with perceived liveability, as higher income would lead to higher perceived liveability (Biswas-Diener, 2009; Diener, 2012; Ng & Diener, 2014; Read et al., 2016; Reyes et al., 2020). However, the results showed that this effect is only valid for the low-income category; those with low income are more likely to experience a decrease in perceived liveability. These findings indicate that the impact of income on perceived liveability is more pronounced at the lower end of the income spectrum. It could also imply that, beyond a certain threshold, income may have a diminishing effect on changes in perceived liveability. Furthermore, changes in income level over time do not significantly impact changes in perceived liveability.

The results of education level on change in perceived liveability show interesting parallels and differences with the reviewed literature. This research found that education level is not a significant predictor of change in perceived liveability; this corresponds to the findings of Pandey et al. (2014b). Nevertheless, a contrast emerges when considering other literature suggesting that individuals with higher education levels tend to experience more annoyance - a measure often used as a proxy for perceived liveability (Marsman & Leidelmeijer, 2001; Miedema & Vos, 1999). While the findings support that education level does not directly impact change in perceived liveability, the literature implies that it may indirectly affect it via increased annoyance. While education might influence some aspects of how liveability is perceived, it is not the main factor driving its change. Despite higher-educated individuals possibly being more sensitive to their environment and feeling more annoyed, this does not alter their perceived liveability significantly.

The results of this study correlate with the findings in the literature on social capital, as it was expected that social capital has a strong relationship with perceived liveability (Li & Zhang, 2021; Marsman & Leidelmeijer, 2001). The results suggest that those who experience an increase in social capital are likely to experience an increase in perceived liveability, while those who experience a decrease in social capital are likely to experience a decrease in perceived liveability. Furthermore, the results on the labour market status do partially not correspond with the findings in the literature. The literature suggests that employment is more beneficial for perceived liveability than unemployment (Namazi-Rad et al., 2016). However, the results showed no significant relationship between unemployment, employment and change in perceived liveability.

Regarding the findings on demographic characteristics, the results on the influence of sex on change in perceived liveability correspond with the findings in the literature. Men and women are equally likely to experience a change in perceived liveability, as was mentioned by the research of Giusta et al. (2011). This demonstrates that, despite potential differences in the drivers of perceived liveability between sex, the likelihood of experiencing a change in liveability appears to be irrespective of sex. The literature suggests that older individuals tend to have a higher perceived liveability than younger individuals, with older individuals tending to view their living environment more positively (Leidelmeijer & Marsman, 1999; Marsman & Leidelmeijer, 2001). Which is supported by results from this study, as individuals 65-73 years old are more likely to experience an increase in perceived liveability compared to individuals 50-64 years old.

The results on household composition partially correspond with the findings in the literature. It was expected that households with children experience more annoyance from road traffic noise but rate

their perceived liveability higher overall than individuals living alone. While multi-person household experience more annoyance from air traffic. However, this study found no significant relationship between household composition and change in perceived liveability, which suggests that all household compositions are equally likely to experience a change in perceived liveability.

Regarding the urbanity of the living environment, these results are not in line with the findings in the reviewed literature. In the literature, no consensus was found on the relationship between perceived liveability and the urbanity of the living environment. This study showed that individuals living in slightly urban environments are more likely to experience no change in perceived liveability rather than non-urban areas. Furthermore, there is a similar effect for individuals living in strongly urban areas. Besides these results, all other categories are equally likely to experience a change in perceived liveability. Furthermore, the literature found that the relationship between homeowners and renters and perceived liveability is not straightforward (Marsman & Leidelmeijer, 2001). The results support this, as no significant relationship was found between homeownership and change in perceived liveability.

The impact of living in an earthquake zone on perceived liveability reveals a discrepancy between the literature and the research findings. While literature suggests a negative impact on perceived liveability from living in an earthquake zone (Sluiter et al., 2018), this research indicates that individuals living in such zones are significantly more likely to experience an increase in perceived liveability compared to those outside these areas. This counter-intuitive result is likely due to a paradigm shift in addressing earthquake-related issues. Since 2018, the earthquake zone has received increased attention, as the Nationaal Programma Groningen has been established (Nationaal Programma Groningen, 2018), additional financial compensation in 2019 (Provincie Groningen, 2019) and 2020 (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2020). This enhanced focus and intervention appear to have a compensatory effect, improving residents' quality of life and increasing perceived liveability. This indicates that, despite the inherent challenges of living in earthquake zones, which are typically viewed as negatively impacting liveability, introducing policy responses and compensation schemes may contribute positively to perceived liveability.

To conclude the discussion, this research only provides selected evidence on the influence of socioeconomic, demographic, and residential characteristics on change in perceived liveability. Most of the chosen variables do not significantly influence change in perceived liveability. While a positive relationship was expected for factors such as income and education level, this was not substantiated in this study. Instead, these factors presented no significant influence on the change in perceived liveability, suggesting that factors beyond socio-economic characteristics contribute to changes in perceived liveability. This result prompts a deeper examination of other factors, and their interactions, in influencing change in perceived liveability.

Interestingly, despite the generally accepted notion that adverse environmental factors such as living in an earthquake zone would reduce perceived liveability, this research found that the increased focus, intervention, and compensation policies offered to residents in these areas appear to enhance perceived liveability. This finding implies that policies directed towards improving the quality of life can mitigate the potentially negative impact of environmental adversities on perceived liveability.

Lastly, this study highlighted that individual characteristics do not exclusively influence perceived liveability but are also tied to residential factors, such as urbanity and amenity satisfaction. While the literature suggested a positive relationship between amenity satisfaction and perceived liveability, the current research indicated an inverse relationship. This discrepancy could be attributed to the focus of

this study on change in perceived liveability, introducing a dynamic perspective on perceived liveability and its determinants.

This research calls for a more comprehensive understanding of perceived liveability beyond static measurements and proposes further exploration into the dynamics of these relationships. Future research might benefit from a longitudinal study design to capture the time-varying nature of perceived liveability and further delve into the relationships between various factors and their influence over time. Moreover, a more detailed examination of the influence of interventions on perceived liveability, especially in areas facing environmental challenges, could provide important insights into formulating policies aimed at improving perceived liveability.

6.1 Limitations and recommendations

This chapter aims to provide a transparent evaluation of the possible limitations encountered during the execution of this research. These limitations may have influenced the results and interpretations derived from the study, and they should be considered when understanding the research implications.

The first limitation to be addressed is the non-response bias. This study might not have captured responses from certain segments of the population, notably those too occupied or not motivated to participate in the survey, such as working individuals or caregivers. These groups may have distinct perspectives on liveability not represented in the study. Non-response bias emerges when the individuals who did not participate have systematically different views or characteristics compared to those who did. This leads to biased estimates as the sample may not accurately reflect the true diversity and sentiments of the entire population. This can be seen in the age demographic of the research sample. The respondents were predominantly older individuals as they are more inclined to participate in a survey, which does not represent the overall demographic makeup of the province of Groningen. However, as age was included in the model, this should control for the aged sample. Therefore, effectively adjusting for the influence it might have on the results. In other words, even though the sample may lean towards older individuals, the effects attributable to age are accounted for in the model.

This research employed a longitudinal study design, where the same participants were required to respond to the survey twice over a given period. This led to an attrition bias where younger respondents were less likely to complete both surveys. This may have skewed the results and may not accurately represent the views of the entire population.

Lastly, it is important to acknowledge that regression towards the mean is evidently occurring in the data. This is relevant in this study because individuals who reported very high or low perceived liveability in the first survey might have reported closer to the mean in the second survey, not necessarily due to changes in their environment but due to this statistical effect. This could have led to over or underestimating changes in perceived liveability over time.

Further research into the drivers of change in perceived liveability could be interesting. Given that many socioeconomic, demographic, and residential characteristics do not significantly influence this change, it would be interesting to investigate which factors play a significant role. Additionally, extending the timeframe of the study to a period of 10 years could provide more comprehensive insights. This expanded interval in the longitudinal research would allow researchers to examine the effect of change in education level and the effect of relocation on perceived liveability.

7. Conclusion

This thesis examined the influence of socioeconomic, demographic, and residential characteristics on change in perceived liveability between 2018-2022 in the province of Groningen. It is relevant to research the drivers behind change in perceived liveability because the province of Groningen exhibits a lower level of perceived liveability than the rest of the Netherlands. The reviewed literature identified different socioeconomic, demographic, and residential characteristics influencing perceived liveability and change in perceived liveability. Survey data from the Groninger Panel from the Sociaal Planbureau Groningen was used to operationalise these variables. Descriptive statistics provided insight into the data, and a multinomial logistic regression model was used to identify a possible relationship between the dependent and independent variables. Different models were tested to ensure the best model fit for the data.

Only part of the socioeconomic, demographic, and residential characteristics significantly influence change in perceived liveability, including income level, changes in social capital, labour market status, age category, the urbanity of the living environment, and living in an earthquake zone. It was found that increases in social capital, the age category 65-74 years old, and living in an earthquake zone are positively related to change in perceived liveability. On the other hand, low and not reported income and decreased social capital are negatively related to change in perceived liveability. Slightly urban and strongly urban areas are related to no change in perceived liveability. This answers the research question, only a selection of the analysed socioeconomic, demographic, and residential characteristics significantly influence change in perceived liveability in the province of Groningen between 2018 and 2022.

These results are helpful for policymakers and suggest that interventions aimed at improving liveability should focus on enhancing social capital, helping individuals in lower income categories, managing urban and rural living conditions, and addressing the issues related to living in earthquake zones. However, it is important to note that these findings are specific to 2018-2022 and may evolve over time. Future research should seek to expand upon these findings, potentially employing a longer study timeframe to discern patterns and changes in perceived liveability over a more extended period. It is important to acknowledge the variables that did not significantly influence changes in perceived liveability: change in income level, education level, sex, household composition, and homeownership. While these results might seem less remarkable than significant findings, they hold valuable insights and present an opportunity to re-evaluate existing assumptions and policies.

The limitations of this research primarily originate from its sample composition and methodology. The sample was skewed towards older individuals, potentially limiting the generalizability of the findings to the broader population. However, the model's incorporation of age as a variable offers some control over this bias. Attrition bias could have influenced the findings, as individuals with low perceived liveability might have been less likely to complete both surveys. Also, regression towards the mean could have impacted the results, with initial extremes of perceived liveability potentially normalizing over time due to statistical effects rather than actual changes in characteristics.

In light of these limitations, future research should explore additional drivers of change in perceived liveability, especially those not identified as significant in this study. Additionally, expanding the research timeframe to 10 years may offer a more robust understanding of long-term changes in perceived liveability, including the effects of changes in education level and relocation.

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Appendix A: Results of the VIF-test on Model 2

Variable	VIF
Perceived liveability 2018	12.6737
Change income level	1.4819
Income 2018 in categories	1.4847
Education level 2018	1.3260
Change Social Capital	1.4142
Social capital 2018	8.6342
Age	8.1514
Sex	1.6755
Household composition	1.8015
Life course stage	1.3146
Urbanity of the living environment	1.2017
Homeownership	1.2489
Living in an earthquake zone	1.5909
Satisfaction with amenities	6.4247

Appendix B: Output multinomial logistic regression Model 2

Reference category dependent variable: no change	Decreased		Increased	
	Odds ratio	p-value	Odds ratio	p-value
(Intercept)	0.02	<0.001***	18	<0.001***
Perceived liveability 2018	2.25	<0.001***	0.46	<0.001***
Education level (ref. high)				
Intermediate	1.3	0.2	0.99	>0.9
Low	1.05	0.8	1.17	0.5
Income level in categories 2018 (ref. high)				
Intermediate	1.57	0.054*	0.86	0.5
Low	1.64	0.09*	0.87	0.7
Not reported	1.88	0.076*	0.98	>0.9
Change income level (ref. no change)				
Decreased	1.23	0.4	1.12	0.7
Increased	1.36	0.2	1.42	0.2
Not reported	0.83	0.5	0.76	0.4
Social capital 2018	0.72	<0.001***	1.42	<0.001***
Change Social Capital (ref. no change)				
Decreased	2.09	<0.001***	0.98	>0.9
Increased	0.55	0.011**	1.86	0.005***
Labour market status (ref. Working)				
Missing	0.87	0.7	0.34	0.034**
Retired, early retirement, pensioner	0.88	0.6	0.61	0.067*
Unemployed	1.21	0.6	0.81	0.6
Age category (ref. 50-64 years old)				
18-34 years old	2.22	0.14	1.94	0.3
35-49 years old	1.24	0.5	1.48	0.2
65-74 years old	0.91	0.7	1.64	0.067*
75 years or older	0.75	0.4	1.29	0.5
Sex (ref. female)				
Male	0.92	0.6	1.04	0.8
Household composition (ref. singe with or without children)				
Married or cohabiting with children living at home	0.8	0.5	0.73	0.3
Married or cohabiting without (children) living at home	1.03	>0.9	0.68	0.14
Homeownership (ref. homeowner)				
Renter	1.2	0.5	0.89	0.7
Urbanity of the living environment (ref. non-urban)				
Moderately urban	0.67	0.2	1.16	0.6
Slightly Urban	0.58	0.01**	0.61	0.035**
Strongly urban	0.97	>0.9	0.48	0.2
Very strongly urban	0.73	0.4	0.87	0.7
Living in an area with earthquakes (ref. area without earthquakes)				
Area with earthquakes	1.31	0.12	1.29	0.2

Satisfaction with amenities	0.89	0.082*	0.97	0.7

*** p<0.01, **p0.05,* p<0.1