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Thesis: **The influence of the urban built environment on the happiness of residents in Rotterdam**

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The influence of the urban built environment on the happiness of residents in Rotterdam

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Summary

In the field of happiness economics, there is limited literature on the influence of places on subjective well-being. Much of the research on the determinants of happiness have focused on individual or life circumstances such as income, health, family and social life, and work while environmental factors relating to the spatial and built environment are less common. There is a growing number of studies which have shown that characteristics of places have an impact on people's well-being but the empirical evidence is still scarce particularly in cities where the physical environment is a ubiquitous part of life.

The main objective of this research is to determine the characteristics of the built environment that significantly affect city residents' happiness, life satisfaction and satisfaction in different urban life domains. The role of urban life domains in predicting subjective well-being is also examined. The research used the bottom-up model on life satisfaction and satisfaction from the urban life domains of housing, neighbourhood and the city to predict subjective well-being. The mediating role of urban life domains was also studied to better understand the effect of the built environment on subjective well-being.

A survey was conducted in two types of neighbourhoods in the city of Rotterdam, one in a highly built-up area and another in a less built-up area. Secondary data was also gathered from official sources. The data was analyzed through multiple ordered probit regressions following Baron and Kenny's (1986) approach to mediation analysis.

The research provides empirical evidence that the built environment has a direct effect and can predict happiness and life satisfaction as well as satisfaction in urban life domains. The built environment characteristics that were found to be significant to both happiness and life satisfaction are house size satisfaction, estimated travel time from home to work, access to parks and green areas in the neighbourhood, access to medical facilities in the neighbourhood, access to sports facilities in the neighbourhood, satisfaction with city education services and city traffic perception.

City satisfaction has a direct positive effect on happiness and life satisfaction. This means that city-wide services and the overall perceived quality of life in the city are important to the well-being of city residents included the study. Thus, in addition to supporting the direct effect of the built environment on subjective well-being, this research also provides evidence that city living exerts a strong influence on subjective well-being. Among the urban life domains, it was the only one that was statistically significant to both measures of subjective well-being. Housing satisfaction is also significant to life satisfaction, however it is negatively associated.

On the mediation analysis, mediation was not found to be a key characteristic of urban life domains. Partial mediation through city satisfaction was only proven twice; first, between satisfaction with city maintenance services and happiness and second, between satisfaction with city education services and life satisfaction. Thus, urban life domains do not transmit a large extent of the effects of significant built environment characteristics on happiness and life satisfaction. The built environment on its own has a bigger impact on subjective well-being without the intervening role of urban life domains.

The results of the study have several important implications to the bottom-up model of life satisfaction. First, it weakly supports the model in the context of urban life domains since only city satisfaction emerged as significant and shows that the bottom-up approach is inapplicable for urban life domains at the housing and neighbourhood level. Instead, specific house and neighbourhood characteristics play a greater role in determining subjective well-being than overall housing and neighbourhood satisfaction. Thus, the importance of life domains, particularly urban life domains, on subjective well-being can be overstated. The

bottom-up model could also be an overly simplistic and deterministic approach to examine the relationship between the built environment and subjective well-being since other non-urban domains and individual characteristics can exert a stronger or moderating influence on subjective well-being. However, these other domain satisfactions were not covered by the study.

The study is limited by the small sample size which does not make the findings generalizable to the neighbourhoods and the city where it was conducted. The small sample could also have made the effects of some variables statistically insignificant. Therefore, it is recommended for further research to have a larger sample size across a wide variety of neighbourhoods to be able to generalize to a larger population. For policy, the strong significance of city satisfaction implies that improvements in the city should not only be targeted to specific areas or neighbourhoods but to enhance the overall quality of life in the city. Furthermore, the built environment characteristics which are significant both to happiness and life satisfaction can be given more consideration in city planning and management especially in the neighbourhoods in Rotterdam where the study was conducted.

Keywords

Built environment, Happiness, Life satisfaction, Quality of life, Mediation analysis

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Abbreviations

IHS	Institute for Housing and Urban Development
OECD	Organisation for Economic Co-operation and Development
QOL	Quality of Life
QOUL	Quality of Urban Life
SCP	Smart City Planner
SWB	Subjective well-being
VIF	Vector Inflator Factor

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Chapter 1: Introduction

1.1 Background

This research examines the influence between the built environment on the happiness of residents in the city of Rotterdam, the Netherlands. In particular, it identifies characteristics of the built environment and urban life domains that significantly influence or impact the subjective well-being (SWB) of urban residents.

The new field on the 'Science of Happiness' aims to measure happiness, explores whether it should be measured, and determine the characteristics affecting it (Ballas, 2013). Happiness can be defined as enduring satisfaction with one's life as a whole and is sometimes used interchangeably with life satisfaction and subjective wellbeing (Veenhoven, 2009). Social scientists use subjective well-being as an umbrella term that covers the study of happiness and life satisfaction wherein happiness relates more to affect or feelings and life satisfaction relates more to the cognitive assessment of life as a whole (Erdogan, et al., 2012).

Happiness is related to many important outcomes that are highly valued in society such as better health conditions, better job performance and job satisfaction (Erdogan, et al., 2012). The importance of happiness is increasingly being recognized as an appropriate measure of development and a goal of public policy. An increasing number of international organizations and governments are now measuring subjective well-being in order to assess how effective public policies are or to formulate better policies to improve the lives of citizens (Helliwel et al., 2013). For example, the Organisation for Economic Co-operation and Development (OECD) includes life satisfaction as an indicator for quality of life in its Better Life Index.

The idea that societies should foster the happiness of their citizens can be traced back to classical and enlightenment thinking which consider the best society as one where citizens are happiest. As experienced by developed countries, material wealth can only increase happiness up to a certain degree but increasing wealth can also lead to stagnation and even decline in happiness and life satisfaction. The most basic goal of measuring happiness in societies over time is to avoid such "happiness traps". Happiness studies have also shown that although happiness differs across countries, they can be changed or improved by how public policies are designed and implemented. Thus, it is logical to pursue policies that not only increases individual and national income but also increases the public's well-being or happiness (Sachs, 2012).

Happiness studies has identified several characteristics that determine individual happiness. Personal income and wealth has been the most extensively studied factor predicting individual happiness (Leyden, 2011). The positive relationship between income and happiness has been clearly established. However, as incomes rise over time, happiness does not rise systematically which is explained by the rise of aspiration levels and position of relative income compared to others (Frey and Stutzer, 2002). Aside from income, there are also other significant characteristics that determine happiness. In his book, Layard (2005) identified the "Big Seven" characteristics that affect happiness among adult populations in the United States, which are income, family relationships, work, community and friends, health, personal freedom and personal values.

Aside from the major and more widely studied characteristics affecting happiness mentioned above, the effect of the built environment[1] on the well-being or happiness of city residents has also been the topic of some studies. In the study by Leyden (2011), specific places in the built environment and maintenance of these places were found to be associated with the happiness of residents in 10 cities in advanced countries. His findings demonstrate a statistically significant relationship between happiness and access to cultural amenities, access to convenient public transportation, residents' perception of the 'beauty' of their city and residents' perception on the cleanliness of streets, sidewalks, and other public places.

In the field of Quality of Life (QoL) in cities, several studies have looked into how urban living affects overall life satisfaction. One approach is the bottom-up theory which explains that residents' overall life satisfaction is determined by satisfaction with different urban life domains (i.e. housing, neighbourhood and community) and other non-urban life domains. Satisfaction with a particular domain is in turn influenced by lower levels of objective conditions or subjective evaluations of that domain (Sirgy et al., 2000). In happiness research, the bottom-up model is also used to explain life satisfaction as a complex function of separate but interrelated life domains such as family, social and community life, work and health (Erdogan, et al., 2012). In the path analysis study by Sirgy and Cornwell (2002), the physical, social and economic features of the neighbourhood affected life satisfaction through the mediating effects of domain satisfactions on housing, home and community. In his study on residents living in South East Queensland, Australia, McCrea et al., (2005) found out that housing and regional satisfaction were better predictors of life satisfaction than neighbourhood satisfaction.

This research used the bottom-up model on life satisfaction and satisfaction from the urban domains of housing, neighbourhood and the city to study the influence of the different characteristics of the urban built environment on happiness of residents in selected neighbourhoods in Rotterdam. Based on these theories, the research has three main hypotheses that will be tested. First, characteristics of the built environment predict satisfaction in urban domains as well as happiness; second, satisfaction in urban life domains predicts overall happiness of an individual; and third satisfaction in urban life domains mediate the relationship between characteristics of the built environment and happiness.

1.2 Problem Statement

The importance of further studies on happiness with a geographic or spatial dimension focusing on urban areas is highlighted by the fact that more than half of the world's population now live in cities and urbanization expecting to swell to almost 5 billion largely in developing countries in Asia and Africa (UNPF, 2007). Similar to avoiding "happiness traps" in affluent countries, such scenario can also be avoided in cities with the help of information in happiness studies with a geographic dimension.

Several studies have revealed that cities have certain characteristics that can decrease or increase human well-being. In a study by Morrison (2011) on 12 settlements throughout New Zealand it was shown that living in highly dense urban environments lowers affective and

[1] Defined by other authors as: "the human-made space in which people live, work, and recreate on a day-to-day basis" and is "comprised of urban design, land use, and the transportation system". See Chapter 2 for literature definitions and Chapter 3 for the research operationalization.

cognitive subjective well-being with Auckland City, the densest city among the settlements studied, on the bottom rank of happiness and life satisfaction measures. Differences in subjective well-being between different locations were also found by Berry and Okulicz-Kozaryn (2011) in their study of subjective well-being in American cities, towns and rural areas. After controlling for many of the characteristics that affect individuals' happiness, a gradient of happiness was observed at its lowest levels in large central cities to its highest levels in the small-towns and rural areas. This gradient is said to be driven by the differences in size, density and ethnic composition between large cities and small town and rural locations and also between the black and white Americans ancestry of people living in those locations.

In another large scale study by Oswald and Wu (2010) on the geography of well-being measured in terms of mental health and life satisfaction of a million respondents in the US, significant differences in well-being across states was shown with the lowest life satisfaction in New York and high satisfaction in Louisiana and Hawaii. On psychological well-being, Louisianan and District Columbia have the highest or best while California and West Virginia have score the lowest. The authors attribute these differences in well-being to characteristics of places saying that "places have characteristics that human beings find objectively pleasant and unpleasant". On the contrary, in his book Triumph of the City which advocates for increasing density in cities as the way to a prosperous and sustainable future, Glaeser (2011) points out that more people living in urbanized countries report being happier than in countries with more than half of the population is rural. Moreover, he cites that studies across countries show that reported life satisfaction rises with the increase of population living in cities even when controlling for the effects of income and education.

The previously cited studies conducted in other countries and cities show that there is a relationship between characteristics of the built environment and different measures of subjective well-being. However, there is still limited literature that analyzes how characteristics of places in urban areas which include the built or physical environment affect the subjective well-being of its residents particularly in the affective dimension of happiness. The impact of places and different levels geographic space (e.g. household, neighbourhood, city, district and regional area levels) are not primarily considered in most happiness to date which focus mostly on demographic and other individual characteristics as determinants of happiness. Nonetheless, it is increasingly being recognized that much knowledge can be added on the influence of spatial characteristics in cities on the happiness of people and there is great potential in complementing objective measures of QoL and subjective measures like happiness to provide a better understanding on what characteristics in urban areas make a "happy city" (Ballas, 2013).

Reflecting on the findings of subjective well-being and happiness with a geographical dimension described earlier, the imminent question that comes to mind is does living in cities make people or unhappier? And if so, what specific characteristics of the city with focus on the physical or built environment affects the happiness of urban residents? This research aims to answer this problem by looking at the case of selected neighbourhoods in the city of Rotterdam in the Netherlands. Rotterdam was chosen as the research area because of residents' less positive perceptions of the built environment and lower satisfaction with living in the city. It provides a good opportunity to study the characteristics of the urban built environment in an urban area that influence the level of happiness of its residents and to relate these findings to studies in other countries and cities.

Rotterdam is the second largest city located in the province of South Holland in the Netherlands with a total population of 616,319 (as of 2013) and with a total area of 325.79 sq. km. Rotterdam is a multicultural, young and dynamic city with the population composed of 167 nationalities and most of the population composed of young adults and working class (City of Rotterdam, 2013). As compared to the whole of Netherlands and to other major Dutch cities like Amsterdam, Groningen, The Hague, and Utrecht, Rotterdam falls behind on some quality of life indicators such as purchasing power index, safety index, health care index and pollution index (Numbeo, 2015).

The perception survey on the quality of life in European cities conducted in 2012 reported that residents living in Dutch cities (i.e. Groningen, Amsterdam, and Rotterdam) are highly satisfied with the city where they live and the life they lead. However, people in Rotterdam compared to the other Dutch cities are less satisfied to live in the city and are slightly less happy with their lives and the place or neighbourhood where they live. Perceptions on the presence and integration of foreigners, safety and the environment (air quality, noise and cleanliness) are also lower in Rotterdam. In terms of some spatial features in the city, people in Rotterdam are reported to have the least satisfaction with streets and buildings, public spaces and green spaces as compared to the other two Dutch cities (European Commission, 2014).

1.3 Research Question

Overall Research question

What characteristics of the built environment affect the urban life domains and happiness of residents in selected neighbourhoods in Rotterdam?

Sub questions:

1. What are the characteristics of the urban built environment that significantly affect the satisfaction with urban life domains?

2. What are the characteristics of the urban built environment that significantly affect the happiness of residents in selected neighbourhoods in Rotterdam?

3. What are the urban life domains that significantly affect the happiness of residents in selected neighbourhoods in Rotterdam?

4. Do urban life domains mediate the effect of characteristics of the urban built environment on happiness?

1.4 Significance of the Study

In the field of happiness research, the study adds knowledge on less researched determinants of happiness by identifying characteristics of the built environment in cities which significantly affect the happiness of urban residents. It will help establish that the physical environment has a direct and significant impact on well-being that is as important as individual characteristics such as income, work and health. In terms of theory, this research

enhances the understanding on the bottom-up theory on life satisfaction by testing its applicability in the case of residents in Rotterdam. The research will support the theory if urban life domains at the housing, neighbourhood and city level are able to predict happiness and/or life satisfaction as assumed by the model. Otherwise, the research gives insights to the possible greater relevance of other non-urban life domains and the alternative theory of top-down model of life satisfaction.

In the Netherlands, studies on the built environment in relation to SWB are still lacking. This study can address this research gap by determining if characteristics of the built environment found to have an influence on SWB in other countries are also applicable to the the Netherlands, in particular to the city of Rotterdam. Although cities in advance countries can have similar physical features and level of services in infrastructure, facilities and amenities, the development of the physical landscape and resident composition is unique and varies in each city which can be a possible reason for different perceptions or effects of the built environment. For example, Rotterdam is a very multicultural city that is mainly composed of new buildings but also has older surviving buildings or houses and unused old port areas.

For urban management practice, the findings of the research can provide policy insights and recommendations to the local city government of Rotterdam on future improvements on the physical environment of the city as a whole and in specific neighbourhoods that can enhance the quality of urban life and increase happiness of its residents.

1.5 Scope and limitations

The research is limited in terms of the theory and methodology used. First, it is theoretically limited to the bottom-up theory on life satisfaction which states that SWB or happiness is determined by satisfaction in different life domains (i.e. operationalized as urban life domains in this research) which are in turn influenced by conditions within that domain (i.e. operationalized as built environment characteristics in this research). Other determinants of happiness such as personality traits and social standards of comparison as suggested by the alternative theory of the top-down model on life satisfaction is outside the scope of the theoretical model and therefore not studied. The bottom-up theory is chosen as the research theoretical model since it predicts life satisfaction from conditions in the environment which captures the independent variable of the study.

Second in terms of methodology, the research is quantitative and therefore does not investigate the specific mechanisms in which the built environment affects happiness of residents. The results from the statistical analysis can uncover possible causal relationships between certain characteristics of the physical environment and happiness of residents but will not be able to explain the exact processes by which these characteristics shape or contribute to different levels of happiness. Findings of previous similar studies are used to validate and substantiate the quantitative results of the research and explain the relationship between the variables studied. Furthermore, it should be noted that the statistical approach used in this research (Baron and Kenny, 1986) is not the only approach to test for mediation analysis. Although it is well known, a growing number of academics have modified and presented other methods for mediation analysis (Iacobucci, et al., 2007, MacKinnon, et al., 2007, Zhao et al., 2010, Gunzler et al., 2013). Despite these methodological challenges, the researcher decided to follow the approach on mediation analysis by Baron and Kenny (1986)

because as a causal step approach, it better reflects and answers the research questions and clearly shows the conceptual links between each type of variables and statistical tests.

The research is also limited by the scale of the survey wherein most of the data used for analysis came from. Due to resource constraints, the survey was conducted in only two neighbourhoods in Rotterdam with a small sample size. Because of this, the results of the study cannot be generalized to other neighbourhoods nor to the city of Rotterdam. Its generalizability to the entire neighbourhoods studied may not also be reliable because of the very sample size (N=66). Nonetheless, the study's theoretical implications are still important for future research that can build on the methodology and findings of this research to conduct more large scale and long term studies.

Chapter 2: Literature review

2.1 State of the Art of the Theories/Concepts of the Study

2.1.1 Overview of Happiness Research and Subjective Well-Being

Happiness is generally considered as the ultimate goal of human existence. The importance of happiness to society can be traced back to the Enlightenment thinker and founder of modern utilitarianism, Jeremy Bentham who said that the best society is the one where citizens are the happiest. Thus, the aim of public policy should be to create the greatest happiness. This requires identifying and understanding what factors have the most influence on our happiness (Layard, 2005). It has been shown that differences in income only explains a low proportion of the differences in happiness which suggests that other pecuniary (e.g. unemployment) and non-pecuniary characteristics (e.g. health, social relations and also personality) are also important in explaining variations of happiness (Frey and Stutzer, 2002).

The study of happiness or subjective well-being (SWB) is an important subject in the fields of psychology and economics. Subjective well-being has been studied earlier in psychology and has been linked to economics by the pioneering work of Easterlin (1974) on economic growth and self-reported happiness which gained more empirical analysis by economists in the 1990s (Frey and Strutzer, 2002).

The concept of SWB has been defined as composed of three dimensions. First is the pleasant affect such as joy, elation or happiness as a feeling; second is unpleasant affect such as sadness and anxiety; and third is life satisfaction which is either overall life satisfaction or satisfaction in particular life domains (McCrea et al., 2011). There are several dimensions or "components" of life such as family, health, financial situation, social relationships, housing etc. which are called life domains. Questions asking people on their satisfaction about specific domains of life and that of their satisfaction with life as a whole can be analyzed similarly. However, it is much easier for people to evaluate a single aspect of life than life as a whole since they have to evaluate and weigh different domains against each other to come up with an overall evaluation (Van Praag and Ferrer-i-Carbonell, 2011).

The affective and cognitive dimensions of SWB were recognized by Veenhoven (2009) as components of overall happiness which he defined as "the degree to which an individual judges the overall quality of his life favorably." Accordingly, SWB is measured differently as an emotional state or as life evaluation. Comparing country level data on different measures of SWB, the World Happiness Report (2012) found out that answers to happiness, when asked in an evaluative mode and not as short-term feelings, and answers to life satisfaction have the same structures across individuals and countries. According to the most recent World Happiness Report (2015), the same key variables, including income, were found to explain both happiness and life satisfaction when comparing the answers between life satisfaction and happy with life questions of the same respondents in the European Social Survey.

At present, economists refer to the hedonistic (affective) subjective concept when talking about happiness (Bruni and Porta, 2005). The hedonistic or affect theory best explains how people assess happiness since happiness is inferred based on how people generally feel in the

first place. From the utilitarian perspective, the affect theory of happiness makes it possible to create greater happiness for a greater number (Veenhoven, 2009).

In most psychology studies, empirical evidence supports that personality often exerts a bigger influence on SWB than demographic or environmental characteristics. Despite that the stronger effect of personality, it is not the sole source of SWB, life circumstances can also influence SWB and must also therefore be integrated in SWB studies (Diener et al., 1999). The dominant theory on SWB in psychology is the 'set-point theory' which holds that each individual is predisposed to a certain level or set-point of happiness given by genetics and personality. Life circumstances and events such as marriage and unemployment only have a small effect on people's happiness since they return to their given set-point by adapting to changes in the environment (Easterlin, 2005). Veenhoven (2009) rejected the set-point theory as a suitable approach to explain happiness since it implies that there is little sense in raising happiness if it reverts to a stable fixed level. He also argued that having a set-point for happiness goes against empirical studies which point out that adaptation to some life events are not always complete and the observed gradual rise of happiness in most nations over the last 30 years.

Turning to economics, economists have only recently begun to be interested in happiness as traditional economic theory employs an objectivist position on utility based on observable behavior or choices made by individuals (Frey and Strutzer, 2002). In contrast to objective utility, subjective utility puts more emphasis on life circumstances, particularly income and employment to have stronger effects on well-being. The theory has been termed as 'more is better' and it is assumed that well-being will move in the same direction as income increases substantially (Easterlin, 2005).

The subjective approach to utility offers a worthwhile complementary path to study individual well-being since it is a much broader concept than decision utility that includes both experienced and procedural utility which for many people can be the ultimate goal in life. In addition, people's revealed preferences which is how decision utility is measured does not always lead to optimal well-being, Thus, it cannot be assumed that people's choices are utility-maximizing. Furthermore, subjective well-being or happiness provides a direct way to capture and better understand human well-being which may be limited by the objectivist approach (Powdthavee, 2007).

There are two main theories of life satisfaction commonly used in subjective well-being or happiness research which are the top-down and bottom-up models. The former explains life satisfaction through personality traits while the latter explains life satisfaction as a function of satisfaction in multiple domains in life. The top-down model is similar to the set-point theory earlier discussed which views life satisfaction as a function of stable personality traits and because of this some people have a tendency to be more happier or feel more satisfied with their lives. Based on a meta-analysis of around 200 studies, five traits have shown to predict 18% of the variance in life satisfaction, from the most to the least related these traits are: neuroticism, extraversion, conscientiousness, agreeableness, and openness. The top-down theory does not disregard the importance of life circumstances, instead it recognizes that personality can shape perceptions and evaluations of life conditions which affect life satisfaction (Erdogan et al., 2012).

According to the bottom-up model, life satisfaction is considered as an interrelated function of satisfaction of different with different life domains such as family, work, health, social life,

etc. People weigh different life domains against each other when evaluating satisfaction with life as a whole and weigh each domain differently based on their own values. Thus, satisfaction with domains that one deems important can increase one's overall life satisfaction. People can also reassess the importance of domains as a result of unhappiness in one domain. For example, a person may value family life more as a result of health problems (Erdogan et al., 2000). The bottom-up approach emphasizes the role of objective life conditions in determining well-being. Under this theory, it is assumed that domain satisfaction is associated with objective situational characteristics (Heller et al., 2004).

2.1.2 Happiness Economics

As mentioned earlier, the study of happiness or SWB in economics was introduced to mainstream economics by the work of Easterlin (1974). By looking at happiness and satisfaction surveys together with income levels within and across countries he found out that people in richer countries are generally happier than poorer ones. However, he argued that within countries especially developed ones, happiness did not increase over time. This is shown by the analysis of time series data in the USA which revealed that although real per capita income increased by more than 60 percent, there were not more people who rated themselves as very happy. This opened up the debate on the 'paradox of happiness' also referred to as the 'Easterlin paradox' since it is expected under standard economic theory that more income leads to greater well-being or happiness. The paradox is now explained by two 'treadmill effects' which are the hedonic treadmill and the satisfaction treadmill. The former depends on adaptation while the latter depends on aspirations and social comparisons (Layard, 2005).

Economists today agree on the positive relationship between income and happiness within a single country at a given point in time such that richer people report a higher SWB. Across countries, evidence indicate that income and happiness are positively correlated but the effects are small and diminishing which suggests that other characteristics such as more developed democratic institutions can better explain the difference in SWB between countries (Frey and Stutzer, 2002).

Adaptation is defined as the "process, or mechanism, that reduces the hedonic effects of a constant or repeated stimulus". Pleasures derived from material goods and services eventually disappear with continued consumption that makes people have higher aspirations. It is also within human nature to constantly have comparisons with the past, future expectations and others. According to the aspiration level theory, "happiness is determined by the gap between aspiration and achievement". The theory also suggests that aspirations adjust to higher income levels thus increases in income yields smaller increase in happiness (Frey and Stutzer, 2002).

With adaptation, people can become more satisfied as perceptions and expectations approximate each other and merge over time. The adaptation process can be used to understand how people generally cope with their living conditions and also to explain resident satisfaction with the place where they live. Adaptation happens through two different processes. First is by adjusting sensory perceptions wherein initially strong perceptions of living conditions can become less prominent over time due to increased familiarity and second, by adjusting standards of comparison to conform to every-day expectations of a particular living condition. This involves making downward comparisons or

selective standards of comparison in order to creating positive cognitive bias. Taking place of residence as an example, people may not initially agree that they are living in their ideal house and neighbourhood but due to familiarity and adjusting comparisons to their current living environment, they eventually adapt and become satisfied or happy with their residence. Adaptation can also occur by relocation to another area which satisfies people's living condition aspects that they deem important. Empirical evidence has been found for adaptation in various life domains and life events most notably getting married and to a lesser extent for widowers. However, studies on the importance of adaptation in urban living are not yet conclusive (McCrea et al., 2011).

Research in subjective well-being has identified several characteristics that determine individual happiness. Using the statistical happiness function of an ordered probit or logit regression, most happiness studies have focused on discovering the major determinants of happiness both at the individual, national and cross-country level. In the comprehensive book by Layard (2005), he identified the "Big Seven" characteristics that have the greatest effect on happiness among adults by analyzing the responses of 19,000 respondents over 18 years in the US General Social Survey. The survey asks people how happy they are in general and also how satisfied they are with the different dimensions of their life where it can be inferred which dimensions of their life are the most important. The top five in decreasing order of importance are: 1) Family relationships, 2) Financial situation, 3) Work, 4) Community and friends and 5) Health. Two other key characteristics are Personal freedom and Personal values.

Using the German Socio-Economic Panel data which follows the same people throughout their lives, it was found that people generally become happier as a result of marriage and remain happier than they were four years before marriage. Inversely, problems in family situation can greatly lower happiness. Having children can also increase happiness. In family life, the quality and stability of relationships matter more than form and can improve physical health and also happiness (Layard, 2005).

Work is the second most important factor for happiness among adults. This is because work not only provides income but also meaning in life. Happiness can fall as a result of unemployment, not just because of the loss of income but the loss of work itself (Layard, 2005). The effect of non-pecuniary costs (i.e. psychic and social) of unemployment was confirmed by Frey and Stutzer (2002) who attributed to it a large extent the drop in happiness among unemployed people.

The next most important factor affecting happiness is community and friends. This domain is an aggregate of two components which are "the city or place you live in" and "your friends". The two are closely associated since it is widely recognized that the quality of the community is crucial in forming social relationships or friendships and feelings of safety. The quality of the community is often referred to as 'social capital' which is composed of social and community ties that inspire trust and reciprocity among people (Layard, 2005).

Self-reported health satisfaction is also an important determinant of happiness although it never comes on top since people have a good ability to adapt to physical problems. A decrease in subjective health can result to a fall in happiness. A more important feature of health is chronic pain or mental illness which can limit people to function normally. To demonstrate the negative effect of poor mental health on happiness, Layard (2005) pointed

out clinical depression has increased in many countries since the Second World War at the same time when gains in happiness has also not substantially increased.

Happiness also depends on the quality of the government. It has been shown that all indices of freedom –political, economic, and personal –are strongly and statistically significantly correlated to happiness. This supports the expectation that people in constitutional democracies are happier because politicians rule according to people's interests and due to opportunities for democratic participation (Frey and Stutzer, 2002).

In addition to the main determinants of happiness discussed above, there are other several personal characteristics that determine happiness which are age, gender, education, and ethnicity that are commonly used as control variables in most SWB studies.

The relationship between age and SWB evaluations is considered as one of the most robust findings in happiness research. Essentially, there is a U-shaped pattern through life: younger people report to have high levels of life satisfaction or overall happiness that eventually declines in middle age (between 40 and 50), and then rises again. Improvement in happiness after a mid-life low can be explained by age through the wisdom of maturity and more realistic aspirations. But, as expected, average happiness declines for more elderly people between the age between 70 to 80 years old as health conditions generally worsen. With regards to gender, women in most advance countries report higher satisfaction and happiness than men. However, in less developed countries, women have smaller advantage than men on happiness or can even have lower levels of happiness. It is also found that countries which have stronger gender rights have relatively happier women. On education, it has no clear direct effect on happiness although it is indirectly related to happiness through its effect on income and employment: since education increases employability and raises income, and employment and income increases happiness (Helliwell et al., 2012).

Cultural background also affects happiness as shown by the differences in the answers to happiness measures across countries that can be shaped by the social context and norms specific for each country. Thus, ethnicity needs to be taken into account when studying the effects of happiness internationally or in a population with different cultural backgrounds. The effect of ethnicity on SWB was recognized by Morrison (2007, 2011) in his quality of life studies in New Zealand and used it as a control variable.

2.1.3 The Built Environment and its Relationship to Life Satisfaction and Social Capital

The built environment is a multidimensional concept that has been defined in a variety of ways. Leyden (2003, p.1546) provides a simple definition of the built environment as "the way we design and build our communities and neighbourhoods". The US Department of Health and Human Services (2004), gives another definition which touches on the built environment's function and form, defined as "the human-made space in which people live, work, and recreate on a day-to-day basis. It includes buildings and spaces we create or modify". A more comprehensive definition is provided by Handy et al., (2002, p.65) which is the built environment "comprises urban design, land use, and the transportation system, and encompasses patterns of human activity within the physical environment". Urban design refers to the arrangement and appearance of physical elements of a city and is also concerned with the function and appeal of public places. Land use is concerned with the spatial distribution of different types of activities across space and groups activities according to categories such as residential, commercial, office, industrial and other activities.

Transportation system refers to the physical infrastructure consisting of roads, sidewalks, bike paths, railroad tracks and so on.

Consistent with the situational, bottom-up approaches to life satisfaction, several studies have looked at the effect or influence of purely objective characteristics and/or subjective perceptions of specific features of the built environment on the happiness or SWB of people living in cities. In the study by Leyden (2011), specific places in the built environment and maintenance of these places were found to be associated with the happiness of residents in 10 cities in advanced countries even after accounting for the usual predictors of happiness such as income, health, social relationships and government effectiveness. This suggests that people are generally concerned about where they live and the maintenance of those places. His findings demonstrate a statistically significant relationship between happiness and perceived subjective access to cultural amenities, perceived subjective access to convenient public transportation, residents' perception of the 'beauty' of their city and residents' perception on the cleanliness of streets, sidewalks, and other public places. Leyden hypothesized that the built environment affects happiness through social capital. Based from existing literature, he suggests that places can facilitate social connections that help develop social capital which is known as a strong determinant for happiness.

Using objective data on distance and proximity processed in GIS, the impact of amenities and spatial variables like population density, congestion, commuting time and climatic and environmental conditions on SWB of people living in Ireland was determined. The amenities which were found to be significantly correlated with life satisfaction are proximity to waste facilities (i.e. landfill), proximity or access to transport and proximity to the coast. The presence of a landfill is found to be a disamenity that is negatively correlated at closer distance (i.e. within 3 km). Access to transport emerges both as an amenity and disamenity depending on the type and distance of the transport mode in question. Population density was also found to be significant and positively associated to life satisfaction (Brereton et al., 2008)

In a study of 12 settlements throughout New Zealand, place or settlement effect on different measures of subjective well-being was proven (Morrison, 2007). This means that SWB is sensitive to the place where one lives and suggests that cities may have certain characteristics that influence well-being. Three measures on well-being (i.e. happiness-cognitive, satisfaction-affective, quality of life-achievement) were regressed on the fixed effects of cities while controlling for personal characteristics known to affect SWB which are age, gender, ethnicity, health, personal income, employment status, educational attainment, household composition, and house tenure. The results show that place effects are more sensitive to the happiness dimension of SWB than satisfaction and quality of life dimensions. It was suggested that density can explain for differences in SWB among cities since high-density urban areas like Auckland City and Manukau City consistently rank lower on all three measures of SWB.

Building on his previous work, Morrison (2011) used the same data from the 2004 Quality of Life Survey in New Zealand and was able to determine more city characteristics that can explain differences in SWB among cities. All the other cities were found to have a positive impact on cognitive and affective dimensions of SWB than Auckland City which is the largest urban center studied. Morrison related his findings to previous studies which suggest that living in very dense cities lowers the cognitive and affective dimensions of SWB. City residents' perceptions on accessibility of local public services were found to have a positive

effect on all measures of SWB. In particular, 'gaining ready access to a preferred education provider' and 'very easy access to green space' were consistently correlated to all SWB measures. Social capital is another variable which is statistically significant to all SWB measures. In particular, a sense of community has a stronger positive effect on well-being than interpersonal trust while perceived level of safety also has an impact on SWB. Morrison concludes that there are still other city characteristics that depress the levels of SWB of people in Auckland City since city fixed effects still remain even after accounting for social capital, residents' perception of accessibility and individual characteristics to explain SWB.

Many studies on the built environment have linked it to the formation of social capital. As early as 1961, Jacobs argued that mixed land use which combines areas of home, work, recreation and public space and a pedestrian oriented neighbourhood has a positive effect on well-being of residents by promoting social connections. Jacobs claimed that an intricate diversity of uses that provides mutual support economically and socially is the principle that cities should abide to become successful. Recent literature considers social capital is an important determinant for predicting individual happiness and can even mediate the impact of the built environment on happiness as pointed out by some authors (Putnam, 2000, Leyden, 2011).

In support to Jacob's argument that neighbourhood design affects social interaction, a study on neighbourhoods with different designs in Galway, Ireland demonstrated that people living in traditional, mixed-use, walkable neighbourhoods have higher levels of social capital as compared to those living in modern, car-dependent suburbs. The relationship between walkability (i.e. the number of destinations one could walk to in the neighbourhood) was found to be positively statistically significant with all the measures of social capital (i.e. how well residents knew their neighbours, political participation, trust in others, and social engagement) used in the study (Leyden, 2003).

Rogers et al., (2011) provides further support in his study of neighbourhoods with different designs which showed that the level of social capital is higher in more walkable neighbourhoods. Aside from social capital, residents in the more walkable neighbourhoods also reported to have better health and happiness than in less walkable neighbourhoods. The authors explain this finding by saying that social capital can be facilitated by land use design and physical infrastructure of neighbourhoods by providing means for people to interact and form social ties.

2.1.4 Quality of Urban Life and Life Satisfaction

The concept of life satisfaction is also closely related to quality of life (QOL) studies which focus on human satisfaction derived from the different characteristics of places. The multi-faceted nature of QOL is captured by its definition of Marans and Stimson (2011, p.1) as "the satisfaction that a person receives from surrounding human and physical conditions, conditions that are scale-dependent and can affect the behavior of people, groups such as households and economic units such as firms". QOL has been studied using two main approaches: the objective and subjective approach affecting satisfaction with life as a whole or satisfaction in specific life domains. The objective approach commonly uses aggregated secondary spatial data which are said to be related to subjective QOL such as level of household income, crime, housing costs, and so on). The subjective approach is focused on people's assessments or evaluations, including their satisfactions of life as a whole or on particular urban life domains (Marans and Stimson, 2011).

QOL can also be can be distinguished between QOL derived from the urban environment (such as housing, neighbourhood, community, or regional) and QOL as experienced in the urban environments (include satisfaction in all life domains such as family/home, work, health, social relationships, and so on). The former is referred to as subjective Quality of Urban Life (QOUL) which unlike overall life satisfaction does not account for all life domains (Marans and Stimson, 2011).

QOL is considered to be more subjective phenomenon although it can also be measured objectively. It is argued that the objective conditions of the environment do not convey the true quality of a place but the meaning attached to conditions by people living in it. This prevailing approach in QOUL research is supported by empirical findings in research which show that subjective evaluations are correlated more strongly to satisfaction in urban life domains and overall life satisfaction as compared to the often weak correlation between objective indicators and satisfaction in life domains. Although quality of life is considered more as a subjective phenomenon, objective attributes affect subjective evaluations of the urban environment that contribute to satisfaction in particular life domains which in turn contribute to overall life satisfaction. This suggests that satisfaction in life domain may mediate the relationship between objective attributes and overall life satisfaction (McCrea et al., 2006).

Based on earlier models by Marans and Rodgers (1975) and Campbell et al. (1976), McCrea et al., (2006) developed a broad conceptual model framework on quality of life that shows relationships between subjective assessments as determinants of urban domain satisfaction and overall life satisfaction.

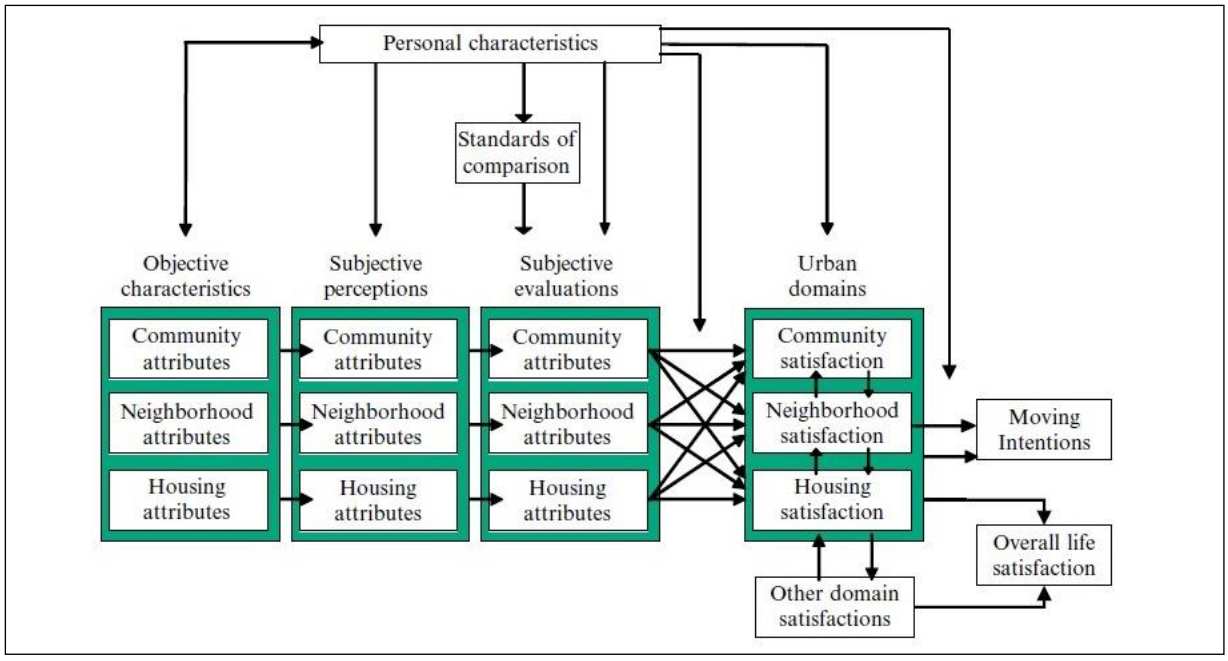

Figure 1. A broad model framework on determinants of satisfaction with the residential environment

Source: McCrea et al., 2006, derived from Campbell et al., 1976; Marans and Rodgers, 1975

The framework has a number of elements that allows for the investigation of determinants of satisfaction within the urban environment. Essentially, it predicts satisfaction in urban

domains from subjective evaluations of various characteristics in the urban environment. It also links objective characteristics of the urban environment to people's subjective evaluation of the urban environment. Satisfaction with urban living or subjective QOUL is organized into urban domains which relate to the different levels of scale in the urban environment which are housing, neighbourhood, community and even to higher levels of the city or region. Satisfaction in the urban domains is predicted by assessments of urban attributes associated with that domain, for example, housing attributes predict housing satisfaction, neighbourhood attributes predict neighbourhood satisfaction, and so on (McCrea et al., 2011).

Urban attributes in other urban domains can also predict satisfaction of a different urban domain as indicated by the hypothesized cross-paths. For example, neighbourhood attributes can also predict housing satisfaction and community satisfaction. Thus, it is clear that the different levels of urban living are closely related to each other and many urban attributes can affect more than one urban domain (McCrea et al., 2005).

Other models which relate to the broad conceptual framework can also incorporated which are bottom-up and top-down models. The bottom-up model can be incorporated in two ways. First is through predicting satisfaction in urban life domains by satisfactions with urban sub-domains, and second by predicting overall life satisfaction determined by urban domains and other life domains. On the other hand, the top down model can be incorporated by predicting overall life satisfaction and satisfaction in the life domains from personality characteristics (McCrea et al., 2011).

Using a simplified structural equation model based from the broad conceptual framework presented in the previous figure, McCrea et al., (2006) compared the extent to which the objective and subjective indicators can predict overall subjective QOUL composed of housing satisfaction, neighbourhood satisfaction and community satisfaction. He found out that all objective latent variables in the study were not significantly associated with QOUL whereas all subjective latent variables predicted QOUL. According to McCrea, his result is supported by findings of previous research which generally indicate that objective indicators are weakly correlated with satisfaction in life domains whereas subjective evaluations of the urban environment are more strongly associated and contribute to satisfaction in urban domains and overall life satisfaction. However, he also suggested that satisfaction in life domains may mediate the relationship between objective attributes and overall life satisfaction since objective attributes are the basis of satisfaction with specific life domains. Thus, it is possible that both objective and subjective variables can influence overall QOUL or life satisfaction through satisfaction in urban domains.

Several studies have used the bottom-up model of subjective QOUL in examining the relationship between different urban characteristics, urban domain satisfactions and overall life satisfaction. All the studies described below support that the hypothesis that urban domain satisfactions –housing, neighbourhood, community and regional satisfaction–predict overall life satisfaction. Furthermore, satisfaction in urban domains are determined by certain urban characteristics which are mostly subjective in nature that are based on the perceptions and evaluations of people.

In a study on satisfaction with urban living in the Brisbane-Southeast Queensland region in Australia, overall life satisfaction was predicted by housing satisfaction and regional satisfaction and not neighbourhood satisfaction. However, since the different urban domains are also interrelated, the impact of neighbourhood satisfaction on life satisfaction was found

to be mediated by housing and regional satisfaction. Neighbourhood satisfaction was determined by the following urban attributes: neighbourhood interaction, perceived crime, and neighbourhood services. Satisfaction with housing was found to be best predicted by housing age, temperature and home ownership (McCrea et al., 2005).

In the study described above, McCrea et al., (2005) used the broad conceptual framework on residential satisfaction as a starting point of his study on regional satisfaction. He then developed a simplified model where overall life satisfaction is predicted by satisfaction from urban domains including regional satisfaction, which in turn are predicted by subjective assessment of urban attributes (Annex 5). To minimize the model complexity, the tested model initially predicted urban domain satisfaction based on assessments of urban attributes specific to each urban domain. Although no cross paths are initially specified in the model, these are later on added to improve the fit of the model (i.e. cross path from regional services to neighbourhood satisfaction and another from neighbourhood services to regional satisfaction).

On the satisfaction in urban life domains in quality of life studies, residential or housing satisfaction is recognized as an important aspect as shown by studies that the extent to which an individual is satisfied with housing also significantly influences their quality of life. Most empirical research is focused on determining the effects of various housing, neighbourhood, household and socio-demographic characteristics on residential satisfaction. Previous research has identified several major determinants of residential satisfaction which are income, tenure, life-cycle stages, house size and house quality. Housing satisfaction is also closely related to neighbourhood satisfaction as assessment of housing can also include its immediate physical, environmental and social surroundings. Furthermore, subjective measures of housing and neighbourhood characteristics are considered to be more important determinants of residential satisfaction than objective measures (Lu, 1999). In a study of public housing in Nigeria (Ibem and Amole, 2013), satisfaction with the sizes of main activity areas of dwelling units, housing services, management of the housing estates, building materials, privacy and the cost of housing were found to be significant predictors of residents' life satisfaction. In another study of different formal and informal housing in Istanbul (Tiirkoglu, 1997), perceived physical comfort, perceived quality of building condition, satisfaction with climatic control of dwelling, dwelling plan and larger size of house were found to be important for housing satisfaction.

In a study by Sirgy and Cornwell (2002) on the relationship between the different features of the neighbourhood and life satisfaction, it was found that the neighbourhood physical, social and economic features affected life satisfaction through the mediating effects of domain satisfactions on housing, home and community. In particular, the satisfaction with the neighbourhood physical features (i.e. upkeep of homes and yards, landscape in the neighbourhood, street lighting in the neighbourhood, crowding and noise level; nearness of neighbourhood to facilities needed, and quality of the environment in the community) contributes to both neighbourhood satisfaction and housing satisfaction. But is housing satisfaction that significantly affects life satisfaction and not neighbourhood satisfaction. Satisfaction with the neighbourhood social features (i.e. social interactions with neighbours, outdoor play space, people living in the neighbourhood, ties with people in the community, crime, race relations and sense of privacy at home) contributes to community satisfaction which in turn significantly affects life satisfaction.

Specific to community satisfaction, resident's satisfaction with community based services was found to be significantly associated not only with community satisfaction but also with overall life satisfaction. Community satisfaction was significantly determined by government, business, and non-profit services but was more strongly predicted by business services. Furthermore, community satisfaction was able to explain life satisfaction above and beyond satisfaction in other life domains such as family, health, financial, leisure, and spiritual. Community satisfaction was significantly determined by government, business, and non-profit services but was more strongly predicted by business services (Sirgy et al., 2000)

In the study, a distinction was made between community and neighbourhood satisfaction. An important distinguishing characteristic of community satisfaction is it is determined by citizen satisfaction with various community resources as allocated by satisfaction with government, business, and nonprofit services whereas neighbourhood is conceptualized as the social context where people live or the nearest psychic space outside of the home. The term community was broadly interpreted in the study as a multilevel concept that was represented by different geographic scales: small town, region, and suburb where the study was conducted.

2.1.5 Lessons learnt from literature

From literature, it was learned that there are two main theories that are used explain subjective well-being, these are the top-down and bottom-up model on life satisfaction. The top-down model is strongly related to psychology and emphasizes the role of personality traits in explaining well-being. On the other hand, the bottom-up model predicts life satisfaction from satisfaction in different life domains and in turn these life domains are influenced by factors in the environment. Relating these theories to happiness economics and quality of life studies, the bottom-up model is a more commonly used framework because it allows for the investigation of well-being from different dimensions in life and also from objective conditions in the environment which can be altered with the aim of increasing happiness or quality of life of people. Thus, the bottom-up model has normative implications to improve subjective well-being while the top-down model is mostly descriptive.

In happiness economics, most of the studies on factors predicting happiness are on individual and other demographic characteristics, most popularly income. The influence of the space and place characteristics which include the physical or built environment is not well-studied as a determinant of happiness. However, there is a growing number of happiness studies with a geographic and place dimension which has shown that certain characteristics of the built environment (such as the presence or absence of amenities and the condition and maintenance of public spaces) and spatial-related indicators (such as proximity, access and density) have a direct effect on happiness and/or life satisfaction. Similarly, quality of life studies also examine the effect of objective characteristics of the environment as predictors of satisfaction in life domains derived from the urban living at the housing, neighbourhood, community, or regional level which in turn predicts overall quality of life in a certain area or life satisfaction of an individual. Aside from the more objective measures of quality of life such as income, rents, amenities and pollution, subjective measures of QOL are also being increasingly used which include the perception or satisfaction of environmental characteristics and also subjective measures of well-being which include individual self-reported happiness and life satisfaction.

The bottom-up model on life satisfaction and satisfaction with urban life domains in quality of life studies provided the framework and methodology for addressing the questions posed in this research that is discussed in more detail in the next section on the conceptual framework.

2.2 Conceptual Framework

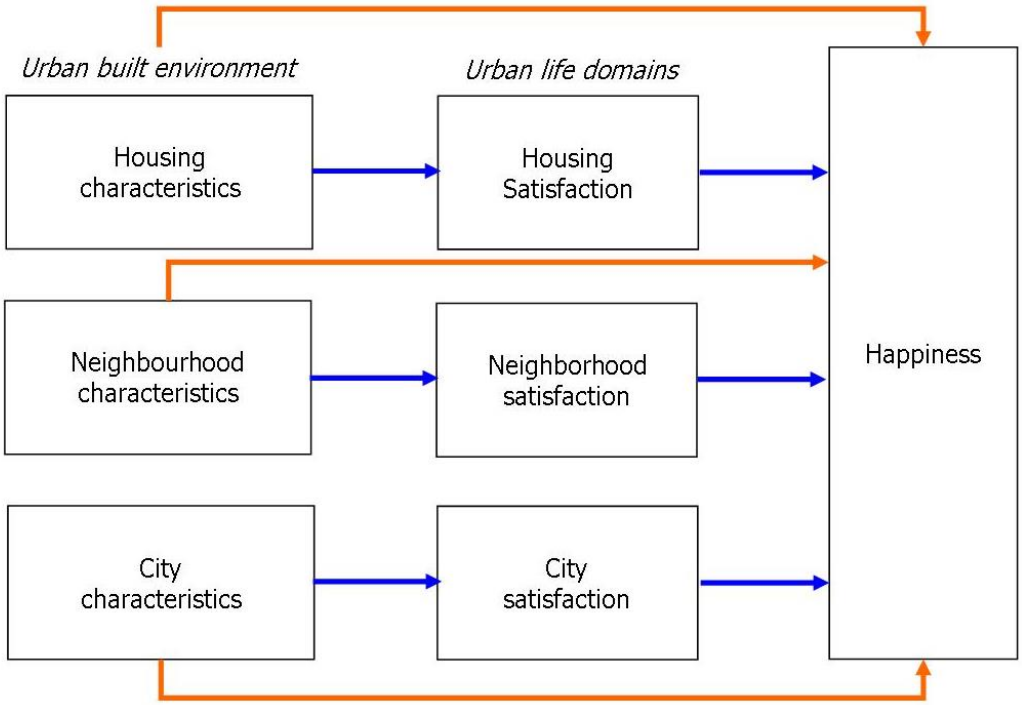

Figure 2. Research conceptual framework

Source: Author, 2015

The conceptual framework of the study integrates the key theories on bottom-up model of life satisfaction from the discipline of happiness research and satisfaction with urban living from the discipline of quality of life studies. According to the bottom-up model, overall life satisfaction is determined by satisfaction in major life domains such as family life, work and health. Satisfaction in major life domains are in turn influenced by objective conditions within that domain (Heller et al., 2004). Satisfaction in the major life domains are experienced in urban environments which are considered as urban life domains. The bottom-up model is also commonly used in quality of life studies which predict overall life satisfaction from satisfaction in urban domains and other life domains.

Based on these theories, the research has three main hypotheses that will be tested. First, characteristics of the built environment predict satisfaction in urban domains as well as happiness; second, satisfaction in urban life domains predicts the happiness of an individual; and third satisfaction in urban life domains mediate the relationship between characteristics of the built environment and happiness.

Following the two main approaches in investigating the quality of life, the urban built environment, which is the independent variable of the study, is composed of objective and subjective characteristics. Objective characteristics are factual data on the individual and characteristics of the urban environment where the individual lives whereas the subjective characteristics are people's perceptions or evaluations of the urban environment. The conceptual model also uses the concept of quality of life or satisfaction derived from the urban environment or urban domains such as housing, neighbourhood and community. In the study, these explicit spatial urban domains are categorized into housing satisfaction, neighbourhood satisfaction and city wide satisfaction. City-wide satisfaction is included as another level of urban life domain satisfaction instead of community satisfaction since the former can be defined in a more specific geographic scale. For city satisfaction, indicators that will be included in the study are those already used or derived from previous studies on quality of life which are satisfaction with public services, city-wide objective conditions and evaluations of these conditions (Sirgy et al., 2000, McCrea et al., 2005).

The dependent variable of the study is happiness or subjective well-being which according to literature is composed of both affective and cognitive aspects and will be measured by asking respondents both their overall happiness and life satisfaction. By having the two measures, the whole concept of happiness can be better captured and the results for each or an average of the two SWB measures can also be compared for a richer data analysis.

In many quality of life studies, satisfaction in urban domains is commonly positioned between subjective and/or objective attributes of the environment and overall life satisfaction although the mediation effect of urban domains are not commonly studied. For example, Sirgy and Cornwell (2002) proved through path analysis their hypothesis that subjective features of the neighbourhood affect domain satisfactions which in turn affect life satisfaction. Although the satisfaction in urban domains is also a subjective measure, it is separated from subjective attributes of the urban environment since it is considered as an overall evaluation of a particular domain or aspect of urban living.

Through statistical analysis, the research will test and compare the effect of different built environment characteristics on the satisfaction with urban life domains and happiness as indicated by the arrows in the conceptual framework. As suggested by literature, the mediation effect of satisfaction in urban life domains will also be tested. The conceptual framework follows the approach of the operational models developed by McCrea et al. (2005, 2006) in his two studies. In the earlier study (2005), subjective attributes are hypothesized to predict satisfaction in urban domains and urban domains are hypothesized to predict overall life satisfaction. Similarly, the focus of this research is to establish that there is a relationship between urban attributes related to a specific urban domain and satisfaction in that domain. In his next study (McCrea et al., 2006), both objective and subjective attributes of the urban environment were used to predict the urban quality of life or overall life satisfaction.

Based on literature, relevant control variables will be included in the study to control for the effect of personal characteristics or personal life situations that can affect SWB which are age, gender, ethnicity, household composition, health, educational level, employment, and income. General neighbourhood characteristics such as the size and population of the neighbourhood will also be included as control variables. The length of stay in the neighbourhood and length of stay in the city will also be asked from the respondents and used as control variables since this can obviously affect emotions and satisfaction with living in the neighbourhood and the city.

Chapter 3: Research Design and Methods

This chapter provides detailed information on the research design, data collection and data analysis methods were employed to meet the research objective which is to determine the characteristics of the built environment that significantly affect the happiness of residents in selected neighbourhoods in Rotterdam.

3.1 Revised Research Question(s)

The overall and sub research questions remain the same as stated in Chapter 1.

Overall Research question

What characteristics of the built environment and urban life domains affect the happiness of residents in selected neighbourhoods in Rotterdam?

Sub questions:

1. What are the characteristics of the urban built environment that significantly affect the satisfaction with urban life domains?

2. What are the characteristics of the urban built environment that significantly affect the happiness of residents in selected neighbourhoods in Rotterdam?

3. What are the urban life domains that significantly affect the happiness of residents in selected neighbourhoods in Rotterdam?

4. Do urban life domains mediate the effect of characteristics of the urban built environment on happiness?

3.2 Operationalization: Variables, Indicators

Based on the conceptual framework, research variables and indicators are derived and categorized under three types: independent variables (X), dependent variable (Y) and mediating variables (M).

There are two types of X-variables which are the objective and subjective characteristics of the built environment with also separate objective and subjective indicators. In the analysis, specific objective and subjective indicators will be regressed to happiness and the urban life domain that it is associated with. For example, housing attributes such as size of the house, condition and maintenance of the house will be used to predict housing satisfaction. The indicators are selected according to indicators used and findings in previous research on significant indicators of the built environment that affect subjective well-being.

The M-variable is satisfaction with urban life domains categorized in this research into three sub variables which are housing satisfaction, neighbourhood satisfaction, and city satisfaction. For each mediating sub-variable, one question will be asked to obtain the respondent's overall satisfaction with their housing condition, neighbourhood living and city living.

The research has one Y-variable which is happiness or the subjective well-being of residents that will be measured by two indicators which are overall happiness and life satisfaction. Two measures are used to capture both the affective and cognitive aspect of SWB that is the common approach of many international polls on quality of life and SWB such as Gallup, the European Social Survey and the World Values Survey. To make the data comparable, the research will adopt the overall happiness and life satisfaction scale of the European Social Survey which both have the same range from 0 to 10.

The study also used control variables which include socio-demographic variables that are known from literature to affect SWB (i.e. gender, age, household composition, ethnicity, health (self-rated), income, employment, educational level, years of residence in neighbourhood and the city) and also general neighbourhood characteristics (i.e. size and population of the neighbourhood) which can also affect levels of happiness.

Table 1 provides an overview of the concepts operationalized by different variables and indicators and also shows the corresponding research analysis done.

Table 1. Operationalization of research concepts

Concept	Variable	Indicators	Analysis
Built environment	A. Objective characteristics - are aggregated secondary spatial data which are related to perceived Quality of Life which is the human satisfaction derived from the different characteristics of places (Marans and Stimson, 2011)	1. Housing size 2. Age of house 3. House energy index 4. Residential density 5. House ownership 6. Housing type 7. Number of basic facilities and amenities in the neighbourhood (grocery shops, shopping area, education, medical and sports facilities, movie theatre, museums and libraries) 8. Number of different modes of public transportation in the neighbourhood (tram, bus, metro, and train) 9. Mode of transport used 10. Neighbourhood crime rate 11. Neighbourhood noise level 12. Neighbourhood building density 13. Neighbourhood population density 14. Travel time to work place 15. Number of public facilities and services in the city (education and medical facilities, trash disposal and sanitation services) 16. City road traffic 17. City building density 18. City population density	Descriptive and Inferential statistics

Concept	Variable	Indicators	Analysis
	B. Subjective characteristics - are disaggregated or individual level data which measure people's assessments or evaluations of Quality of Life (Marans and Stimson, 2011)	1. Satisfaction with housing size 2. Perceived house condition 3. Satisfaction with maintenance of house by housing agency 4. Control of house temperature 5. Perceived residential crowding/density 6. Perceived access to basic facilities and leisure amenities in the neighbourhood 7. Perceived access to work place 8. Perceived access to different modes of public transportation in the neighbourhood 9. Maintenance of public places in the neighbourhood 10. Cleanliness of neighbourhood 11. Visual appeal of buildings in the neighbourhood 12. Social capital a. Neighbour interactions b. Neighbour relationships c. Trust of Neighbours d. Attachment to community 13. Neighbourhood perceived safety 14. Neighbourhood perceived noise level 15. Neighbourhood perceived crowding/density 16. Perceived access to public facilities in the city 17. Satisfaction with government services in public facilities in the city 18. Satisfaction with maintenance of public places in the city 19. Satisfaction with trash disposal and sanitation service in the city 20. Perceived road traffic in the city 21. Perceived crowding/	Descriptive and Inferential statistics

Concept	Variable	Indicators	Analysis
		density in the city 22. Visual appeal of buildings in the city	
Urban life domains	Housing satisfaction Neighbourhood satisfaction City satisfaction	Overall satisfaction with housing condition Overall satisfaction with living in the neighbourhood Overall satisfaction with living in the city	Descriptive and Inferential statistics
Happiness	Overall happiness Life Satisfaction	Taking all things together, how happy would you say you are? Scale=0 (very unhappy) to 10 (very happy) from the European Social Survey All things considered, how satisfied are you with your life as a whole nowadays? Scale=0 (very unhappy) to 10 (very happy) from the European Social Survey	Descriptive and Inferential statistics

Source: Author, 2015

3.3 Research Strategy and Approach

The main research strategy is a one-time survey that was conducted in two selected neighbourhoods in Rotterdam to collect primary data. Secondary official government data from the municipality of Rotterdam was also used to obtain information on objective indicators of the built environment. The primary data from the survey was analyzed together with secondary aggregated spatial data to achieve the research objective which is to identify the characteristics of the built environment that can explain or predict the satisfaction with urban life domains and the happiness of residents in selected neighbourhoods in Rotterdam. The research approach is quantitative and explains the relationship between the built environment and happiness of residents mainly by statistical tests and analysis.

Van Thiel (2014) describes the survey as a large-scale approach which allows the efficient collection of a substantial amount of information on a number of variables and many units of study referred to as respondents. Because the survey uses a large amount of respondents and standardized information, data collected can be easily generalized to the population making it highly external valid strategy.

The survey is considered to be a suitable strategy for theory-driven or deductive forms of research that has an explanatory or testing objective which applies existing theories in order to add to theory or ascertain if the theory holds true for the context being studied (Van Thiel, 2014). From the review of the related literature, certain characteristics of the built environment have already been identified to have a direct or indirect effect on the happiness

of people and their satisfaction with different urban life domains. Thus, the relationships between the variables being studied are already known to some extent. The research will test hypotheses on the relationships between variables as indicated in the conceptual framework of the study.

3.4 Data Collection Methods

Primary data from a survey questionnaire and secondary data from the municipal government of Rotterdam was used in the study. The questionnaire was translated from English to Dutch and was pretested to some Dutch speaking staff of IHS (Annex 4).

A self-administered questionnaire was distributed personally by the researcher to a sample of households in two selected neighbourhoods in Rotterdam. Respondents were asked if they prefer to have the questionnaire picked up from their house by the researcher in a few days or if they prefer to mail back the questionnaire on their own in which case a mail stamp was provided. For each household, any member 18 years old or above was requested to complete and return the questionnaire before a specified deadline.

In addition to mail, an online and printed version of the survey was also distributed through some local organizations and the district area committee in the neighbourhood of Cool. Since not enough responses were gathered from the mail and online survey, residents from the two neighbourhoods were also approached in public areas to answer the questionnaire to increase the survey's response rate. Reminder letters were also sent to respondents who received the mail survey which gave them more time to return the questionnaire.

A questionnaire is the most adequate method for the research since it is an efficient way to gather a large amount of information from many respondents on their subjective perceptions and assessments on a number of attributes of the built environment. A questionnaire also generates sufficient standardized information that can be transformed into quantitative data which allows for statistical analysis and generalization of findings to the whole target population.

Secondary objective data at the household, neighbourhood and city level was obtained from the municipality of Rotterdam (Urban Development Cluster/Department of Space and Living). Some of the secondary data was also gathered from the municipality's Smart City Planner (SCP) database which contains information on indicators that have a geographical or spatial dimension and are categorized under people (social), planet (environment) and prosperity (economic). Other secondary data were gathered online from the Netherlands national statistics agency, google maps and the Netherlands official post (mail) website.
Annex 1 shows the data collection matrix which includes the source, type and measurement or scale of data for each variable and indicator in the study.

3.5 Sample Size and Selection

Two steps were carried out to determine the survey sample of the research. First is the selection of the neighbourhoods and second is the probability sampling of respondents in each neighbourhood. Two neighbourhoods were selected to determine if different types of built environment can explain the level of happiness of residents in the area. The approach of comparing neighbourhoods with different physical designs ranging from traditional, mixed-use, pedestrian-friendly neighbourhoods to modern, suburban and automobile-oriented

neighbourhoods, or a hybrid of both (i.e. based on different street networks, the number of amenities and walkable destinations) has been used in several studies to determine the effect of neighbourhood design on the level of social capital, sense of community, walkability and travel behavior (Lund, 2002, Lund, 2003, Leyden, 2003, Wood et al., 2007, Rogers et al., 2010, French et al., 2014). All these studies have shown that there is a relationship between neighbourhood design and social connections and behavior of people. Since social capital is one of the key determinants of happiness, this research by extension adopts the above described approach of previous studies which compares neighbourhoods with different physical designs. Due to resource constraints to conduct a survey research, only two types of neighbourhoods are included. Further research in the future can build on the preliminary results of this study and include more neighbourhoods of different types to make findings more generalizable to more contexts and to a greater population.

The two neighbourhoods selected, Cool and Terbregge, are those that varied greatly from each other based on an averaged index of built environment indicators[2]. The averaged index consists of the following indicators which were given equal weight: 1) share of total public space of total surface area; 2) share of total surface area using green; 3) average number of different types of commercial facilities per inhabitant within 500 meters; 4) average number of different types of entertainment facilities per inhabitant within 500 meters; 5) dwelling per hectare; 6) proportion of residents with a public transport stop (train, metro, tram) within a reasonable distance; 7) share of cycling routes of total length of cycle network; 8) residential and pedestrian are per hectare; and 9) share of 30 km roads. Data for the identified indicators were obtained from the official SCP database of the municipality of Rotterdam for the period 2009 to 2012.

As expected, the selected neighbourhoods correspond to inner city and suburban type of neighbourhoods which have distinct differences on urban design, land use, presence of facilities and amenities and transportation network.

In each neighbourhood, systematic sampling was used to select every 3rd or 5th household on each major street of the neighbourhood depending on the length of each street. A simple random sample was not possible because a list of households for each neighbourhood was not provided by the municipality due to confidentiality regulations. Convenience sampling was also used to select some household respondents who were present in their house when the survey was distributed by mail and some residents from the neighbourhood were also approached in public places in the neighbourhood to increase the number of respondents.

Instead of individuals, households are selected as the population of the research in order to increase the response rate by making it possible to have more than 1 responsible adult to answer the questionnaire. Systematic probability is sufficient because the aim of the study is not to have separate statistical estimates and analysis for subgroups in the population but to compare populations of two neighbourhoods.

A sample of 105 households was selected in each neighbourhood, for a total sample size of 210. The sample size was calculated by the formula for determining the sample size of the mean with a confidence level of 90%, a standard deviation set at 0.5 (to ensure that the sample is large enough), and a margin of error of +/-8% as shown below:

[2] Lower index Neighbourhoods of Zestienhoven and Charlois Zuidrand were not selected because these Neighbourhoods had much lower population and number of households as compared to Cool. Said Neighbourhoods also had distinct spatial features such as an airport and a large park which takes up most of the Neighbourhood area.

$$n_0 = z^2 * \sigma^2 / e^2$$
$$= (1.645)^2 * (0.5)^2 / (0.08)^2$$
$$= 105$$

Where n_0 is the sample size, z is the z-score of the confidence level, σ is the standard deviation or variance in responses and e is margin of error or desired level of precision.

3.6 Data Analysis Methods

The data gathered was processed using the statistical software STATA and tested for mediation through multiple ordered probit regressions. As indicated in the conceptual framework, a mediated path between the built environment (X-variables) and happiness (Y-variable) through satisfaction in the urban life domains of housing, neighbourhood and city (M-variables) is hypothesized.

Mediation is a hypothesized causal relationship whereby the X-variable causes the mediator, M, and the M-variable causes the Y-variable. The intervening variable, M, is called the mediator since it "mediates" the relationship between a predictor, X, and an outcome, Y (MacKinnon, et al., 2007). Figure 3 shows a single-mediator model wherein the relations among the X, M and Y variables are depicted by the arrows a, b, and c'.

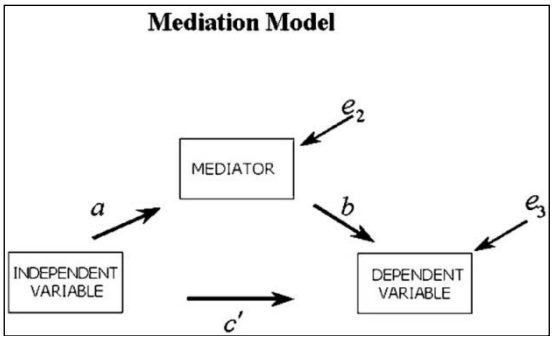

Figure 3. Mediation Model

Source: MacKinnon, et al., 2007

In the figure, paths *a* and *b* are called direct effects relating X to Y while the mediated effect by which X indirectly affects Y through M is called the indirect affect that can be represented by *c'*. The symbols e_2 and e_3 represent residuals in the M and Y variables, respectively. Baron and Kenny (1986) developed a four-step approach to test mediation which involves several regression analyses. In the first to third step, simple regression analysis between X and Y, X and M, and M and Y are conducted. If one or more of these relationships are non-significant, it is usually conclude that mediation is not possible or likely. Assuming that all previous relationships are found to be significant, the fourth step is conducted which is a multiple regression analysis with X and M predicting Y that can indicate partial or full mediation depending if X is still significant or not when M is controlled.

An ordered probit regression model was chosen as a statistical model because the dependent and the mediating variables (which also serve as the dependent variable in some steps of the mediation analysis) are ordered outcomes which have a scale from 0 to 10 and 0 to 5.

In an ordered probit or logit model, there is a distinction between an observed binary outcome, y, viewed as the discrete realizations of an underlying, unobservable (latent) continuous random variable, y*. An index model for a single latent variable y* (which is unobservable, we only know when it crosses thresholds), would satisfy a linear regression model, that is:

$$y_i^* = \mathbf{x}_i'\beta + u_i$$

$$y_i = j \quad \text{if} \quad \alpha_{j-1} < y_i^* \leq \alpha_j$$

where x is a covariate vector, b a vector of regression coefficients and u the error term

The probability that observation i will select alternative j is:

$$p_{ij} = p(y_i = j) = p\left(\alpha_{j-1} < y_i^* \leq \alpha_j\right) = F\left(\alpha_j - \mathbf{x}_i'\beta\right) - F\left(\alpha_{j-1} - \mathbf{x}_i'\beta\right)$$

The ordered logit/probit model with j alternatives will have one set of coefficients with (j-1) intercepts and will have j sets of marginal effects. Because only the signs of the coefficients can only be interpreted, the marginal effects of the ordered logit/probit models need to be estimated to determine the marginal effect of an increase in a regressor x on the probability of selecting alternative j, given by the formula:

$$\partial p_{ij}/\partial \mathbf{x}_{ri} = \left\{F'\left(\alpha_{j-1} - \mathbf{x}_i'\beta\right) - F'\left(\alpha_j - \mathbf{x}_i'\beta\right)\right\}\beta_r$$

For research questions 1, 2 and 3, multiple regressions were performed between the independent variables and the mediating variables, between the independent variables and the dependent variable, and also between the mediating variables and the dependent variable. This corresponds to the first to third step of Baron and Kenny's test for mediation as explained above. The fourth research question on mediation effects by satisfaction in urban life domains will be answered by the third and fourth step of Baron and Kenny's approach. Table 2 below indicates the specific methods, tools and expected outcomes to answer each research question.

In the regressions at the neighbourhood and city level, all the objective secondary data except for the number of grocery shops and estimated travel time from home to work or study were omitted in STATA because of collinearity or redundant observed values since there are only two unique values for the neighbourhoods and one for the city. Thus, mostly subjective neighbourhood characteristics from the survey were available for analysis.

Table 2. Overview of Data Analysis Methods

Research Question	Data used	Method	Tool/ Software	Outcome/s
1. What are the characteristics of the urban built environment that significantly affect the satisfaction with urban life domains?	Primary and secondary data	Multiple ordered probit regression	STATA	• Causal relationship between characteristics of the urban built environment and satisfaction with each urban life domain (housing, neighbourhood and city)
2. What are the characteristics of the urban built environment that significantly affect the happiness of residents in selected neighbourhoods in Rotterdam?	Primary and secondary data	Multiple ordered probit regression	STATA	• Causal relationship between characteristics of the urban built environment and happiness of residents
3. What are the urban life domains that significantly affect the happiness of residents in selected neighbourhoods in Rotterdam?	Primary data	Multiple ordered probit regression	STATA	• Causal relationship between satisfaction with each urban life domain (housing, neighbourhood and city) and happiness of residents
4. Do urban life domains mediate the impact of characteristics of the urban built environment on happiness?	Primary data	Mediation effect/ Multiple ordered probit regression	STATA	• Test of mediation effect (no mediation, partial mediation or full mediation) of the mediating variables of satisfaction in different urban life domains on housing, neighbourhood and city satisfaction

Source: Author, 2015

3.7 Validity and Reliability

To ensure the reliability of the questionnaire, it was translated into Dutch and was pretested to several IHS staff. Based on the feedback from the pretest, the questionnaire was modified slightly to improve clarity and understandability. During the actual conduct of the survey, the respondents were left to answer the questionnaire on their own without the interference of the researcher to avoid bias except when they asked for clarifications. In the modelling of the indicators, multiple collinearity checks was undertaken to eliminate indicators with VIF greater than 10. Access to shopping area and entertainment access were dropped in the neighbourhood regression model because of high multi-collinearity with other variables. Robust standard errors were also used in all the regressions to correct for any heteroskedasticity in the data which are common for cross-sectional data like the survey used in this research. In linear regressions, errors are assumed to be both independent and identically distributed but heteroskedasticity causes standard errors to be biased. Robust standard errors relax either or both of those assumptions. Hence, when heteroskedasticity is present, robust standard errors tend to be more trustworthy.

On the validity of the research, indicators and measurements in previous studies were used in the questionnaire. For each level of analysis at the housing, neighbourhood and city level, multiple indicators of the independent variable (e.g. at least five or more) were used to capture more comprehensively the concepts being studied. The dependent variable was also measured using two indicators happiness and life satisfaction to distinguish between the affective and cognitive approaches to subjective well-being.

Chapter 4: Research Findings

4.1 Overview of the research area and survey respondents

The research was conducted in two neighbourhoods in Rotterdam which are Cool and Terbregge. Cool is part of the Rotterdam city center district and has a population of 4,322 and a total of 2,821 households as of 2014. The neighbourhood has an area of around 63 hectares and is composed of a northern and southern part divided by the main road of Westblaak. Northern Cool is characterized by a large and varied selection of shops, restaurants, entertainment and cultural amenities and other businesses that provide employment to about 16,860 people. Southern Cool has a mix of residential and business areas which the Witte de Withstraat that is known for its restaurants, bars, shops and galleries. Terbregge is located in the north eastern part of Rotterdam in the Hillegersberg-Schiebroek district. It has a population of 3,443 and a total of 1,308 households as of 2014. The neighbourhood has an area of around 170 hectares and is composed of an old and newly developed area. In general, Terbregge is mostly a residential area surrounded by water and greenery. The 'Old Terbregge' is said to date back to the 1500's when a small settlement sprang up along the river river Rotte. The 'New Terbregge' is located between the Rotte and the major highway A20 and was developed in the late 1990s as a new residential area. This part of the neighbourhood has diverse types of residences, a number of children playgrounds and a sports complex. There are very few shops inside the neighbourhood although grocery and commercial shops can be easily accessed by bike or car in the surrounding neighbourhoods (Wijkprofiel Rotterdam, 2015).

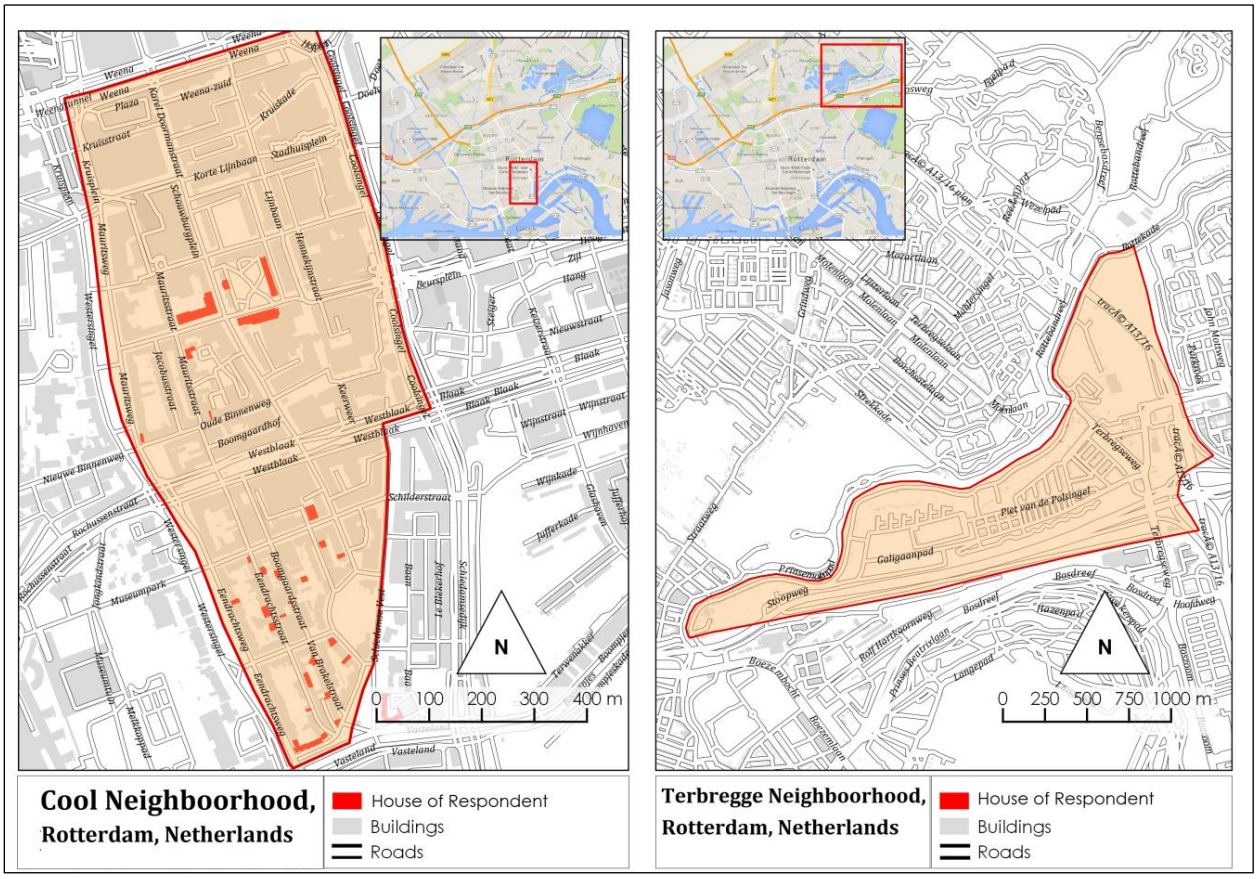

Figure 4. Map location of research areas and survey respondents

Source: Google Maps and Open Street Map, 2015

A total of 66 responses were collected through mail, face-to-face interview and online method from the survey of the two neighbourhoods. From the 210 questionnaires distributed, the response rate is 31%. A slightly higher number of respondents came from the neighbourhood of Terbregge (34) than Cool (32).

As a whole, an equal number of male and female respondents were included in the study, mostly between the age of 36 to 51 years old (47%) and of Dutch origin (74%). The respondents are composed mostly of couple with children at home (46%) and have university level education (49%). In terms employment and income, most have a permanent job (55%) and have a household income between € 3050 or more per month (40.30%). On self-rated personal health, most of the respondents rate their health as good to very good (77%). Looking separately at each research area, all of the general characteristics of the respondents stated above are also the case except for income. More respondents from Terbregge (65%) report to be in the highest income class than those in Cool which has more respondents (36%) in the second highest income class of € 1750-3050 per month. Annex 2 shows the frequency data on demographic variables collected from all respondents.

4.2 Overview of data and comparison between research areas

As mentioned in the methodology section, this research has many independent (X) variables and indicators which are the characteristics of the built environment. There are three mediating variables (M) and indicators which are housing satisfaction, neighborhood satisfaction, and city satisfaction which was measured by one question each on a five-point likert scale: disagree strongly (1), disagree (2), neither agree or disagree (3), agree (4) and strongly agree (5). The dependent variable (Y), subjective well-being, is measured by two indicators which are happiness and life satisfaction. Respondents were asked in a scale from 0 (most negative/low) to 10 (most positive/highest) to rate their overall level of happiness with the question "Taking all things together, how happy would you say you are?" and also on life satisfaction with the question "All things considered, how satisfied are you with your life as a whole nowadays?". Several demographic variables such as gender, age, household composition, ethnicity, health (self-rated), income, employment, educational level, years of residence in neighbourhood and the city were also included. A detailed summary statistics with the mean, standard deviation, maximum and minimum values for all the indicators is provided in Annex 3.

Two neighbourhoods were selected to determine if different types of built environment are associated with different levels of happiness, life satisfaction and satisfaction in urban domains of residents. Based on previous studies it was expected that people living in mixed-use and walkable neighbourhoods (i.e. inner city neighbourhood), where there are more public spaces for interaction, have higher levels of well-being in particular higher social capital that is known as a strong predictor of happiness (Leyden, 2003, Wood et al., 2007, Rogers et al., 2010).

However, there was no significant difference found between residents' level of happiness, life satisfaction and satisfaction in urban life domains for housing, neighbourhood and city living in the two research areas. In other words, the neighbourhoods (and the difference between their built environments) do not have a significant effect on the residents' subjective well-being and perceptions on urban living. Also, the scores on the social capital indicators between the two neighbourhoods do not have any significant difference except for trust of neighbours. Further statistical tests also show that among the four social capital indicators,

only neighbour interaction significantly affects life satisfaction and happiness. Thus, contrary to previous studies, social capital was not found to vary between neighbourhoods with different physical forms nor was it a good predictor of well-being of residents surveyed.

On the dependent indicator Happiness, most the respondents from the two neighborhoods reported a high level of overall happiness (7-9 score) with a combined mean of 7.65. Residents of Terbregge have more respondents who have higher happiness scores with a slightly higher mean score of 7.85 as compared to 7.44 in Cool. However, a t-test revealed that there is no significant difference between residents of Cool and Terbregge in their mean score on the dependent variable happiness, $t(64) = -1.348$, $p > .05$.

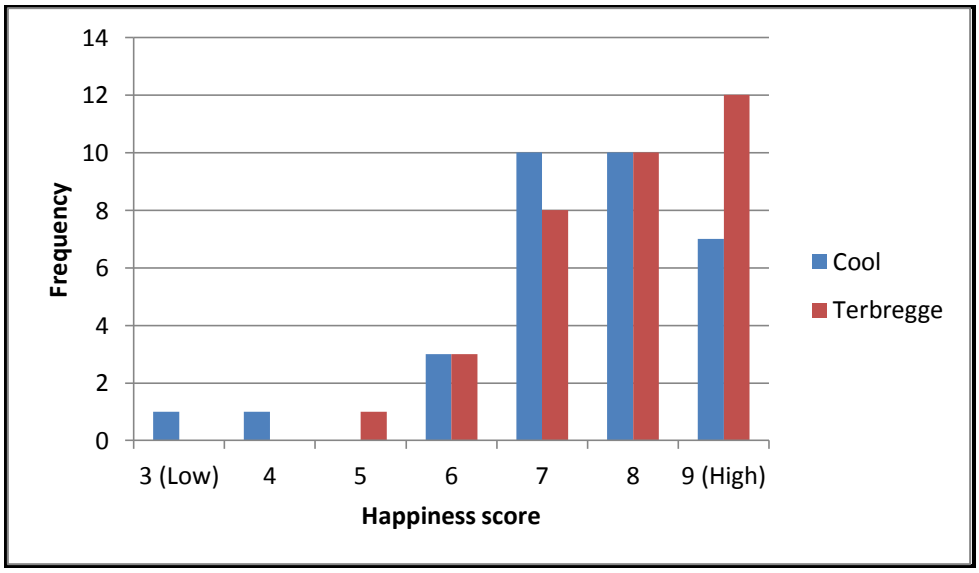

Chart 1. Happiness scores of respondents
Source: Author, 2015

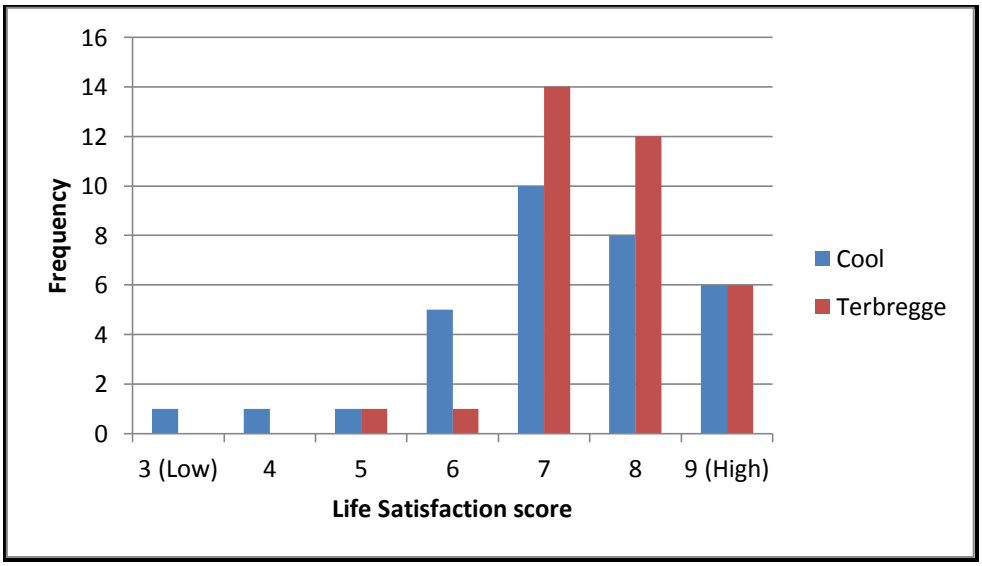

Chart 2. Life Satisfaction scores of respondents
Source: Author, 2015

Similarly, most the respondents from the two neighborhoods reported a high level of overall Life Satisfaction (7-9 score) with a combined mean of 7.41. Residents of Terbregge have more respondents who have higher life satisfaction scores with a slightly higher mean score of 7.62 as compared to 7.19 in Cool. However, a t-test revealed that there is no significant

difference between residents of Cool and Terbregge in their mean score on the dependent variable life satisfaction, t(64) = -1.450, $p > .05$.

Taking the two indicators of subjective well-being into account, it can be said that most of the respondents feel happy and satisfied with their lives. This finding is consistent with international World Happiness Reports which rank the Netherlands as among the top countries which have the highest scores in Europe and globally on subjective well-being measures.

Table 3. T-test for Dependent variables by research area

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Happiness	Equal variances assumed	.529	.470	-1.348	64	.182	-.415	.308
Life Satisfaction	Equal variances assumed	3.187	.079	-1.450	64	.152	-.430	.297

Source: Author, 2015

For all the mediating variables, most of the respondents agree that they are satisfied to live in their house, in their neighborhood and the city of Rotterdam. The combined mean scores for house satisfaction, neighbourhood satisfaction and city satisfaction for the two research areas are 4.20, 4.27, 4.06 respectively. T-tests were also conducted to determine any differences on the mean scores of the three mediating variables between the two research areas, but again no significant differences were found (Table 5).

Table 4. Mean scores for mediating variables by research area

		N	Mean	Std. Deviation	Std. Error Mean
House satisfaction	Cool	32	4.03	1.031	.182
	Terbregge	34	4.35	.774	.133
Neighborhood satisfaction	Cool	32	4.19	.644	.114
	Terbregge	34	4.35	.646	.111
City satisfaction	Cool	32	3.94	.716	.127
	Terbregge	34	4.18	.521	.089

Source: Author, 2015

Table 5. T-test for mediating variables by research area

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
House satisfaction	Equal variances assumed	.347	.558	-1.439	64	.155	-.322	.224
Neighbourhood satisfaction	Equal variances assumed	.589	.446	-1.041	64	.302	-.165	.159
City satisfaction	Equal variances assumed	.608	.438	-1.558	64	.124	-.239	.153

Source: Author, 2015

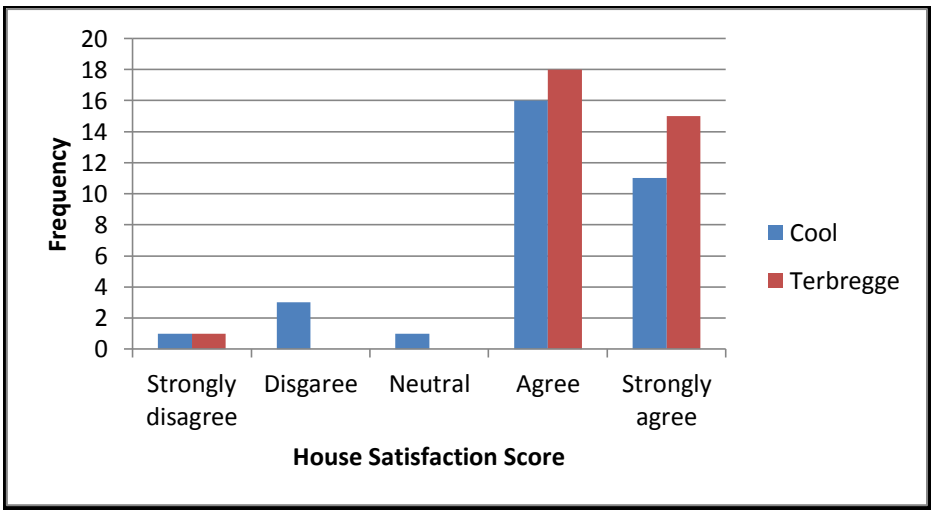

Chart 3. House Satisfaction scores of respondents
Source: Author, 2015

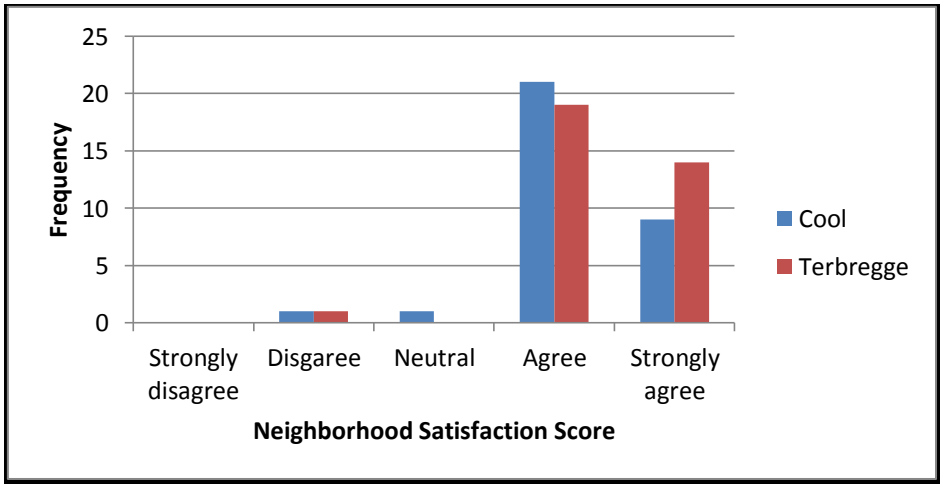

Chart 4. Neighbourhood Satisfaction scores of respondents
Source: Author, 2015

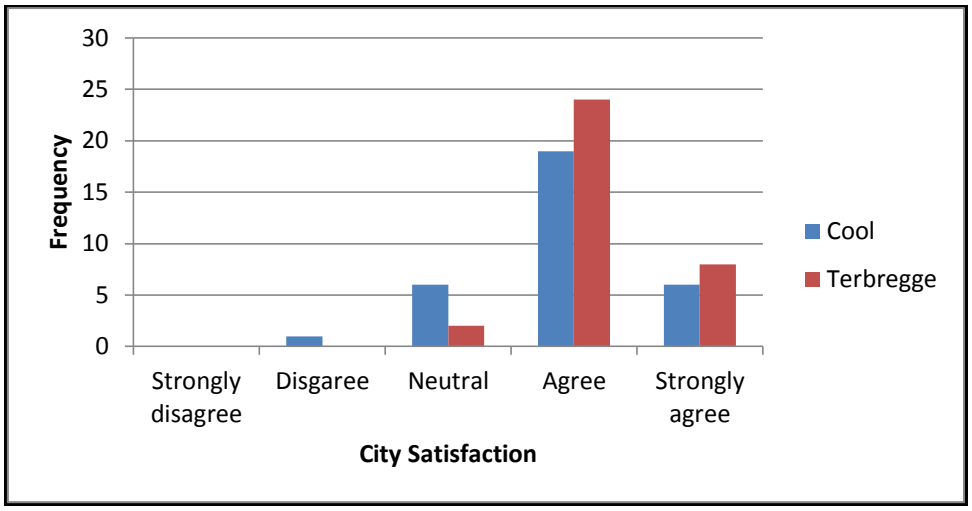

Chart 5. City Satisfaction scores of respondents
Source: Author, 2015

Although residents in the two neighbourhoods do not have statistically significant differences in their mean scores on the mediating and dependent variables, there are several independent variables in which the scores of residents in the two neighbourhoods significantly differ. This confirms to some extent that there are indeed differences in the physical or built environment of the two neighbourhoods as perceived by the residents and also supports the research's classification of the two neighbourhoods. Table 6 shows the house, neighbourhood and city characteristics in which residents of Cool and Terbregge have significant differences in their mean scores based on a t-test.

Table 6. T-test for Independent variables by research area

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
House condition	Equal variances assumed	2.428	.124	-3.008	64	.004	-.722	.240
House temperature	Equal variances not assumed	5.471	.023	-4.284	54.974	.000	-1.149	.268
House crowding	Equal variances not assumed	9.299	.003	4.491	53.368	.000	1.020	.227
Neighborhood cleanliness	Equal variances not assumed	4.389	.040	-4.173	56.094	.000	-.855	.205
Pleasant appearance of neighborhood buildings	Equal variances assumed	.713	.402	-4.912	63	.000	-.866	.176
Neighborhood safety	Equal variances assumed	2.896	.094	-5.558	62	.000	-1.016	.183

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Neighborhood noise	Equal variances not assumed	8.269	.005	3.384	54.401	.001	.903	.267
Crowding of buildings in the neighborhood	Equal variances not assumed	5.714	.020	3.371	57.381	.001	.642	.191
Crowding of people in the neighborhood	Equal variances not assumed	4.993	.029	2.953	57.185	.005	.537	.182
Trust of neighbors	Equal variances assumed	4.058	.048	-2.682	64	.009	-.588	.219
Grocery access	Equal variances assumed	.188	.666	4.805	63	.000	1.017	.212
Commercial area access	Equal variances assumed	2.969	.090	6.741	63	.000	1.213	.180
Parks and green area access	Equal variances assumed	1.857	.178	-2.612	63	.011	-.447	.171
Medical access	Equal variances assumed	2.144	.148	3.974	63	.000	.802	.202
Entertainment access	Equal variances assumed	1.985	.164	8.009	60	.000	1.638	.205
Public transport access (mean score for tram, bus, metro and train)	Equal variances assumed	.259	.613	9.743	61	.000	1.369	.141
Adequacy of education facilities	Equal variances assumed	4.180	.045	-2.630	60	.011	-.483	.184
Satisfaction of education services	Equal variances not assumed	5.102	.028	-2.460	51.864	.017	-.489	.199
Satisfaction with waste and sanitation services	Equal variances assumed	2.456	.122	-2.141	63	.036	-.512	.239

Source: Author, 2015

Among all the house characteristics, it was shown that there is significant difference between residents of Cool and Terbregge in their mean scores on house condition, house temperature and house crowding.

More residents in Terbregge agree that their house is in good condition (91% vs.75%) and they can maintain a comfortable temperature in their house (82% vs. 45%) as compared to fewer residents in Cool. On perception of living in a crowded housing area, more residents of Cool agree that they live in a crowded housing area as compared to a very low percentage of residents in Terbregge (31% vs. 3%).

On neighborhood characteristics, it was shown that there is significant difference between residents of Cool and Terbregge in their mean scores on neighborhood cleanliness, pleasant appearance of neighborhood buildings, neighborhood safety, neighborhood noise, crowding of buildings in the neighborhood, crowding of people in the neighborhood, and trust of neighbors.

More residents in Terbregge agree that their neighborhood is clean (94% vs. 63%), neighbourhood buildings have a pleasant appearance (97% vs. 56%), the neighborhood is safe (94% vs. 47%), and neighbors can be trusted (82% vs. 56%). On perception of noise, overcrowding of buildings and overcrowding of people in the neighborhood, more residents in Cool as compared to residents in Terbregge agree that their neighborhood is noisy (34% vs. 6%), has too many buildings (13% vs. 3%), and has too many people (13% vs. 3%). On neighborhood accessibility characteristics, it was shown that there is significant difference between residents of Cool and Terbregge in their mean score on grocery access, commercial area access, parks and green area access, medical access, entertainment access, and public transport access. More residents in Cool as compared to Terbregge agree that grocery shops, shopping area, medical facilities, entertainment facilities and public transport stops are quite to very accessible in their neighborhood. On the other hand, all the surveyed respondents in Terbregge agree that parks and green spaces are quite to very accessible in their neighborhood as compared to only 72% residents in Cool.

Among all the city characteristics, it was shown that there is significant difference between residents of Cool and Terbregge in their mean score on adequacy of education facilities, satisfaction of education services, and satisfaction with waste/sanitation services. More residents in Terbregge agree that there is an adequate number of public education facilities in the city (91 vs. 66%), more satisfied with public education services in the city (66% vs. 56%) and more satisfied with waste and sanitation services in the city (71% vs. 41%) as compared to residents in Cool.

4.3 Mediation Analysis

A total of six mediation analyses were performed to test if there exists a mediated path between characteristics of the built environment (X-variables) and subjective well-being indicators of happiness and life satisfaction (Y-variable) through urban life domains of housing satisfaction, neighbourhood satisfaction and city satisfaction (M-variables). Six mediation analyses are required since there are three mediating variables and two dependent variables. The six mediation analyses are:

Mediation 1: House characteristics → House satisfaction → Happiness

Mediation 2: House characteristics → House satisfaction → Life Satisfaction

Mediation 3: Neighbourhood characteristics → Neighbourhood satisfaction → Happiness

Mediation 4: Neighbourhood characteristics→Neighbourhood satisfaction→ Life Satisfaction

Mediation 5: City characteristics → City Satisfaction → Happiness

Mediation 6: City characteristics → City Satisfaction → Life Satisfaction

Baron and Kenny (1986) developed a four-step approach to test mediation which involves several regression analyses as described in the methodology section. This involves establishing significant relationships between the variables X and Y, X and M, and M and Y that was performed through ordered probit regression in this research. Assuming that all previous relationships are found to be significant, the fourth step is conducted which is a multiple regression analysis with X and M predicting Y that can indicate no, partial or full mediation depending on which predictors are significant.

Beyond proving mediation, the mediation analysis described above also determines in the process which of the independent built environment characteristics of the study are significant or important to subjective well-being and satisfaction in urban life domains.

4.3.1 Housing satisfaction as mediator

In this section, the role of housing satisfaction as a mediator between housing characteristics and happiness and between housing characteristics and life satisfaction was examined. Table 7 shows the regression for happiness as the dependent variable. In the first column, happiness is predicted by the house characteristics; in the second, housing satisfaction is predicted by house characteristics and in the third column, happiness is predicted by house satisfaction.

Mediation through housing satisfaction was not found as indicated in the third column which shows that house satisfaction is not significantly associated with happiness. Since there is no significant relationship between house satisfaction and happiness, mediation is not possible or likely between house characteristics to happiness through house satisfaction. This also means that as an urban life domain, house satisfaction is not a significant predictor of happiness.

Table 7. Mediation between house characteristics, house satisfaction and happiness

	(1) Happiness	(2) House satisfaction	(3) Happiness
House satisfaction			-0.0834 (0.08)
House size (m^2)	0.0004 (0.00)	0.0029* (0.00)	
House age	-0.0072** (0.00)	-0.0017 (0.00)	
House type	0.0262 (0.08)	-0.1307* (0.06)	
House condition perception	-0.0140 (0.07)	0.1278* (0.06)	
House size satisfaction	0.1389** (0.05)	0.1450*** (0.03)	

	(1) Happiness	(2) House satisfaction	(3) Happiness
Agecat==3 (52-67 yrs. old)	-0.7990* (0.33)	-0.2755 (0.16)	-0.3888* (0.15)
Agecat==4 (> 68 yrs. old)	-1.4193** (0.54)	0.5443* (0.24)	0.5928 (0.34)
Ethnicity==3 (Suriname)	-0.3352* (0.17)	-0.0177 (0.10)	-0.2231 (0.16)
Ethnicity==4 (Turkey)	-0.1837 (0.22)	-0.4770** (0.16)	-2.2623*** (0.61)
Ethnicity==5 (Morocco)	-0.0332 (0.30)	-0.3587* (0.17)	-0.4309 (0.26)
Ethnicity==7 (Western)	-0.5635* (0.22)	0.3889 (0.22)	-0.1230 (0.29)
Ethnicity==8 (Non-western)	0.7252** (0.27)	0.2382 (0.24)	-0.0594 (0.23)
Ethnicity==9 (Others)	-0.3369 (0.29)	-0.6848*** (0.20)	-1.2423** (0.38)
Employment==2 (Temporary job)	-0.7219 (0.71)	-0.1468 (0.23)	-2.0912** (0.80)
Employment==3 (Permanent job)	-0.7838 (0.50)	-0.1930 (0.19)	-2.0389** (0.73)
Employment==4 (House wife/husband)	-0.0486 (0.29)	-0.7290* (0.29)	-1.4965** (0.54)
Employment==6 (Unable to work)	-1.4518* (0.57)	-1.3559*** (0.29)	-0.4471 (0.28)
Employment==7 (Retired)	0.0282 (0.44)	-0.4803* (0.22)	-2.6283** (0.82)
Employment==8 (Self-employed)	-0.5410 (0.47)	0.0448 (0.22)	-2.1061** (0.77)
Income==2 (€1000-1350/mo)	0.1881 (0.21)	-0.4969*** (0.12)	1.4050*** (0.42)
Income==3 (€1350-1750/mo)	0.1721 (0.18)	0.0405 (0.18)	1.2132*** (0.36)
Income==4 (€1750-3050/mo)	0.4265 (0.24)	-0.4787** (0.15)	1.5663** (0.51)
Income==5	0.4849*	-0.4382**	1.6542***

	(1) Happiness	(2) House satisfaction	(3) Happiness
(> €3050/mo)	(0.20)	(0.17)	(0.49)
Health==3	-0.5876*	-0.7122**	0.0540
	(0.30)	(0.25)	(0.28)
Education_level==6 (HBS, lyceum, athenaeum)			1.4071*** (0.38)
Observations	47	62	62
Pseudo R^2	0.41	0.62	0.35

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)
Reference groups: House type (Apartment); Agecat 1 (20-35 yrs.old); Gender 1 (Male); Ethnicity 1 (Netherlands); Employment 1 (Unemployed); Income 1 (<€1000/mo); Health 1 (Very Bad); Household 1 (Live alone); Education 1(No studies).
Source: Author, 2015

The first column shows which house characteristics significantly predict happiness; these are house age and house size satisfaction which are both highly significant at $p < 0.01$. House age is negatively associated with happiness while house size satisfaction is positively associated. Out of all the objective house characteristics, only house age is significantly associated with happiness. House size, house type, house ownership, house energy index and residential density were found to be insignificant. Among the subjective house characteristics, only house size satisfaction is significantly associated with happiness. House condition perception, house temperature control, house maintenance satisfaction and house crowding perception were also found to be insignificant.

The second column shows which house characteristics predict house satisfaction. Among the objective characteristics, house size (in m^2) and house type are significantly associated with house satisfaction. House size is positively associated, thus, a bigger house can increase house satisfaction. House type is also significantly associated with house satisfaction. The negative sign is due to the reference group which is living in an apartment, the other house types are shared apartment, single family detached house, single family semi-detached house and single family terraced or town house. This means that single family dwellings especially terraced or town houses are more associated with higher house satisfaction. Since most of the respondents in Terbregge indicated that they live in terraced or town houses, this complements the data earlier presented in section 4.2 which showed that residents in Terbregge have a higher mean score on house satisfaction

For subjective house characteristics, house condition perception and house size satisfaction are positively associated with house satisfaction. House size satisfaction is especially very highly significant at $p < 0.001$. This result is consistent with findings of previous studies which also report that satisfaction with the house size, including the size of the major activity areas of the house, and perceived house quality or building condition are major determinants of house satisfaction (Lu, 1999; Tiirkoglu, 1997).

There are also several control variables that are significant to house satisfaction. Older people (above 68 yrs. old) are more satisfied with their house which seems to contradict the other significant finding that retired people are less satisfied with their house. Housewives/househusbands, people unable to work due to illness are also found to be less satisfied with their houses. High household income is associated with house satisfaction however it has a negative sign which can mean that the respondents with high income may have higher aspirations of their housing condition.

The second mediation analysis is similar to the first one but instead of happiness, the dependent variable is life satisfaction (Table 8). As shown in the third column, house satisfaction was not found to be significantly associated with life satisfaction. This confirms the result of the previous mediation, thus house satisfaction is not a significant urban life domain that predicts subjective well-being whether measured in terms of overall happiness or life satisfaction. The results of the two mediation analyses also reveal that certain house characteristics directly affect and are better predictors of subjective well-being than house satisfaction.

Table 8. Mediation between house characteristics, house satisfaction and life satisfaction

	(1) Life Satisfaction	(2) House satisfaction	(3) Life Satisfaction
House satisfaction			-0.1039 (0.06)
House size (m^2)	-0.0002 (0.00)	0.0029* (0.00)	
House type	-0.0153 (0.08)	-0.1307* (0.06)	
House condition perception	-0.0063 (0.06)	0.1278* (0.06)	
House size satisfaction	0.1546*** (0.04)	0.1450*** (0.03)	
Agecat==3 (52-67 yrs. old)	-0.2084 (0.21)	-0.2755 (0.16)	-0.3559*** (0.10)
Agecat==4 (> 68 yrs. old)	-0.3066 (0.32)	0.5443* (0.24)	0.4825 (0.27)
Ethnicity==4 (Turkey)	-0.2004 (0.20)	-0.4770** (0.16)	-1.1976*** (0.30)
Ethnicity==5 (Morocco)	-0.4511 (0.28)	-0.3587* (0.17)	-0.4267* (0.20)
Ethnicity==7 (Western)	-0.4073* (0.19)	0.3889 (0.22)	0.5731*** (0.17)
Ethnicity==8 (Non-western)	0.9409*** (0.22)	0.2382 (0.24)	1.0483*** (0.25)
Ethnicity==9 (Others)	0.1887 (0.19)	-0.6848*** (0.20)	-0.7872*** (0.19)
Employment==2 (Temporary job)	0.7098 (0.39)	-0.1468 (0.23)	-0.4434* (0.19)
Employment==3 (Permanent job)	0.3461 (0.22)	-0.1930 (0.19)	-0.3922** (0.13)

	(1) Life Satisfaction	(2) House satisfaction	(3) Life Satisfaction
Employment==4 (House wife/husband)	0.1467 (0.21)	-0.7290* (0.29)	-0.6996*** (0.19)
Employment==5 (Student)	0.3745 (0.28)	-0.4094 (0.23)	1.3254*** (0.27)
Employment==6 (Unable to work)	-0.9912*** (0.30)	-1.3559*** (0.29)	-0.2578 (0.25)
Employment==7 (Retired)	0.4683 (0.36)	-0.4803* (0.22)	-0.8693** (0.27)
Employment==8 (Self-employed)	0.3235 (0.29)	0.0448 (0.22)	-0.4935** (0.19)
Income==2 (€1000-1350/mo)	-0.1983 (0.19)	-0.4969*** (0.12)	0.3435* (0.13)
Income==3 (€1350-1750/mo)	-0.0832 (0.13)	0.0405 (0.18)	0.2723** (0.08)
Income==4 (€1750-3050/mo)	0.0069 (0.16)	-0.4787** (0.15)	0.4332*** (0.13)
Income==5 (> €3050/mo)	0.2475 (0.21)	-0.4382** (0.17)	0.5203*** (0.16)
Health==3	-1.0555*** (0.27)	-0.7122** (0.25)	-0.2346 (0.25)
Health==4	-0.9261*** (0.26)	-0.4520 (0.25)	0.0243 (0.26)
Health==5 (very good)	-0.9085*** (0.21)	-0.5193 (0.27)	0.0833 (0.27)
Household_no==5 (With parents)		-0.1265 (0.26)	-0.8554*** (0.22)
Education_level==3 (Mavo/MBO)			-0.9313*** (0.25)
Education_level==4 (HAVO)			-1.4797*** (0.35)
Education_level==5 (VWO)			-1.6692*** (0.34)
Education_level==7 (HBO/University)			-1.0469*** (0.28)
Observations	47	62	62

	(1) Life Satisfaction	(2) House satisfaction	(3) Life Satisfaction
Pseudo R^2	0.38	0.62	0.47

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)
Reference groups: House type (Apartment); Agecat 1 (20-35 yrs.old); Gender 1 (Male); Ethnicity 1 (Netherlands); Employment 1 (Unemployed); Income 1 (<€1000/mo); Health 1 (Very Bad); Household 1 (Live alone); Education 1(No studies)
Source: Author, 2015

Only house size satisfaction is significant to life satisfaction among all the house characteristics as shown in column 1. Although it is the only significant predictor of life satisfaction, it is very highly significant at $p < 0.001$. This result is consistent with the findings of Ibem and Amole (2013) which also identified satisfaction with the sizes of main activity areas of dwelling units as one of the significant predictors of residents' life satisfaction. Looking back at the first mediation analysis, house size satisfaction is a highly significant predictor of both happiness and life satisfaction making it a very important house characteristic since it has a strong effect on different measures of subjective well-being.

4.3.2 Neighbourhood satisfaction as mediator

The next two mediation analyses are on the neighbourhood level with neighbourhood satisfaction as the mediating variable between neighbourhood characteristics and happiness and between neighbourhood characteristics and life satisfaction. Table 9 shows the regression result for happiness as the dependent variable. Mediation through neighbourhood satisfaction was not found as indicated in the third column which shows that neighbourhood satisfaction is not significantly associated with happiness. Since there is no significant relationship between neighbourhood satisfaction and happiness, mediation is not possible or likely between neighbourhood characteristics to happiness through neighbourhood satisfaction. This also means that as an urban life, domain neighbourhood satisfaction is not a significant predictor of happiness.

Table 9. Mediation between neighbourhood characteristics, neighbourhood satisfaction and happiness

	(1) Happiness	(2) Neighbourhood satisfaction	(3) Happiness
Neighbourhood satisfaction			0.0392
			(0.11)
Travel time (home to work)	0.0038**		
	(0.00)		
Home to work travel perception	0.0222	0.3753**	
	(0.06)	(0.12)	
Nbh cleanliness	-0.1202	0.2498*	
	(0.07)	(0.12)	
Nbh bldgs appearance	0.0609	0.2136*	
	(0.10)	(0.09)	
Nbh maintenance	0.0560	-0.1269**	

	(1) Happiness	(2) Neighbourhood satisfaction	(3) Happiness
	(0.05)	(0.05)	
Nbh bldgs crowding perception	0.1638	0.1636**	
	(0.10)	(0.06)	
Nbh people crowding perception	-0.1724*	-0.4321**	
	(0.09)	(0.14)	
Neighbor interaction	0.1921**	0.1201*	
	(0.06)	(0.05)	
Neighbor trust	-0.0657	-0.2052***	
	(0.09)	(0.06)	
Neighbor relationship	0.0900	0.3436***	
	(0.09)	(0.09)	
Community attachment	-0.1682*	-0.0982*	
	(0.07)	(0.05)	
Grocery access	-0.1062	-0.1749*	
	(0.08)	(0.08)	
Parks/Green access	0.3348***	-0.1059	
	(0.07)	(0.08)	
Medical access	0.2143***	0.0506	
	(0.05)	(0.07)	
Sports access	-0.1810**	0.0810	
	(0.07)	(0.05)	
Income==4 (€1750-3050/mo)	0.6303* (0.26)		
Income==5 (> €3050/mo)	0.5678* (0.26)		
Health==3	1.0382***		
	(0.25)		
Health==4	1.2920***		
	(0.27)		
Health==5 (very good)	1.4698*** (0.31)		
Education level==6 (HBS, lyceum, athenaeum)			1.1771** (0.41)
Observations	52	58	62
Pseudo R^2	0.50	0.71	0.37

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)
Reference groups: Income 1 (<€1000/mo); Health 1 (Very Bad); Education 1(No studies)
Source: Author, 2015

As shown in column 1, the neighbourhood characteristics which are positively associated with happiness are access to park or green areas and access to medical facilities which are very highly significant at $p < 0.001$. Other variables which are positively associated with life satisfaction are estimated travel time from home to work and interaction with neighbours outside of the house. The importance of access to parks and interaction with neighbours to subjective well-being is supported by findings in previous research (Leyden, 2011, Morrison 2011).

On the other hand, perception of too many people in the neighbourhood is negatively associated with happiness. The negative association between happiness with community attachment and access to sports facilities are unexpected. A possible explanation for the negative association with access to sports facilities could be the negative effect of noise and lack of privacy (due to people crowding to the area) that outweigh the benefits of being near the facility. The negative association with sense community is more perplexing. In the questionnaire, the statement was phrased as "I am attached to my neighbourhood"; a possible interpretation is that people who agree more to this statement are not necessarily happier because their feeling of attachment to the neighbourhood might be affected by a lack of ability to move to other neighbourhoods even if they want to. Thus, the lack of residential mobility can have a negative impact on happiness.

The second column shows the neighbourhood characteristics that are significant predictors of neighbourhood satisfaction. Home to work travel perception, neighbourhood cleanliness, neighbourhood buildings appearance, neighbourhood building crowding perception, neighbour interaction and neighbour relationship are all positively associated with neighbourhood satisfaction. The positive association between neighbourhood satisfaction and perception that there are too many buildings can mean that urban dwellers do not mind too much that there are many buildings in their neighbourhood as long as their area is kept clean and the buildings have a pleasant appearance.

Although related to happiness and not neighbourhood satisfaction, Leyden (2011) also had similar results which identified cleanliness of public places and the perceived 'pleasant' appearance of buildings as significant characteristics of the built environment. Compatible with the results of other studies (Sirgy and Cornwell, 2002, McCrea et al., 2005), the effect of social characteristics of the built environment, such as interaction with neighbours and satisfaction with relationship with neighbours, on neighbourhood and community satisfaction was also shown in this research.

The indicators negatively associated with neighbourhood satisfaction are unexpected. The results show that satisfaction with neighbourhood maintenance, trust of neighbours, community attachment and grocery access can decrease neighbourhood satisfaction. The explanation of the negative relationship between community attachment to happiness in the previous regression can also be applied in the case of neighbourhood satisfaction such that the lack of residential mobility might have a negative impact on neighbourhood satisfaction. The negative sign of neighbourhood maintenance can be caused by the inconvenience of maintenance operations such as disruption of normal activities of residents and noise that can negatively affect neighbourhood satisfaction. Thus, even though residents value cleanliness and pleasant buildings in their neighbourhood they might not positively associate this as a result of neighbourhood maintenance services. Other studies also found that satisfaction with the maintenance of the physical environment, such as upkeep of homes and yards,

neighbourhood services like street cleaning, road maintenance and garbage collection are significant to neighbourhood satisfaction (Sirgy and Cornwell, 2002, McCrea et al., 2005).

Although trust of neighbours and community attachment are negatively associated with neighbourhood satisfaction, it should be noted that other indicators of social capital, which are neighbour interaction and neighbour relationship, are also significant and have bigger coefficients. The positive significant aspects of social capital can be more important for neighbourhood satisfaction and can compensate for the negative aspects. The negative sign of trust can also be a result of 'correcting' another finding in the next multiple regression which indicate that high education is strongly and positively associated with happiness.

The fourth mediation analysis is also on neighbourhood satisfaction as the mediating variable but instead of happiness, the dependent variable is life satisfaction (Table 10). The regression in the third column shows that neighbourhood satisfaction is not significantly associated with life satisfaction. This confirms the result of the previous mediation thus neighbourhood satisfaction is not a significant urban life domain that predicts subjective well-being whether measured in terms of overall happiness or life satisfaction. The results of the two mediation analyses also reveal that neighbourhood characteristics directly affect and are better predictors of subjective well-being than neighbourhood satisfaction. So far, the mediation analyses prove that mediation from built environment characteristics to subjective well-being through housing and neighbourhood satisfaction is not possible.

Table 10. Mediation on neighbourhood characteristics, neighbourhood satisfaction and life satisfaction

	(1) Life Satisfaction	(2) Neighbourhood satisfaction	(3) Life Satisfaction
Neighbourhood satisfaction			0.0617 (0.06)
Grocery shops number	0.0226* (0.01)	0.0072 (0.01)	
Travel time (home to work)	0.0034* (0.00)		
Home to work travel perception	0.1225* (0.05)	0.3753** (0.12)	
Nbh Cleanliness	0.0307 (0.06)	0.2498* (0.12)	
Nbh bldgs appearance	-0.0974 (0.08)	0.2136* (0.09)	
Nbh maintenance	0.1215** (0.04)	-0.1269** (0.05)	
Nbh bldgs crowding perception	0.0316 (0.08)	0.1636** (0.06)	
Nbh people crowding perception	-0.0824 (0.07)	-0.4321** (0.14)	

	(1) Life Satisfaction	(2) Neighbourhood satisfaction	(3) Life Satisfaction
Neighbor interaction	0.0200 (0.03)	0.1201* (0.05)	
Neighbor trust	0.0559 (0.07)	-0.2052*** (0.06)	
Neighbor relationship	-0.0357 (0.07)	0.3436*** (0.09)	
Community attachment	-0.0606 (0.06)	-0.0982* (0.05)	
Grocery access	-0.0369 (0.07)	-0.1749* (0.08)	
Parks/Green access	0.2135** (0.07)	-0.1059 (0.08)	
Medical access	0.1008* (0.05)	0.0506 (0.07)	
Sports access	-0.2023*** (0.05)	0.0810 (0.05)	
Ethnicity==4 (Turkey)			-0.9515** (0.30)
Ethnicity==5 (Morocco)			-0.5498* (0.23)
Ethnicity==8 (Non-western)			0.8709*** (0.24)
Ethnicity==9 (Others)			-0.4412*** (0.12)
Employment==4 (Housewife/husband)			-0.4956* (0.20)
Employment==5 (Student)			1.2004*** (0.27)
Employment==7 (Retired)			-0.8232*** (0.24)
Income==2 (€1000-1350/mo)	0.5800* (0.24)		0.4438** (0.14)
Income==3 (€1350-1750/mo)	0.0292 (0.22)		0.2300* (0.11)

	(1) Life Satisfaction	(2) Neighbourhood satisfaction	(3) Life Satisfaction
Income==4	0.3413		0.5039***
(€1750-3050/mo)	(0.21)		(0.13)
Income==5	0.6069**		0.5346**
(> €3050/mo)	(0.19)		(0.18)
Health==3	0.6672***		-0.2583
	(0.17)		(0.23)
Health==4	0.6055***		0.0104
	(0.16)		(0.25)
Health==5	0.7825***		0.0846
(very good)	(0.18)		(0.26)
Household_no==5			-0.8788***
(Living with parents)			(0.23)
Education_level==3			-0.7217*
(Mavo/MBO)			(0.28)
Education_level==4			-1.1351***
(HAVO)			(0.34)
Education_level==5			-1.0998***
(VWO)			(0.33)
Education_level==7			-0.7851*
(HBO/University)			(0.31)
Observations	52	58	62
Pseudo R^2	0.48	0.71	0.48

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)
Reference groups: House type (Apartment); Agecat 1 (20-35 yrs.old); Gender 1 (Male); Ethnicity 1 (Netherlands); Employment 1 (Unemployed); Income 1 (<€1000/mo); Health 1 (Very Bad); Household 1 (Live alone); Education 1(No studies)
Source: Author, 2015

The significant neighbourhood characteristics that are associated with life satisfaction are number of grocery shops in the neighbourhood, estimated travel time from home to workplace, perception of travel from home to work, satisfaction with neighbourhood maintenance services, access to parks or green areas, medical and sports facilities in the neighbourhood. All of the said characteristics are positively associated with life satisfaction except for access to sports facilities. Looking back at the previous regression of happiness as determined by neighbourhood characteristics, three neighbourhood characteristics are positively associated with both happiness and life satisfaction which are estimated travel from home to workplace, good access to parks and green areas as well as good access to medical facilities. On the other hand, access to sports facilities is negatively associated with both happiness and life satisfaction.

It is interesting to see that both estimated travel time from home to workplace and perception of ease of travel from home to work are both positively associated with life satisfaction. This can mean that people who have longer hours of travel from home to the work place are not less satisfied with life as long as they find their travel easy or convenient. A frequency of the transport mode used reveals that almost half of the respondents use cars (30 out of 66 or 45%) and 44% use bikes which is also a common mode of transport in the Netherlands. Buses (11%) and trains (12%) are the least used mode of transport while the metro/subway (20%), tram (14%) and walking (14%) have slightly higher use.

In contrast to the negative relationship between satisfaction with neighbourhood maintenance services and neighbourhood satisfaction, a positive relationship was found between neighbourhood maintenance and life satisfaction. This can mean that although people can be inconvenienced by neighbourhood maintenance they still acknowledge its long-term importance to better living. Another peculiar result is that the number of grocery shops is positively associated to life satisfaction but grocery access is negatively associated to neighbourhood satisfaction. Bearing in mind that one of the neighbourhoods studied did not have any actual grocery shop inside of the neighbourhood, this result can be interpreted such that although the number of grocery shops are important, they must also be accessible to have a positive impact on the well-being of residents.

4.3.3 City satisfaction as mediator

The next two mediation analyses are on the city level with city satisfaction as the mediating variable between city characteristics and happiness and between city characteristics and life satisfaction. Table 11 shows the regression result for happiness as the dependent variable. Mediation through city satisfaction was found in two cases; first is between satisfaction with city maintenance services and happiness and second is between satisfaction with city education services and life satisfaction.

Unlike the previous mediation analyses on the other urban life domains, only city satisfaction was found to be significantly (and positively) associated with happiness and life satisfaction if controlled for certain demographic characteristics[3] known to have an effect on SWB and also years of residence in the city. Thus, city satisfaction appears to be the most important among the urban life domains that significantly influences and predicts subjective well-being. The significance of city satisfaction to subjective well-being is supported by its higher (Pseudo) R^2 as compared to house and neighbourhood satisfaction which means that it can explain more of the variance in happiness and life satisfaction scores. Looking back at section 4.2, housing, neighbourhood and city satisfaction all have a high mean of around 4 (out of 5) but it is city satisfaction that has the lowest standard deviation which means that most scores are concentrated near the mean and can have a bigger effect on the regression with happiness and life satisfaction scores. Because it has the lowest standard deviation, city satisfaction also has the lowest standard error[4] which implies that its sample mean is an accurate reflection of

[3] Control variables: Age, gender, ethnic origin, household composition, level of education, employment status, household income and personal rated health.

[4] The computed standard error of the mean, given the same sample size N=66 for all domains, is as follows: House satisfaction (0.113), Neighbourhood satisfaction (0.079) and City satisfaction (0.077). While the mean of each domain is as follows: House satisfaction (4.20), Neighbourhood satisfaction (4.27) and City satisfaction (4.06).

the actual population mean that can be a basis to generalize the results to the whole population.

Another possible reason for the high significance of city satisfaction as an urban life domain could be the because of the significance of years of residence in the city on happiness and life satisfaction. For instance as shown in the regression results in Table 11 and 12, living in the city from 16 to 45 years is positively associated to happiness while living in the city for a very long time (more than 60 years) decrease both happiness and life satisfaction. In contrast, a significant relationship was not observed between years of residence in the neighbourhood and subjective well-being while there was no measure of years of residence in the current house included in the study.

Since there is a significant relationship between city satisfaction and happiness, the fourth regression of the mediation analysis was performed which is predicting the dependent variable (happiness) by the mediating variable (city satisfaction) and the significant independent variables. Looking back at previous two regressions in this particular mediation analysis, satisfaction with city educational services and satisfaction with city maintenance were the only two consistent significant independent variables. These significant independent variables were regressed separately to test for mediation as shown in column 4.1. and 4.2.

In the first mediation test (column 4.1), both city satisfaction and satisfaction with city educational services are not significant predictors of happiness thus mediation is not supported. In other words, the effect of satisfaction with city education services on happiness is not mediated or goes through city satisfaction. Nonetheless as shown by the previous regressions, city satisfaction and satisfaction with city education services both have separate direct effect on happiness but none when taken together in one regression.

In the second mediation test (column 4.2), partial mediation is supported since both satisfaction with city maintenance services and city satisfaction are significant predictors of happiness. Thus, the effect of satisfaction with city maintenance services on happiness is indirect as it goes through or is mediated by city satisfaction. As indicated by the regression result, the coefficient of city satisfaction increased from the third to fourth regression (0.1747 to 0.1753) while the coefficient of satisfaction with city maintenance services decreased (-0.0880 to -0.0982) which means that a portion of the effect of satisfaction with city maintenance services was 'taken in' or mediated by city satisfaction. In other words, a significantly larger portion of the variance in happiness is explained via the indirect effect through city satisfaction than the direct path from satisfaction with city maintenance services. With regards to the negative sign of satisfaction with city maintenance services, an explanation is provided in the discussion that follows.

Table 11. Mediation between city characteristics, city satisfaction and happiness

	(1) Happiness	(2) City satisfaction	(3) Happiness	(4.1) Happiness	(4.2) Happiness
City satisfaction			0.1747*	0.0851	0.1753*
			(0.07)	(0.11)	(0.07)
City education services satisfaction	0.4743***	0.1508**		0.1528	
	(0.13)	(0.05)		(0.11)	
City maintenance services satisfaction	-0.1285*	-0.0880*			-0.0982*
	(0.06)	(0.04)			(0.05)

	(1) Happiness	(2) City satisfaction	(3) Happiness	(4.1) Happiness	(4.2) Happiness
City buildings crowding perception	0.0625 (0.07)	0.0867* (0.04)			
City people crowding perception	0.1399 (0.10)	-0.2408*** (0.06)			
City traffic perception	-0.2524** (0.08)	0.0285 (0.03)			
City trash services satisfaction	0.0530 (0.06)	0.0489* (0.02)			
Agecat==2 (36-51 yrs.old)	-0.7540*** (0.17)	0.1199 (0.06)	-0.1640 (0.09)		
Agecat==3 (52-67 yrs.old)	-0.8343** (0.27)	0.0797 (0.08)	-0.1868 (0.22)		
Agecat==4 (68 yrs.old and above)	0.9149* (0.43)	0.3108 (0.16)	1.5216*** (0.43)		
Ethnicity==4 (Turkey)	-0.1263 (0.27)		-1.2262** (0.45)		
Ethnicity==9 (Others)	1.2634** (0.45)		-0.6841*** (0.21)		
Employment==2 (Temporary job)	-0.1610 (0.48)		-1.6054** (0.54)		
Employment==3 (Permanent job)	0.5718 (0.43)		-1.2781** (0.47)		
Employment==4 (Housewife/husband)	1.4476* (0.58)		-0.9770** (0.36)		
Employment==7 (Retired)	-0.4582 (0.46)		-1.8945*** (0.54)		
Employment==8 (Self-employed)	0.6900 (0.43)		-1.3177** (0.46)		
Income==2 (€1000-1350/mo)	-0.2109 (0.38)	-0.1980 (0.14)	1.0086*** (0.25)		
Income==3 (€1350-1750/mo)	-0.9070* (0.45)	-0.3128* (0.15)	0.9995*** (0.26)		
Income==4 (€1750-3050/mo)	-0.3484 (0.42)	-0.3908** (0.14)	1.2885*** (0.34)		
Income==5 (> €3050/mo)	-0.4572 (0.43)	-0.3105* (0.15)	1.3005*** (0.38)		
Health==4	-0.0557	0.3060**	0.0034		

	(1) Happiness	(2) City satisfaction	(3) Happiness	(4.1) Happiness	(4.2) Happiness
	(0.31)	(0.11)	(0.32)		
Health==5	0.2643	0.2715**	-0.0023		
(very good)	(0.31)	(0.10)	(0.32)		
Yrs_residence_city2==2	0.4870*	-0.0699	0.3049*		
(16-30 years)	(0.20)	(0.06)	(0.14)		
Yrs_residence_city2==3	0.3681*	-0.0296	0.1341		
(31-45 years)	(0.16)	(0.07)	(0.10)		
Yrs_residence_city2==5	-0.6006	0.5378*	-1.3845**		
(> 60 years)	(0.43)	(0.22)	(0.48)		
Observations	59	59	62	60	62
Pseudo R^2	0.48	0.63	0.46	0.46	0.48

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)
Reference groups: House type (Apartment); Agecat 1 (20-35 yrs.old); Gender 1 (Male); Ethnicity 1 (Netherlands); Employment 1 (Unemployed); Income 1 (<€1000/mo); Health 1 (Very Bad); Household 1 (Live alone); Education 1(No studies)
Source: Author, 2015

There are three city characteristics that are significantly associated with happiness. Satisfaction with educational services in the city is highly and positively associated with happiness while city traffic perception and satisfaction with maintenance of public places in the city are negatively associated with happiness. The negative sign of satisfaction with maintenance of public places in the city is unexpected but similar to the results of Table 9 and 10 where satisfaction with neighbourhood maintenance was also negatively associated to neighbourhood satisfaction. The same reason why neighbourhood maintenance services can negatively affect neighbourhood satisfaction can also be applicable to the case of city maintenance services such that it can also decrease city satisfaction and happiness due to the inconvenience brought by maintenance operations like disruption of normal activities and noise which are larger in scale at the city level.

Column 2 shows the city characteristics that are significant predictors of city satisfaction. Satisfaction with city education services, perception of city buildings crowding and satisfaction with city trash services are positively associated with city satisfaction. On the other hand, perception of city people crowding and satisfaction with city maintenance services are negatively associated with city satisfaction. Similarly, the importance of local public services in cities, particularly education services on the subjective well-being and city or community satisfaction was also identified in previous research (Sirgy et al., 2000, Leyden, 2011, Morrison, 2011). Among the control variables, having good health and living in the city for a very long time (more than 60 years) can increase city satisfaction.

Although satisfaction with city maintenance services is negatively associated, it should be noted that satisfaction with city trash services is positively associated which can mean that for city residents included in the research, the more important aspect of city maintenance is keeping the city clean. An interesting finding is the results on perception of building crowding and people crowding are consistent for the neighbourhood and city level such that building crowding is positively associated while people crowding is negatively associated with neighbourhood and city satisfaction. This finding suggests that different types of density (i.e. building or population density) have different effects on quality of life in cities and in urban neighbourhoods. Previous studies relating spatial characteristics to subjective well-being have also suggested that living in high-density urban areas can lower well-being although empirical evidence is only beginning to accumulate (Morrison, 2007, Morrison, 2011). In contrast, Brereton et al. (2008) found that population density was positively

associated to happiness although the data he used was objective or factual population density and not perceived people density which was the one used in this research.

The last mediation is similar to the previous one but instead of happiness, the dependent variable is life satisfaction (Table 12). As mentioned earlier, city satisfaction was found to be significantly associated with life satisfaction. Based from last two mediation analyses, city satisfaction is found to be significant for both happiness and life satisfaction but it is more significant to life satisfaction. Since there is a significant relationship between city satisfaction and life satisfaction, the fourth regression of the mediation analysis was performed which is predicting life satisfaction by city satisfaction and satisfaction with city educational services which was the only consistent significant independent variable in the previous two regressions in this mediation analysis.

As shown in column 4, partial mediation is supported since satisfaction with city education services is a significant predictor of life satisfaction. Thus, the effect of satisfaction with city education services on life satisfaction is indirect as it goes through or is mediated by city satisfaction. The coefficient of satisfaction with city educational services decreased from 0.4 to 0.2 as a result of including city satisfaction as another predictor. Although city satisfaction became insignificant, it was already established in the regression in column 3 that there is a significant relationship between city satisfaction and life satisfaction. This means that partial mediation exists in the presence of a direct effect. In other words, a significantly larger portion of the variance in life satisfaction is explained via the direct effect of satisfaction with city education services than the indirect or mediated path through city satisfaction.

Table 12. Mediation between city characteristics, city satisfaction and life satisfaction

	(1) Life Satisfaction	(2) City satisfaction	(3) Life Satisfaction	(4) Life Satisfaction
City satisfaction			0.1911***	0.1126
			(0.05)	(0.09)
City education services satisfaction	0.4257**	0.1508**		0.2130**
	(0.14)	(0.05)		(0.08)
City buildings crowding perception	0.0071	0.0867*		
	(0.04)	(0.04)		
City people crowding perception	0.0893	-0.2408***		
	(0.09)	(0.06)		
City traffic perception	-0.1364*	0.0285		
	(0.07)	(0.03)		
City trash services satisfaction	-0.0025	0.0489*		
	(0.04)	(0.02)		
City maintenance services satisfaction	-0.0505	-0.0880*		
	(0.04)	(0.04)		
Agecat==2 (36-51 yrs.old)	-0.6510***	0.1199	-0.0713	
	(0.19)	(0.06)	(0.07)	
Agecat==3 (52-67 yrs.old)	-0.8555***	0.0797	-0.2300	
	(0.25)	(0.08)	(0.13)	

	(1) Life Satisfaction	(2) City satisfaction	(3) Life Satisfaction	(4) Life Satisfaction
Agecat==4	-0.2672	0.3108	0.9013**	
(68 yrs.old and above)	(0.28)	(0.16)	(0.29)	
Gender==2	-0.2146*	-0.0468	0.0940	
(Female)	(0.09)	(0.04)	(0.06)	
Ethnicity==3	-0.1394		-0.2322*	
(Suriname)	(0.12)		(0.11)	
Ethnicity==4	-0.6086*		-0.8230**	
(Turkish)	(0.29)		(0.29)	
Ethnicity==5	-0.4411		-0.3750*	
(Morocco)	(0.27)		(0.19)	
Ethnicity==7	0.3030		0.4476*	
(Western)	(0.24)		(0.17)	
Ethnicity==8	0.8830*		0.5891*	
(Non-western)	(0.36)		(0.27)	
Ethnicity==9	1.0218**		-0.6531***	
(Others)	(0.39)		(0.17)	
Household_no==5	-0.6237		-0.8093**	
(Living with parents)	(0.32)		(0.25)	
Employment==3	0.7548*		-0.0803	
(Permanent job)	(0.33)		(0.19)	
Employment==4	1.3857*		-0.2005	
(Housewife/husband)	(0.55)		(0.17)	
Employment==5	0.3964		1.3695***	
(Student)	(0.32)		(0.30)	
Employment==8	1.0383**		-0.0809	
(Self-employed)	(0.39)		(0.23)	
Income==3	-0.9905**	-0.3128*	0.1195	
(€1350-1750/mo)	(0.37)	(0.15)	(0.12)	
Income==4	-0.4116	-0.3908**	0.4428*	
(€1750-3050/mo)	(0.30)	(0.14)	(0.18)	
Income==5	-0.5515	-0.3105*	0.3398	
(> €3050/mo)	(0.30)	(0.15)	(0.21)	
Health==3	-1.0597**	0.1943	-0.7975**	
	(0.41)	(0.10)	(0.27)	
Health==4	-1.0087**	0.3060**	-0.5217*	

	(1) Life Satisfaction	(2) City satisfaction	(3) Life Satisfaction	(4) Life Satisfaction
	(0.38)	(0.11)	(0.25)	
Health==5	-0.7524*	0.2715**	-0.5287*	
(very good)	(0.31)	(0.10)	(0.26)	
Education_level==4			-0.5807*	
(Havo)			(0.26)	
Education_level==5			-0.6563*	
(VWO)			(0.26)	
Education_level==6			0.8084*	
(HBS, lyceum, athenaeum)			(0.40)	
Education_level==8			0.7113**	
(Others)			(0.27)	
Yrs_residence_city2==5	0.7618*	0.5378*	-0.7557***	
(> 60 years)	(0.34)	(0.22)	(0.19)	
Observations	59	59	62	60
Pseudo R^2	0.58	0.63	0.58	0.66

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)
Reference groups: House type (Apartment); Agecat 1 (20-35 yrs.old); Gender 1 (Male); Ethnicity 1 (Netherlands); Employment 1 (Unemployed); Income 1 (<€1000/mo); Health 1 (Very Bad); Household 1 (Live alone); Education 1(No studies)
Source: Author, 2015

There are only two city characteristics that are significantly associated with life satisfaction. Satisfaction with city educational services is highly and positively significant while city traffic perception is negatively associated. Looking back at the regression in Table 11, satisfaction with city educational services and city traffic perception are significant predictors of both happiness and life satisfaction and are also significant to city satisfaction which highlights the importance of these city characteristics.

As mentioned earlier, living in the city for a very long time (more than 60 years) decreases life satisfaction as shown in column 3. The result shows that is very highly significant at $p < 0.001$ and also has a large coefficient. However, it should be noted that the sign of the coefficient of living in the city for more than 60 years is inconsistent in the first regression (column 1) which is positive and also significant. Between the two results, it is better to consider the result in the third column since it is more significant and goes better with the previous result which shows that living in the city for more than 60 years reduces happiness.

A summary of the regression results of the six mediation analyses on each subjective well-being measure is given in Table 13 and answers the second research question on what built environment characteristics significantly affect the happiness of residents in Rotterdam.

Table 13. Built environment characteristics that significantly affect subjective well-being

Subjective well-being	Objective characteristics	Subjective characteristics
Happiness	• House age (-)	• House size satisfaction (+) • Travel time from home to work (+) • Neighbourhood people crowding

Subjective well-being	Objective characteristics	Subjective characteristics
		perception (-) • Community attachment (-) • Neighbor interaction (+) • Park/green area access in neighbourhood (+) • Medical access in neighbourhood (+) • Sports access in neighbourhood (-) • City education services satisfaction (+) • City traffic perception (-) • City maintenance service satisfaction (-)
Life satisfaction		• House size satisfaction (+) • Number of grocery shops (+) • Travel time from home to work (+) • Home to work perception (+) • Neighborhood maintenance services satisfaction (+) • Park/green area access in neighbourhood (+) • Medical access in neighbourhood (+) • Sports access in neighbourhood (-) • City education services satisfaction (+) • City traffic perception (-)

Source: Author, 2015

4.4 Urban life domains

Based on the regression results of the six mediation analyses, Table 14 provides a summary of built environment characteristics that significantly affect urban life domain satisfaction on housing, neighbourhood and city level and answers the first research question on what built environment characteristics significantly affect the urban life domains.

Table 14. Built environment characteristics that significantly affect urban life domains

Urban Life Domain	Objective characteristics	Subjective characteristics
House satisfaction	• House size (+) • House type (-)	• House condition perception (+) • House size satisfaction (+)
Neighborhood satisfaction		• Home to work perception (+) • Neighbourhood cleanliness (+) • Neighbourhood buildings appearance (+) • Neighbourhood maintenance services satisfaction (-) • Neighbourhood buildings crowding perception (+) • Neighbourhood people crowding perception (-)

Urban Life Domain	Objective characteristics	Subjective characteristics
		• Neighbor trust (-) • Neighbor relationship (+) • Neighbor interaction (+) • Community attachment (-) • Grocery access (-)
City satisfaction		• City education services satisfaction (+) • City buildings crowding perception (+) • City people crowding perception (-) • City trash services satisfaction (+) • City maintenance service satisfaction (-)

Source: Author, 2015

In order to answer research question 3 on what urban life domains affect the happiness and life satisfaction of residents in Rotterdam, two more separate regressions must be conducted with all the three urban life domains predicting happiness and life satisfaction. It is not appropriate to get the results from the previous mediation analyses between each urban life domain and each subjective well-being measure since the effect of the other urban life domains were not taken into account.

Table 15. Happiness and life satisfaction as determined by urban life domains

	(1) Happiness	(2) Life satisfaction
House satisfaction	-0.0669	-0.2877**
	(0.08)	(0.10)
Neighbourhood satisfaction	0.0061	0.0348
	(0.06)	(0.05)
City satisfaction	0.2321**	0.3725***
	(0.09)	(0.10)
Agecat==3 (52-67 yrs.old)		-0.3981**
		(0.15)
Agecat==4 (68 yrs.old and above)	0.9940*	
	(0.43)	
Ethnicity==3 (Suriname)		-0.2055*
		(0.10)
Ethnicity==4 (Turkish)		-0.9866**
		(0.31)
Ethnicity==5 (Morocco)	-0.6439*	-1.2793***
	(0.29)	(0.36)
Ethnicity==7 (Western)		0.9754**
		(0.36)
Ethnicity==8 (Non-western)		1.2150**
		(0.37)
Ethnicity==9 (Others)		-1.1587**
		(0.36)
Employment==3 (Permanent job)		0.2975*
		(0.15)
Employment==4 (Housewife/husband)		-0.9003***
		(0.27)
Employment==5 (Student)		2.5833***
		(0.68)
Employment==6 (Unable to work)		-1.0969**
		(0.38)
Employment==7 (Retired)	-0.8847*	
	(0.37)	
Employment==8 (Self-employed)		0.4127*
		(0.20)
Income==2 (€1000-1350/mo)		-0.2870*
		(0.14)

	(1) Happiness	(2) Life satisfaction
Income==3 (€1350-1750/mo)	0.4839** (0.17)	
Income==4 (€1750-3050/mo)	0.6380** (0.22)	0.3035* (0.15)
Income==5 (> €3050/mo)	0.6805** (0.25)	
Health==3		-0.9612*** (0.29)
Health==4		-0.4789* (0.21)
Health==5 (very good)		-0.5287* (0.23)
Education_level==3 (Mavo)	0.9147* (0.42)	
Education_level==6 (HBS, lyceum, athenaeum)	1.7828*** (0.50)	1.7092** (0.63)
Education_level==7 (HBO/University)	1.0440* (0.47)	
Education_level==8 (Others)	1.1577* (0.48)	
Household_no==5 (Living with parents)		-1.3669*** (0.40)
Yrs_res_nbh2==2 (11-20 years)		-0.2041* (0.09)
Yrs_res_nbh2==3 (11-20 years)	0.4377** (0.16)	0.7591*** (0.23)
Yrs_res_city2==5 (> 60 years)	-1.1835* (0.47)	-0.6970* (0.30)
Observations	62	62
Pseudo R^2	0.49	0.70

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)
Source: Author, 2015

As shown in Table 15, city satisfaction is the only urban life domain that is significant to happiness in the regression with all the control variables. City satisfaction is highly significant at $p < 0.01$ and is positively associated with happiness. Among the control variables, those that are positively associated with happiness are old age (68 yrs. old and above), income, education and living in the neighbourhood for 11 to 20 years. On the other hand, living in the city for more than 60 years and Moroccans are less happy.

City satisfaction is positively and highly significant to life satisfaction at $p < 0.001$ as shown in Table 17. House satisfaction is also significantly associated with life satisfaction but the coefficient sign is negative. In a regression without controls, house satisfaction is the only urban life domain associated with happiness and has a positive sign. Looking back to Table 9 on the regression on life satisfaction as determined by house satisfaction (with controls), the sign of house satisfaction is also negative. The negative sign on house satisfaction seems to be an effect of introducing control variables into the regression model. The control variables positively associated to life satisfaction are having a permanent job, being a student, being self-employed, high income, high education, living in the neighbourhood for more than 20 years and Western and Non-western ethnicities. On the other hand, the elderly (52-67 yrs. old), housewives/husbands, those unable to work, low income, living with parents, Suriname and Moroccans are significantly less satisfied with their life. Living in the neighbourhood for 11 to 20 years, living in the city for more than 60 years and health is also negatively associated with life satisfaction.

In the regressions without control variables, the (Pseudo) R^2 of the urban life domains (housing, neighbourhood and city satisfaction) is very low and explain very little of the

variance in happiness and life satisfaction (e.g. Happiness R^2: 0.03; Life Satisfaction R^2: 0.04). By including control variables in the regression models, the explanatory power of the model dramatically increases to 0.49 for happiness and 0.70 for life satisfaction which means that individual characteristics may have a more important role than satisfaction in urban life domains in determining subjective well-being.

A simple correlation between the mediating variables provides an insight into the relationship between housing, neighbourhood and city satisfaction. As shown in the table below, each mediating variable is positively correlated with the other mediating variables with varying degrees of strength (Table 16).

Table 16. Correlation between urban life domains

		House satisfaction	Neighbourhood satisfaction	City satisfaction
House satisfaction	Pearson Correlation	1	.272*	.353**
	Sig. (2-tailed)		.027	.004
	N	66	66	66
Neighbourhood satisfaction	Pearson Correlation	.272*	1	.299*
	Sig. (2-tailed)	.027		.015
	N	66	66	66
City satisfaction	Pearson Correlation	.353**	.299*	1
	Sig. (2-tailed)	.004	.015	
	N	66	66	66

* Correlation is significant at the 0.05 level (2-tailed), ** significant at the 0.01 level (2-tailed).

Source: Author, 2015

A moderate positive correlation was found between house satisfaction and city satisfaction. A weak positive correlation was found between house satisfaction and neighbourhood satisfaction as well as between neighbourhood satisfaction and city satisfaction. The lowest or weakest correlation was found between house satisfaction and neighbourhood satisfaction. Since the urban life domains are interrelated with one another, increasing the satisfaction with one domain can also improve the condition of other domains. However, the direction of the relationship is difficult to determine and can go either or both ways. For example, improving the housing satisfaction can increase the satisfaction with city living but increasing satisfaction with city living can also make a resident perceive the house satisfaction more favourably as a result of better housing management services particularly for public supported or socialized housing.

It is interesting to note that housing satisfaction and city satisfaction which refer to the smallest and largest scale of urban life domain in this research has a stronger correlation than domains which are nearer in scale (i.e. housing and neighbourhood satisfaction or neighbourhood and city satisfaction). It is expected that domains which are nearer in scale are more closely related and therefore should have a stronger correlation. For example, housing studies often include neighbourhood conditions or neighbourhood satisfaction as a variable affecting house satisfaction (or vice versa) and significant results between the two are often found (Lu, 1999, Sirgy and Cornwell, 2002).

Chapter 5: Conclusions and recommendations

This research determined the effect or influence of the built environment in an urban area on the subjective well-being or happiness of residents in selected neighbourhoods in the city of Rotterdam. The bottom up theory on life satisfaction and satisfaction in the urban life domains of housing, neighbourhood and the city were adopted in the conceptual framework to guide the study. According to the bottom-up theory on life satisfaction, life satisfaction or happiness is determined by satisfaction in different life domains (i.e. operationalized as urban life domains) which are in turn influenced by conditions within that domain (i.e. operationalized as built environment characteristics). Since mediation is an important theme of the bottom-up theory, the research used mediation analysis of Baron and Kenny (1986) to test the mediating or intermediate role of satisfaction in urban life domains on the effect of characteristics of the built environment on happiness, suggesting that both direct and indirect effects to happiness exists.

Based on the conceptual framework, the research has three main hypotheses that were tested and are answered in the conclusion:

1. Characteristics of the built environment predict satisfaction in urban domains as well as happiness
2. Satisfaction in urban life domains predicts overall happiness of an individual
3. Satisfaction in urban life domains mediates the relationship between characteristics of the built environment and happiness.

The main conclusion of this research is that the physical environment directly affects the happiness of urban residents. This adds to the limited but growing number of studies which have studied the direct effect of various characteristics of the built environment on subjective well-being measured through different indicators such as overall happiness and/or life satisfaction (McCrea et al., 2006, Brereton et al., 2008, Leyden, 2011, Morrison, 2011). Meanwhile, the mediating role of urban life domains was found to be weak with partial mediation through city satisfaction only proven twice for two city characteristics which are satisfaction with city maintenance services effect on happiness and satisfaction with city education services effect on life satisfaction. Thus, urban life domains do not transmit a large portion of the effects of the significant built environment characteristics on happiness and life satisfaction. In other words, the direct effect of specific characteristics of the built environment is greater than the indirect effect through urban life domains.

The stronger direct impact of independent built environment characteristics and weak mediation are unexpected findings that reject the third research hypothesis. The mediating role of urban life domains was hypothesized since it is commonly positioned between objective or subjective characteristics of the environment and overall life satisfaction and its significance to environmental characteristics and well-being is well established in literature. However, this study indicates that mediation is not a key characteristic of the urban life domains. Thus, it does not add value on further understanding the relationship between characteristics of the environment and well-being. It implies that step by step causal relationships from characteristics of the environment to life domains and then life domains to well-being is a more appropriate framework as commonly seen in many quality of life studies (Marans and Stimson, 2011).

To some extent, it is also not supportive of the bottom-up theory of life satisfaction since it implies that specific house and neighbourhood characteristics have a bigger impact on subjective well-being without the intermediate or mediating role of urban life domains. However it should be noted that Baron and Kenny's (1986) test for mediation is a rigorous process to prove mediation since the likelihood of having significant relationships for all the first three steps (i.e. X→Y, X→M, M→Y) in their approach is difficult to meet most of the time, as demonstrated in this research.

The second important conclusion of the study is that city satisfaction is the only urban life domain that is significant to both measures of subjective well-being which are happiness and life satisfaction. Therefore, in addition to supporting the direct effect of the built environment on subjective well-being, this research also provides evidence that city living exerts a strong influence on subjective well-being. This means that city-wide conditions and services are very important to the well-being of city residents included in the study. City residents are not only concerned about their immediate surroundings such as their home and neighbourhood but more on the overall quality of life in the city. Although housing satisfaction was also found to be significant to life satisfaction, its negative sign cannot be interpreted logically such that an increase in house satisfaction decreases life satisfaction. Hence, only city satisfaction can be considered as the urban life domain that matters to subjective well-being.

It is quite unexpected that city satisfaction emerged as the significant urban life domain since it is the largest geographic scale among the domains studied and smaller scale domains such as housing and the neighbourhood satisfaction are expected to be more relevant or strongly related to subjective well-being of residents. A similar result was found by McCrea et al. (2005) for a much larger geographic scale which is regional area satisfaction for the Brisbane-South East Queensland region that was a significant predictor of overall life satisfaction together with housing satisfaction, while neighbourhood satisfaction was not. Still, McCrea argued that neighbourhood satisfaction has an indirect effect on life satisfaction as mediated by housing and regional satisfaction. However, McCrea's approach of performing mediation between urban life domains may not be accurate since the direction of the relationships between these domains can go in different ways. Thus, a causal relationship cannot be fully ascertained which is a primary consideration for doing a regression analysis. Instead, a simple correlation test done in this research revealed that urban life domains are indeed (positively) correlated with each other and it is housing and city satisfaction which has the strongest correlation.

In light of the main findings previously discussed, a critique of the bottom-up model on life satisfaction is necessary which is the theoretical model used in the research. This research concludes that the model is weak in the context of urban life domains because it is found to be inapplicable for urban life domains of housing and neighbourhood satisfaction. Instead, specific house and neighbourhood characteristics play a greater role in determining subjective well-being (e.g. happiness and life satisfaction) than overall housing and neighbourhood satisfaction. The insignificance of the other urban life domains could mean that satisfaction in other non-urban life domains such as family, health, financial and work are more important although these domains were not studied in this research. This implies that the importance of life domains, particularly urban life domains, on subjective well-being can be overstated.

It is also possible that the characteristics of the urban built environment interact with other non-urban life domains or individual characteristics such as age, income or life stages (e.g. single, married, with or without children) which can act as moderators to reveal significant results on subjective well-being for specific groups of people. This was the approach by

McCrea et al. (2005) who found in his study that parents gave more importance to larger homes while younger people prefer smaller homes. At the neighbourhood level, older people gave more importance to neighbourhood interaction while perceived crime was more important for younger people. This suggests that relationship between the built environment and subjective well-being is more complex and there can be other factors influencing it. Thus, the bottom-up model appears to be an overly deterministic or simplistic framework for examining the influence of built environment characteristics on subjective well-being.

The research has two other minor conclusions that are supported by the results in the previous chapter. First, certain characteristics of the built environment significantly affect or predict satisfaction in urban life domains as hypothesized (see Table 13, Chapter 4 for the complete list of characteristics). The relationship between the built environment characteristics and the urban life domains is strong as indicated by the (pseudo) R^2 since each urban life domain is 'composed' of and thus closely related to the different built environment characteristics associated with that domain (i.e. house size satisfaction is a component of overall house satisfaction).

Second, the different types of neighbourhoods was unexpectedly not found to have a significant effect on the residents' subjective well-being and satisfaction with housing, neighbourhood and city living. In addition, social capital does not strongly vary between the neighbourhoods with dissimilar physical forms nor was it a good predictor of well-being for the residents surveyed. These research findings contradict previous studies which demonstrate that neighbourhoods with different physical environments have different levels of social capital and the area with a high social capital can also have higher levels of happiness or well-being since social capital is considered as an important factor affecting it. It should be noted though that the small sample could have made the differences between the two research areas on the dependent and mediating variables insignificant. Given that one area, Terbregge (i.e suburban neighbourhood) consistently had higher scores on the said variables, statistically significant differences may have been found for a larger sample.

Limitations and recommendations for further research and policy

A reflection on the method and data used in this research is important to guide the interpretation of findings and recommendations for further research and also for policy. First, the research is limited by the small scale of the survey conducted. Only a small sample of respondents (N=66) in two neighbourhoods were included due to resource constraints and difficulty to encourage more respondents to participate (i.e. survey response rate of 31%). Because of this, the results are not applicable to other neighbourhoods nor to the entire city of Rotterdam. Its generalizability to the neighbourhoods studied may not also be reliable because of the very sample size. In addition, the low sample size may have made some variables statistically insignificant which would have been otherwise significant if there was a larger sample. Thus, the significant effects of some variables may not have been captured by the study.

Nonetheless, the findings of the study still have theoretical implications since it was able to demonstrate statistically significant results as discussed thoroughly in the previous chapter. Second, regarding the data used for this research, most came from the survey and were thus subjective. Most of the secondary objective data gathered at the neighbourhood and city level were not used for analysis because they were omitted in STATA due to collinearity or redundant observed values.

As mentioned earlier, one of the objectives of the study was to determine if satisfaction in urban life domains mediate the effect of built environment characteristics on subjective well-being of city residents following Baron and Kenny's (1986) basic approach for mediation analysis. Although Baron and Kenny's approach is the general approach that most researchers use for mediation analysis, it should be noted that many academics have disputed some of the points of their approach and modified and presented other methods for mediation analysis.

For example one problem commonly cited problem of Baron and Kenny's approach is it can miss some true mediation effects where mediation exists but the relation between the independent variable and the outcome variable is not significant because of the first requirement of a significant relation between the independent and outcome variable (Iacobucci, et al., 2007, MacKinnon, et al., 2007, Zhao et al., 2010, Gunzler et al., 2013). Another limitation of Baron and Kenny's approach is it does not really calculate the mediated or indirect effect and its significance. To address this, two other alternative tests for mediation can be done which are the difference in coefficients tests (Judd and Kenny, 1981) and product of coefficients tests (Sobel, 1982). The indirect effect is then tested for significance using tailor-made statistics of *P* and z' or through bootstrapping for standard errors that appear to be more reliable for smaller samples (MacKinnon, et al., 2007).

Other researchers have advocated the use of structural equation modelling (SEM) as a more powerful tool than regression techniques to test mediation especially for more complicated models where there are multiple independent variables, mediators or outcomes and it can also provide model fit information (Iacobucci, et al., 2007, Gunzler et al., 2013). Despite these methodological challenges, the researcher decided to follow the approach on mediation analysis by Baron and Kenny (1986) because as a causal step approach, it better reflects and answers the research questions and clearly shows the conceptual links between each type of variables and statistical tests.

Finally, this research is theoretically limited to the bottom-up theory on life satisfaction and does not take into account the personality traits as determinants of happiness as suggested by the alternative theory of the top-down model on life satisfaction.

Recommendations for further research

To increase external validity, further research should aim to have a larger sample size across a wide variety of neighbourhoods to be able to generate findings which can be generalized to a larger population. A research across cities in the same country on subjective well-being and quality of life can also be conducted to have a good comparison of city characteristics that can increase or decrease happiness among residents. In terms of data, other forms of secondary objective data instead of frequency can be used for analysis and comparison with subjective data from surveys.

On the other hand, internal validity can be improved by using other methods of mediation analysis mentioned earlier and comparing the results against Baron and Kenny's classic approach. Furthermore, the causality of the variables in this research is argued based on theory but future research can also acknowledge the possibility of reverse causality and test at least one rival model that should yield results that are less meaningful than the proposed model.

Since it was suggested by the results of the study that the bottom-up theory is an overly simplistic framework for examining the effect of the built environment on subjective well-

being, further research can expound on the conceptual framework used in this research in several ways. First, the effects of other non-urban life domains can be determined and compared to urban life domains to find out which is more important. Second, a moderated model, similar to the approach of McCrea et al., 2005, with some demographic variables such as age, life stages and income serving as moderators of built environment characteristics can be used as a framework to be able to capture significant effects of the built environment on specific groups of people which is otherwise absent or weak without the use of moderators. Going a step higher, further research can also try to incorporate both top-down and bottom-up models in a single framework to study the relative effects of personality traits and environmental factors in predicting well-being to determine if indeed bottom-up factors are less powerful predictors. The model can also include more complex interactions on the effect of personality traits on subjective perceptions or evaluations of attributes of the urban environment. These approaches could all provide a more complex and holistic understanding of the effects of different factors on happiness in the context of an urban environment.

Recommendations for policy

Since city satisfaction was the only significant urban life domain that affects subjective well-being, improvements in the city should not only be targeted to specific areas or neighbourhoods but to enhance the overall quality of life in the city.

Based on the city characteristics which are most significant to the well-being of surveyed residents, satisfaction with living in the city can be increased by: a) maintaining good quality public education, b) developing a well-designed and balanced mix of buildings, open and green space that creates a pleasant 'crowding' of buildings or a pleasant physical landscape, c) maintaining good trash and sanitation services throughout the city, d) reducing too much people crowding or people congestion and e) relieving disruptions and inconveniences brought about by maintenance services of public places in the city. Furthermore, the research results also suggests that better care for the elderly living in the city should also be given attention since it was found that living in the city for a very long time (more than 60 years) decrease both happiness and life satisfaction.

The built environment characteristics which are significant both to happiness and life satisfaction can be given more emphasis and consideration in city planning and management especially in the neighbourhoods in Rotterdam where the study was conducted. The subjective well-being of residents' can be increased by an adequate size of the house which includes the main activity areas, good access to parks, green areas and medical facilities in the neighbourhood, and good quality public education available in the city. Although increased travel time from home to work emerged as positively associated with well-being, the convenience of the travel is also an important factor that needs to be considered for longer commuting times. On the other hand, road traffic should be addressed since it negatively affects well-being and strangely, access to sports facilities in the neighbourhood is also negatively associated with well-being which can mean that it is not a very important consideration in designing neighbourhoods.

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Annex 1: Data collection matrix

Variable	Indicator/s	Data type	Scale/Unit	Data source
Dependent variable (Y)				
Happiness	Overall Happiness	Ordinal	0-10 (0=very unhappy; 10=very happy)	Questionnaire
	Life Satisfaction	Ordinal	0-10 (0=very unsatisfied; 10=very satisfied)	
Independent variables (X)				
Objective factors of the built environment	1. Housing size	Interval	m^2	Postcode.nl
	2. Age of house	Interval	number of years	Municipal data*
	3. House energy index	Ratio	average index	
	4. Residential density	Ratio	house/hectare	
	5. House ownership	Nominal	-	Questionnaire*
	6. Housing type	Nominal	-	
	7. Number of the following facilities/amenities: a. grocery shops, b. shopping centers, c. parks and green space, d. education facilities (crèche, primary and secondary) e. medical facilities (clinics and hospitals) f. entertainment and cultural amenities (movie theaters, museums, libraries)	Interval*	actual count*	Municipal data*
	8. Number of available public transportation such as train, metro (subway), tram and bus stop/station in the neighborhood			
	9. Mode/s of transport used		Multiple count	Questionnaire
	10. Crime rate		Percentage	Municipal data*
	11. Noise level		decibels	
	12. Building density		building/hectare	
	13. Population density		people/hectare	
	14. Travel time to work place	Interval*	minutes	Questionnaire
	15. Number of public facilities such as primary school, secondary school, vocational schools, hospitals and clinics in the city	Interval*		Municipal data*
	16. City road traffic	Interval	Number of vehicles	
	17. City building density	Ratio*	Buildings/hectare	

Variable	Indicator/s	Data type	Scale/Unit	Data source
	18. City population density		People/hectare	
Subjective factors of the built environment	1. Satisfaction with housing size 2. Perceived house condition 3. Satisfaction with maintenance of house by housing agency 4. Control of house temperature 5. Perceived residential crowding/density 6. Perceived access to the following facilities/ amenities in the neighborhood: a. grocery shops, b. shopping centers, c. parks and green space, d. education facilities (crèche, primary and secondary) e. medical facilities (clinics and hospitals) f. entertainment and cultural amenities (movie theaters, museums, libraries) 7. Perceived access to public transportation such as train, metro (subway), tram and bus in the neighborhood 8. Perceived access to work place 9. Maintenance of public places such as streets, sidewalks, parks/green spaces 10. Cleanliness of neighborhood 11. Visual appeal of buildings in the neighborhood 12. Social capital 13. Neighbor interactions 14. Neighbor and race relationships 15. Trust of neighbors 16. Attachment to community	Ordinal*	5 point Likert: 1 = disagree strongly; 5 = agree strongly 4 point scale=1(not at all accessible; 4(very accessible) 5 point Likert: 1 = disagree strongly; 5 = agree strongly	Questionnaire*

Variable	Indicator/s	Data type	Scale/Unit	Data source
	17. Perceived safety in the neighborhood 18. Perceived noise level 19. Perceived crowding/ density in neighborhood 20. Perceived adequacy of public facilities such as primary school, secondary school, vocational schools, hospitals and clinics, in the city 21. Satisfaction with government services in public facilities such as primary school, secondary school, vocational schools, hospitals and clinics 22. Satisfaction with maintenance of public places such as streets, sidewalks, parks and green spaces in the city 23. Visual appeal of buildings in the city 24. Satisfaction with trash disposal and sanitation service 25. Perceived road traffic 26. Perceived crowding/ density in the city			
Mediating variables (M)				
House satisfaction Neighborhood satisfaction City satisfaction	Overall housing satisfaction Overall neighborhood satisfaction Overall city satisfaction	Ordinal*	5 point Likert: 1 = disagree strongly; 5 = agree strongly	Questionnaire*
Control variables				
Gender Age Household type	Gender Age Household type	Nominal Interval Nominal	0=Male, 1=Female Years 1=Live alone, 2=two adults, no children at home, 3=couple with children at home, 4=single parent with	Questionnaire*

Variable	Indicator/s	Data type	Scale/Unit	Data source
			children at home, 5=living with parents	
Ethnicity	Ethnicity	Nominal	1=Netherlands 2=Netherlands Antilles/Aruba 3=Suriname 4=Turkey 5=Morocco 6=Cape Verde 7=Western 8=Non-Western 9=Others	
Health	Self-rated health condition	Ordinal	5 point Likert: 1=Very bad, 5=Very good	
Income	Household Income	Interval	1=less than € 1000/mo 2=between € 1000-€ 1350/mo 3=between € 1350- € 1750/mo 4=between € 1750-€ 3050/ mo 5=€ 3050 or more/ mo	
Employment	Employment status	Nominal	1=Unemployed 2=Housewife 3=Retired 4=With temporary job 5=With permanent job 6=Unable to work due to illness/disability 7=Retired 8=Self-employed	
Education level	Highest level of education attained	Ordinal	1=no studies 2=primary education 3=primary professional education or preparatory professional education 4=VWO (secondary education) 5=HAVO (secondary education) 6= HBS, lyceum, atheneum 7=HBO or university 8=Others (specify)	

Variable	Indicator/s	Data type	Scale/Unit	Data source
Years of residence in the neighborhood	Years of residence	Interval*	Years	
Years of residence in city				
Size of the neighborhood	Total area		hectare	*Municipal data
Population of the neighborhood	Neighborhood population		number of people	

*The same data type and/or source to the next variables except when stated otherwise

Annex 2: Demographic data of survey respondents

	Frequency	Percent	Valid Percent
Age			
20-35 years old	16	24.2	24.2
36-51 years old	31	47.0	47.0
52-67 years old	12	18.2	18.2
More than 68	7	10.6	10.6
Total	66	100.0	100.0
Gender			
Male	33	50.0	50.0
Female	33	50.0	50.0
Total	66	100.0	100.0
Ethnicity			
Netherlands	49	74.2	74.2
Suriname	6	9.1	9.1
Turkey	2	3.0	3.0
Morroco	2	3.0	3.0
Western	1	1.5	1.5
Non-western	1	1.5	1.5
Others	5	7.6	7.6
Total	66	100.0	100.0
Household type			
Live alone	11	16.7	16.7
Couple, no children at home	15	22.7	22.7
Couple, with children at home	30	45.5	45.5
Single parent with child at home	5	7.6	7.6
Living with parents	4	6.1	6.1
Others	1	1.5	1.5
Total	66	100.0	100.0
Education level			
No studies	1	1.5	1.5
Primary education	1	1.5	1.5
Mavo/MBO	17	25.8	25.8
Havo	7	10.6	10.6
VWO	3	4.5	4.5
HBS, lyceum, atheneum	2	3.0	3.0
HBO or university	32	48.5	48.5
Others	3	4.5	4.5
Total	66	100.0	100.0
Employment			
Unemployed	3	4.5	4.5
With temporary job	5	7.6	7.6
With permanent job	36	54.5	54.5
Housewife/Househusband	5	7.6	7.6

		Frequency	Percent	Valid Percent
	Student	2	3.0	3.0
	Unable to work (illness)	1	1.5	1.5
	Retired	8	12.1	12.1
	Self-employed	6	9.1	9.1
	Total	66	100.0	100.0
Income	Less than €1000/month	3	4.5	4.8
	€1000-1350/month	8	12.1	12.9
	€1350-1750/month	8	12.1	12.9
	€1750-3050/month	18	27.3	29.0
	More than €3050/month	25	37.9	40.3
	Total	62	93.9	100.0
Missing	System	4	6.1	
Total		66	100.0	
Health				
	Bad	5	7.6	7.6
	Neutral	10	15.2	15.2
	Good	30	45.5	45.5
	Very good	21	31.8	31.8
	Total	66	100.0	100.0
Years of residence in neighbourhood				
	>10 years	26	39.4	39.4
	10-20 years	25	37.9	37.9
	More than 30 years	15	22.7	22.7
	Total	66	100.0	100.0
Years of residence in city				
	0-15 years	16	24.2	24.2
	16-30 years	17	25.8	25.8
	31-45 years	18	27.3	27.3
	46-60 years	10	15.2	15.2
	More than 60 years	5	7.6	7.6
	Total	66	100.0	100.0

Annex 3: Summary statistics of all variables

	mean	sd	min	max
house_size_bypost	118.71	61.99	48	361
house_age	48.32	45.03	12	150
house_type	3.09	1.87	1	5
house_tenacy	1.32	0.47	1	2
house_energy_index	1.70	0.56	1	3
residential_density	25.27	18.29	8	44
groceryshops	6.30	6.55	0	13
commercialshops	186.33	188.35	5	379
entertain_rec_cult_shops	12.67	11.08	2	24
sports_fac	1.00	0.00	1	1
medical_pharmacy	3.39	3.53	0	7
medical_GP_500m	0.18	0.16	0	0
education_creche_nbh	4.94	2.01	3	7
education_basic_nbh	1.48	0.50	1	2
education_middle_nbh	1.94	2.01	0	4
education_total_nbh	8.36	4.53	4	13
green_of_surface area	0.07	0.03	0	0
density_popn1	41.64	22.51	20	65
density_FSI1	1.18	1.02	0	2
density_GSI1	0.32	0.14	0	0
crime_records	2082.03	1993.25	163	4121
excess_noise_standard_popn	0.48	0.09	0	1
tram_no	4.36	4.53	0	9
metro_no	1.94	2.01	0	4
bus_no	3.00	0.00	3	3
train_no	0.48	0.50	0	1
Total_transportnodes_nbh	9.79	7.05	3	17
tram_mode	0.15	0.36	0	1
metro_mode	0.21	0.41	0	1
bus_mode	0.11	0.32	0	1
train_mode	0.13	0.34	0	1
auto_mode	0.49	0.50	0	1
bike_mode	0.48	0.50	0	1
walk_mode	0.15	0.36	0	1
travel time	32.22	26.52	0	120
education_basic_city	267.00	0.00	267	267
education_middle_VO_city	174.00	0.00	174	174
education_HBO_city	22.00	0.00	22	22
education_total_city	463.00	0.00	463	463
medical_hospitals_clinics	9.00	0.00	9	9
medical_GPs_number	312.00	0.00	312	312
roadtraffic	29.61	0.00	30	30

	mean	sd	min	max
density_popn2	29.52	0.00	30	30
density_FSI2	0.60	0.00	1	1
density_GSI2	0.31	0.00	0	0
Happiness	7.65	1.26	3	9
house_satisfaction	4.20	0.92	1	5
house_condition	4.09	1.03	1	5
house_size2	3.88	1.20	1	5
house_temperature	3.68	1.21	1	5
house_maintenance	3.35	1.25	1	5
house_crowding	2.32	1.04	1	5
Nbh_satisfaction	4.27	0.65	2	5
Home_to_work	4.27	0.73	2	5
Nbh_Clean	3.91	0.92	1	5
Nbh_buildings_beauty	3.97	0.83	1	5
Nbh_maintenance	3.58	1.12	1	5
Nbh_safety	3.91	0.89	1	5
Nbh_noise	2.43	1.15	1	5
Nbh_buildings_no	2.28	0.82	1	5
Nbh_people	2.14	0.77	1	4
Nbh_interaction	3.57	1.02	1	5
Nbh_trust	3.80	0.93	1	5
Nbh_relationship	3.88	0.83	1	5
Nbh_community	3.83	0.92	1	5
Socialcapital_meanscore	3.77	0.73	2	5
Grocery_access	2.66	0.99	1	4
Commercial_access	2.78	0.94	1	4
Parks/Green_access	3.17	0.72	1	4
Education_access	3.23	0.66	2	4
Medical_access	3.00	0.90	1	4
Sports_access	2.80	0.82	1	4
Entertainment_access	2.65	1.15	1	4
Meanscore_access_amenities	2.90	0.65	1	4
Tram_access	2.67	1.12	1	4
Bus_access	3.11	0.70	1	4
Metro_access	2.67	1.16	1	4
Train_access	2.59	1.04	1	4
Meanscore_access_transport	2.76	0.88	1	4
City_satisfaction	4.06	0.63	2	5
City_education_fac	4.02	0.76	1	5
City_education_serv	3.67	0.80	1	5
City_medical_fac	4.15	0.71	1	5
City_medical_serv	4.02	0.64	1	5
City_buildings	3.03	0.93	1	5
City_people	2.92	0.92	1	5
City_traffic	3.39	1.05	1	5
City_trash_serv	3.35	0.99	1	5
City_maintenance_serv	3.54	0.94	1	5

	mean	sd	min	max
City_buildings_beauty	3.60	0.72	1	5
Life Satisfaction	7.41	1.21	3	9
Gender	1.50	0.50	1	2
Age	46.18	15.78	20	90
Ethnicity	2.20	2.43	1	9
Household_no	2.68	1.13	1	6
Education_level	5.41	1.95	1	8
Employment	3.95	1.99	1	8
Income	3.87	1.22	1	5
Health	4.02	0.89	2	5
Yrs_residence_nbh	15.24	13.80	1	72
Yrs_residence_city	33.42	20.10	2	88
Population of neighborhood	3738.18	342.95	3408	4089
Area of neighborhood	118.57	54.10	63	171
Agecat	2.15	0.92	1	4
Yrs_residence_city2	2.56	1.23	1	5
Yrs_residence_nbh2	1.83	0.78	1	3
Observations (N)	66			

Annex 4: Survey Questionnaire (English and Dutch)

A) English Version:

Dear Madam, Sir,

I am Theresa Jane Cajarte, a registered student in the MSc. Master Course in Urban Management and Development program at the Institute for Housing and Urban Development Studies-Erasmus University Rotterdam. As a major requirement of this course, I am doing my research (thesis) in the City of Rotterdam through a survey. Your household has been randomly selected to receive this questionnaire. I would like to ask any member of your household above 18 years old to completely fill-in the questionnaire which I will pick-up from your house a few days from now at your convenient time.

In general, my research is about the quality of life of residents in Rotterdam. Please be assured that all information you provided in the questionnaire will be confidential and will only be used for academic purposes.

Thank you very much for your time and cooperation.

Instructions: Most of the questions included in this questionnaire are phrased in the form of a statement. On a scale of 1 (totally disagree) to 5 (totally agree), indicate the extent to which each statement applies to your situation by ticking the corresponding box. Please fill-in the questionnaire as complete and correct as possible to ensure complete information for each respondent. This questionnaire is composed of four parts and five pages. It will take approximately 15 minutes to completely answer it.

1. Taking all things together, how happy would you say you are?
   (Please encircle the number that best corresponds to your answer)

Very unhappy										**Very Happy**
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Part I. Housing

Several questions will be asked about your housing condition. Please indicate the extent to which each of the following statements is relevant to your situation.

2. In which type of house do you now live?

Multi-family dwelling:

- ☐ Apartment (self-contained)
- ☐ Shared apartment (with private bedroom and shared facilities)

Single-family dwelling:

- ☐ Detached (Vrijstaand)
- ☐ Semi-detached (Twee onder een kap)
- ☐ Terraced/Town houses (Rijtjeshuis)

3. What is your house tenure?

☐ Owner
☐ Renting

	Disagree strongly	Disagree	Neither agree or disagree	Agree	Agree strongly
4. I am satisfied with the house where I live.					
5. In general, my house is in good condition.					
6. I am satisfied with the size of my house which includes the size of my bedroom, living or kitchen area, toilets and bathroom.					
7. I can maintain a comfortable temperature in my house at all times.					
8. I am satisfied with the maintenance of my house by my housing provider.					
9. I live in a crowded housing area.					

Part II. Neighborhood living

Several questions will be asked about your neighborhood. Please think of your neighborhood (Cool/Terbregge) only when answering the questions below.

	Disagree strongly	Disagree	Neither agree or disagree	Agree	Agree strongly
10. I am satisfied with the neighborhood where I live.					
11. I can easily go to my work place from my home.					
12. My neighborhood is clean.					
13. Most of the buildings in my neighborhood have a pleasant appearance.					
14. I am satisfied with the maintenance of public places such as streets, sidewalks, parks/green spaces in my neighborhood.					
15. I feel safe walking in my neighborhood in any time of the day and night.					
16. It is noisy in my neighborhood most of the time.					
17. There are too many buildings in my neighborhood.					
18. There are too many people in my neighborhood.					
19. I interact with my neighbors frequently when I am outside my house.					

	Disagree strongly	Disagree	Neither agree or disagree	Agree	Agree strongly
20. I trust my neighbors.					
21. I am satisfied with my relationship with my neighbors.					
22. I feel a strong attachment to my neighborhood.					

The next questions are on accessibility. Please indicate the extent to which you have an access to the following facilities, amenities and transport modes in your neighborhood.

	Not at all accessible	Not very accessible	Quite accessible	Very accessible
23. Grocery shops for my daily needs				
24. Shopping area				
25. Parks and green space				
26. Education facilities (including crèche, primary and secondary schools)				
27. Medical facilities (including clinics and pharmacies)				
28. Sports facilities				
29. Entertainment and cultural amenities (movie theaters, museums, libraries)				
30. Tram				
31. Bus				
32. Metro (subway)				
33. Train				

The next questions will be on your travel habit, please answer the questions as accurately as possible:

34. In an ordinary day, how many hours and/or minutes is your travel from your home to your place of work or study?

Please estimate time in: ___ hour(s) and/or ___ minutes

35. What mode/s of transport do you usually take from your house to your place of work or study? (Please tick all applicable answers)

☐	Tram	☐	Car
☐	Metro (subway)	☐	Bike
☐	Bus	☐	Walking
☐	Train		

Part III. City living

Several questions will be asked about the city of Rotterdam. Please think of the city of Rotterdam as a whole when answering the questions below.

	Disagree strongly	Disagree	Neither agree or disagree	Agree	Agree strongly
36. I am satisfied with living in Rotterdam.					
37. There are an adequate number of public education facilities (including primary schools, secondary schools, vocational schools) in the city.					
38. I am satisfied with government services in education facilities in the city.					
39. There are an adequate number of public medical facilities (including clinics and hospitals) in the city.					
40. I am satisfied with the pubic medical facilities in the city.					
41. Rotterdam is crowded with buildings.					
42. There are too many people in Rotterdam.					
43. Road traffic is a serious problem in Rotterdam.					
44. I am satisfied with the trash disposal and sanitation services in the city.					
45. I am satisfied with the maintenance of public places such as streets, sidewalks, parks/green spaces in the city.					
46. Most of the buildings in the city have a pleasant appearance.					

47. All things considered, how satisfied are you with your life as a whole nowadays? (Please encircle the number that corresponds to your answer)

Very unsatisfied										Very satisfied
0	1	2	3	4	5	6	7	8	9	10

Part IV. Background Information

Several questions will be asked about your personal information. Please answer all of the questions by ticking the correct box or providing the information requested. All personal information will be confidential and will not be used to identify any of the respondents of this study.

48. What is your gender?

☐ Male ☐ Female

49. What is your age? **_____ years old**

50. Which Ethnic group do you originate from?

☐ Netherlands
☐ Netherlands Antilles/Aruba
☐ Suriname
☐ Turkey
☐ Morroco
☐ Cape Verde
☐ Western
☐ Non-western

Others (please specify):

_____

51. What is your household composition?

☐ Live alone
☐ Couple, no children at home
☐ Couple, no children at home
☐ Single parent with children at home
☐ Living with parents

52. What is your highest level of education attained?

☐ No studies
☐ Primary education
☐ Primary professional or preparatory professional
☐ Secondary education (HAVO)
☐ Secondary education(VWO)
☐ HBS, lyceum, atheneum
☐ HBO or university

Others (please specify):

_____

53. What is your employment status?

☐ Unemployed
☐ With temporary job
☐ With permanent job
☐ Housewife
☐ Student
☐ Unable to work due to illness or disability
☐ Retired
☐ Self-employed

54. Where does your household income fall?

☐ less than € 1000/month
☐ between € 1000-€ 1350/month
☐ Between € 1350- € 1750/month
☐ Between € 1750-€ 3050/month
☐ € 3050 or more/month

55. How would you rate your personal health now? Please encircle the number that corresponds to your answer.

Very Bad				**Very good**
1	**2**	**3**	**4**	**5**

56. How many years have you lived in the neighborhood where you are now? _____ year/s

57. How many years have you lived in the city of Rotterdam? _____ year/s

End of Questionnaire
Thank you!

B) Dutch Version:

Instructies: De meeste van de vragen in deze vragenlijst opgenomen, zijn geformuleerd als verklaring. Op een schaal van 1 (helemaal niet mee eens) tot 5 (geheel mee eens), kruis het vakje in dat van toepassing is op uw situatie. Vul alstublieft de vragenlijst zo volledig en correct mogelijk in. Deze vragenlijst is samengesteld uit vier delen en vijf pagina's. Het beantwoorden duurt ongeveer 15 minuten.

1. Samengevat, hoe gelukkig zou u zeggen dat u bent?
(Gelieve het nummer dat overeenkomt met uw antwoord omcirkelen)

Zeer ongelukkig										**Erg blij**
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Deel I. Huisvesting

Verschillende vragen zullen worden gesteld over uw huisvesting. Gelieve aan te geven van de mate waarin elk van de volgende uitspraken relevant zijn voor uw situatie.

2. In welke type woning woont u?

Appartementencomplex:

- ☐ Appartement (eigen)
- ☐ Gedeeld appartement (met een eigen slaapkamer en gedeelde faciliteiten)

Eengezinswoning:

- ☐ Vrijstaand
- ☐ Twee onder een kap
- ☐ Rijtjeshuis

3. Bent u eigenaar of huurt u?

- ☐ Eigenaar

☐ Huren

	Helemaal niet mee eens	Niet eens	Noch eens of oneens	Eens	Geheel mee eens
4. Ik ben tevreden met het huis waar ik woon.					
5. In het algemeen is mijn huis in goede conditie.					
6. Ik ben tevreden met de grootte van mijn huis alsmede ook de grootte van mijn slaapkamer, woonkamer of keuken, toiletten en badkamer.					
7. Ik kan altijd een aangename temperatuur in mijn huis te handhaven.					
8. Ik ben tevreden met het onderhoud van mijn huis door zorg van mijn huisbaas of huisvestings organisatie.					
9. Ik woon in een overvolle woonwijk.					

Deel II. Buurt

Verschillende vragen zullen worden gesteld over uw buurt. Denkt u bij het beantwoorden van de vragen alstublieft alleen aan uw buurt.

	Helemaal niet mee eens	Niet eens	Noch eens of oneens	Eens	Geheel mee eens
10. Ik ben tevreden met de buurt waar ik woon.					
11. Ik kan gemakkelijk reizen tussen mijn huis en werk of school.					
12. Mijn buurt is schoon.					
13. De meeste gebouwen in mijn buurt hebben een aangename uitstraling.					
14. Ik ben tevreden met het onderhoud van openbare plaatsen, zoals straten, stoepen, parken/groene ruimten in mijn buurt.					
15. Ik voel me veilig wandelen in mijn buurt in dag en nacht.					
16. Er is vaak geluidsoverlast in mijn wijk.					
17. Er zijn te veel gebouwen in mijn buurt.					

	Helemaal niet mee eens	Niet eens	Noch eens of oneens	Eens	Geheel mee eens
18. Er zijn te veel mensen in mijn buurt.					
19. Ik heb vaak contact met mijn buren als ik buiten mijn huis.					
20. Ik vertrouw mijn buren.					
21. Ik ben tevreden met de relatie met mijn buren.					
22. Ik ben gehecht aan mijn buurt.					

De volgende vragen gaan over toegankelijkheid. Gelieve aan te geven in hoeverre u toegang heeft tot de volgende faciliteiten, voorzieningen en vervoerswijzen in uw buurt.

	Helemaal niet toegankelijk	Niet erg toegankelijk	toegankelijk	Zeer toegankelijk
23. Supermarkt voor mijn dagelijkse behoeften				
24. Winkelcentrum				
25. Parken en groene ruimte				
26. Onderwijs faciliteiten (waaronder crèche, basisscholen en middelbare scholen)				
27. Medische faciliteiten (inclusief klinieken en apotheken)				
28. Sportfaciliteiten				
29. Entertainment en culturele voorzieningen (bioscopen, musea, bibliotheken)				
30. Tram				
31. Bus				
32. Metro				
33. Trein				

De volgende vragen gaan over uw reis gewoontes, beantwoord de vragen zo nauwkeurig mogelijk:

34. Op een gewone dag, hoeveel uren en/of minuten reist u vanaf uw huis naar uw werk- of studieplek?

Geef hier uw tijd in: ___ uren(n) en/of ___ minuten

35. Welke vorm van vervoer neemt u meestal vanaf uw huis naar de plaats van werk of studie? (Kruis alle toepasselijke antwoorden)

☐	Tram	☐	Auto
☐	Metro	☐	Fiets
☐	Bus	☐	Wandelen
☐	Trein		

Deel III. Leven in de stad

Verschillende vragen zullen worden gesteld over de stad Rotterdam. Denkt u alstublieft van de stad Rotterdam als geheel bij het beantwoorden van de vragen hieronder.

	Helemaal niet mee eens	Niet eens	Noch eens of oneens	Eens	Geheel mee eens
36. Ik ben tevreden met het leven in Rotterdam.					
37. Er zijn in de stad voldoende openbaar onderwijs faciliteiten (inclusief basisscholen, middelbare scholen en scholen voor beroepsonderwijs).					
38. Ik ben tevreden met overheidsdiensten in onderwijs faciliteiten in de stad.					
39. Er zijn in de stad voldoende openbare medische faciliteiten (inclusief klinieken en ziekenhuizen).					
40. Ik ben tevreden met de openbare medische faciliteiten in de stad.					
41. Rotterdam is overvol met gebouwen.					
42. Er zijn teveel mensen in Rotterdam.					
43. Wegverkeer is een ernstig probleem in Rotterdam.					
44. Ik ben tevreden met de afvalverking en sanitaire voorzieningen diensten in de stad.					
45. Ik ben tevreden met het onderhoud van openbare plaatsen zoals					

	Helemaal niet mee eens	Niet eens	Noch eens of oneens	Eens	Geheel mee eens
parken/groene ruimten in de stad, straten, stoepen.					
46. De meeste van de gebouwen in de stad hebben een aangename uitstraling.					

47. Alle dingen beschouwd, hoe tevreden bent u over uw leven als geheel tegenwoordig?
(Gelieve het nummer dat overeenkomt met uw antwoord omcirkelen)

Zeer ontevreden **Zeer tevreden**

0 1 2 3 4 5 6 7 8 9 10

Deel IV. Achtergrondinformatie

Verschillende vragen zullen worden gesteld over uw persoonlijke gegevens. Gelieve beantwoord alle vragen door het aanvinken van het juiste vakje of het verstrekken van de gevraagde informatie. Alle persoonlijke gegevens zullen vertrouwelijk en anoniem worden behandeld.

48. Wat is uw geslacht?

☐ Man ☐ Vrouw

49. Wat is uw leeftijd? _____ jaar

50. Welke etnische groep kom je vandaan?

☐ Nederland
☐ Nederlandse Antillen
☐ Suriname
☐ Turkije
☐ Marokko
☐ Kaapverdië
☐ Western
☐ Niet-westerse

Andere (gelieve te specificeren):
_____

51. Wat is uw huishoudelijke samenstelling?

☐ Ik woon alleen
☐ Samenwonend zonder kind(eren)
☐ By ouder(s)
☐ Samenwonend met kind(eren)
☐ Alleenstaande ouder met kind(eren)

52. Wat is uw hoogste niveau van het onderwijs bereikt?

- ☐ Geen studie
- ☐ Basisonderwijs
- ☐ Mavo / MBO
- ☐ Havo
- ☐ VWO
- ☐ HBS, lyceum, atheneum
- ☐ HBO of Universiteit

Andere (gelieve te specificeren): _____

53. Wat is uw arbeidsstatus?

- ☐ Werkloos
- ☐ Tijdelijk contract
- ☐ Vast contract
- ☐ Huisvrouw
- ☐ Student
- ☐ Arbeidsongeschikt
- ☐ Gepensioneerd
- ☐ Ondernemer

54. Wat is uw huishouden inkomen?

- ☐ Minder dan € 1000/maand
- ☐ Tussen € 1000 - € 1350/maand
- ☐ Tussen € 1350 - € 1750/maand
- ☐ Tussen € 1750 - 3050€ /maand
- ☐ € 3050 of meer /maand

55. Hoe beoordeelt u uw persoonlijke gezondheid nu?
(Gelieve het nummer dat overeenkomt met uw antwoord omcirkelen)

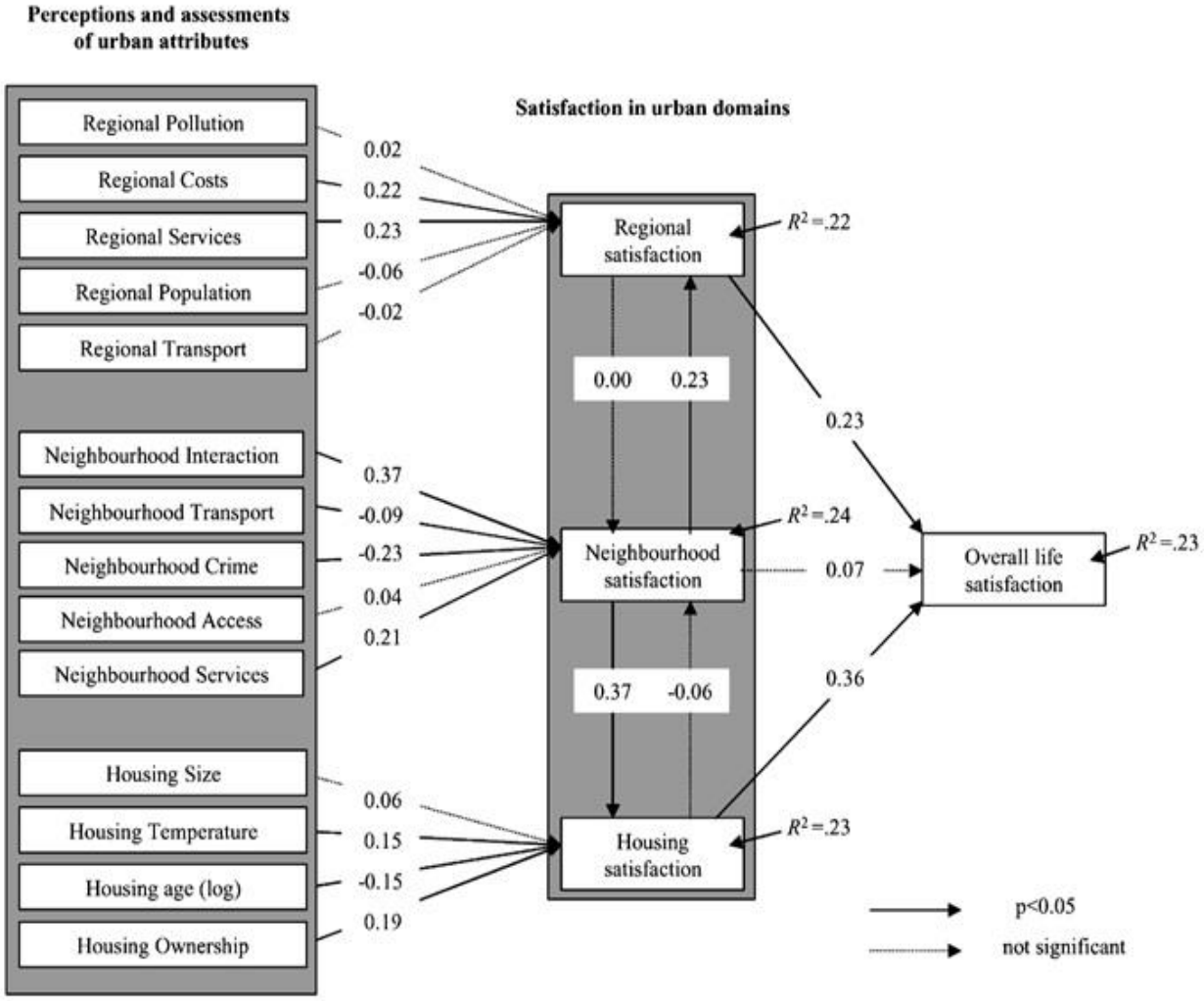
Heel slecht				**Heel goed**
1	**2**	**3**	**4**	**5**

56. Hoe veel jaren of maanden woont u op deze plek? _____ jaar of _____ maanden

57. Hoe veel jaar of maanden woont u in de stad Rotterdam? _____ jaar of _____ maanden

Einde van vragenlijst
Dank u!

Annex 5: Model of satisfaction with urban living



Source: Testing a moderated model of satisfaction with urban living using data for Brisbane-South East Queensland, Australia (McCrea et.al., 2005)