Interrelations between qualities of street, sense of place and subjective wellbeing:

A quantitative study of streets in Groningen

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Abstract
This research set out to investigate how qualities of street, sense of place and subjective well-being are interrelated with each other under the context of Groningen. 3 types of streets were selected as area of study, known as traffic calming residential street, street with large area of greenery / next to a park, and finally the streets in city centre. Research was done by studying various works from different academics. Result shows that the qualities of streets is a significant factor contributing to residents' sense of place and subjective well-being, while among the 10 defined street qualities, things to see and do serves the best in terms of predictive power of sense of place and subjective well-being. Result also proves that there is positive relationship between sense of place and subjective wellbeing. However, there is no statistically significant result showing that duration of residency contributes to stronger sense of place, which could partly explained by the multi-faceted nature of sense of place, that it can emerge from daily interpersonal experiences regardless of the environment one is in.

Content

1. Introduction

1.1 Research Background

“Think of a city and what comes to mind? Its streets. If a city’s streets look interesting, the city looks interesting; if they look dull, the city looks dull”, said Jane Jacobs, author of the book *The Death & Life of Great American Cities*. Street emerged before humans notice it, between houses built opposite each other’s. From soil to cobblestone to asphalt and brick, from carriage to steam-powered car to bike, petrol- and electricity-powered vehicles, one can hardly say that streets did not go through a drastic change throughout history.

Apart from its physical form, the idea of and character behind the word street have shifted. From Le Corbusier’s approach to human-car separation to a more humanistic, experience-based approach to street design and management, human perception and expectation on street had gone through a change with respect to a revolution in scale and function. Nowadays streets are viewed as part of a built environment that can bring about a more enjoyable experience and healthier lifestyle, while streets are seen less as a simple connecting corridor and more of a place with their own value and characteristics that attract people to stay longer on it (Global Designing Cities Initiative, 2016; Jones & Boujenko, 2009). Street design nowadays aims to cater for the needs of pedestrians over cyclists and commuters, people who work or provide services on street comes next, and finally the drivers of personal automobiles (Global Designing Cities Initiatives, 2016).

When the human factor was given more attention in designing streets, the influence of streets on humans is then worth investigating. Several scholars have provided research showing built environment serves as a strong factor contributing to subjective wellbeing (Davis and Fine-Davis, 1991; Morrisson, 2007; Ng et al., 2021). Scholars from Hong Kong have also delved into place qualities, sense of place and subjective wellbeing, though the same framework should be applied in different cultural contexts to test its viability (Ng et al, 2021). However, the interrelations between different qualities of the street, sense of place and subjective wellbeing are less covered by academics. This research thus aims to help fill up the research gap by investigating the relationship between the three concepts, to provide fresh information for the betterment of the urban environment, making streets more beneficial to citizens.

1.2 Research Problem

The research aims to investigate the effect of different qualities of street on sense of place perceived by residents, and how different qualities of street and sense of place ultimately affect the subjective wellbeing. The main research question is thus stated below:

How does the different qualities of street influence the sense of place of people, and hence bring about impact on subjective wellbeing?

The main research question is broken down into the following sub-question:

- How and to what degree does street design influence sense of place?
- How and to what extent does street design contributes to subjective wellbeing?
- To what degree does sense of place contributes to subjective wellbeing?

2. Theoretical framework

2.1 Qualities of street, and Healthy Streets Indicator

Various scholars and research institutes have provided numerous tools, from indicators, checklists, to guidelines, for measuring, evaluating, and catalyzing better design of streets. For example, Global Street Design Guide, published by Global Designing Cities Initiatives, in cooperation with NACTO (National Association of City Transportation Officials), stresses the importance of viewing street as public space to enhance safeness, accessibility and economic sustainability of street (Global Designing Cities Initiative, 2016). Appleyard (1980) raised the idea of a livable street, defining street “as sanctuaries; as livable places; as communities; as resident territory, as places for play, greenery, and local history” (p. 106, Appleyard, 1980). Institute Healthy Streets, founded by Lucy Saunders, proposed 10 indicators of healthy streets, as tool for evaluating various dimensions of streets (Healthy streets, 2022). The set of indicators aim to promote sustainable society, economy, and environment (Healthy Streets, 2022). It is expected that the more indicators certain street fulfills, the healthier the streets is. In the following paragraph the 10 healthy street indicators will be translated into qualities of street with further explanation in methodology.

Figure 1. The 10 Indicators of Healthy Streets, Healthy Street (2022).

2.2 Sense of Place

People have various feelings and emotions towards space, and sense of place serves as a term that seeks to cover a broader sense of meaning under it. The inclusive nature of the sense of place and thus the vagueness has been acknowledged by academics (Shamai, 1991; Shamai & Ilatov, 2005). Tuan (1979; as cited by Jorgensen & Stedman, 2001) first defines place as a separate concept versus space, as a concept centralizing on emotional attachment or relationship with space. Shamai (1991) suggested that among philosophical and descriptive means to access the idea of the sense of place, descriptive methods are more vulnerable to being limited to a certain context and encounter more resistance in exchanging information for their lack of systematic analysis (Tuan, 1979, p. 389; as cited in Shamai, 1991). In this

paper, the measurement of a sense of place suggested by Ng et al. (2021) is adopted. In their framework SOP can be measured based on 3 types of responses, namely cognitive, affective, and behavioral sense of place. Cognitive sense of place refers to how dependent the residents are on the place they live in; the emotional sense of place can be explained by one's affection towards the place they live in; and behavioral sense of place suggested one's willingness and actual commitment towards the place (Ng et al. 2021).

Sense of place can be derived from a different scale of space, while in this research the focus is set at a street level. Different scholars have researched the sense of place on a street scale. Shamsuddin and Ujang's (2008) study suggested that a traditional shopping street within an urban context is where economic and social activities take place, which provides an example of the economic and social function of a street that helps establish place attachment and thus the sense of place for citizens. Another research was done by a different incision point, arguing that amendment in typomorphology can negatively affect the sense of place (Gokce & Chen, 2018). The same research furthers its work by comparing the physical amendment in the neighborhood, street and building level (Gokce & Chen, 2018). The result shows that out of the three-level of the built environment the amendment in street and neighborhood scale has a larger impact on the sense of place than the amendment on the building level has (Gokce & Chen, 2018). The aforementioned research prove the importance of the street in the formation and change in terms of sense of place, thus the importance of studying it.

2.3 Subjective Well-being

Well-being as a crucial determinant of public health has been measured by governments and scholars through different means (Das et al, 2020). Subjective wellbeing, in contrast to other objective ways of measurement, focuses on the personal perceived experience that shapes individual or collective wellbeing. Das et al. (2020) describes subjective well-being as the entirety of internal and external factors and categorize a range of previous theories on subjective wellbeing into 4 main groups, namely fulfilment and engagement theories, personal orientation theories, evaluative theories, and emotional theories. To better capture subjective wellbeing, Keyes' Mental Health Continuum Short Form (MHC-SF) will be adopted for measurement. Keyes et al. (2008) developed the model based on emotional (hedonic), social, and psychological (both eudaemonic) wellbeing, embodied in 14

items and questions respectively. Subjective wellbeing, according to Ryth (1989, as cited in Keyes et al., 2008), is “the appraisals individuals make about the quality of their lives—i.e., their experiences, accomplishments, relationships, and other culturally relevant and valued ways of functioning in life”. Keyes et al. (2008) specifically mentioned that, compared to previous studies focused on the positive emotions and life satisfaction only, the Keyes’ Mental Health Continuum Short Form (MHC-SF) incorporated not only Hedonic (emotional) wellbeing, but also the Eudaemonic (functioning) wellbeing.

The relationship between the street as a kind of built environment and subjective well-being can be studied by the aforementioned categories of subjective well-being. Hedonic well-being focuses on the immediate short-term pleasure and escapes from pain, while eudaemonic well-being is usually related to long-term endurance and stress relief (Hajrasoulih et al., 2018). Hajrasoulih et al. (2018) had provided an example of how the built environment can effectively affect subjective well-being: taking a walk after work in an urban park generates immediate happiness (hedonic, emotional well-being); while integrating it into a daily routine can turn the effect into a restorative and stress relieving ones towards (eudaemonic) psychological well-being; the social bonding arises from the daily routine also positively influences the (eudaemonic) social well-being. In their article Hajrasoulih et al. (2018) stress the importance of the natural environment in an urban context by citing scholars’ findings. For example, 95% of respondents had reported that being in nature can help with stress-relieving; urbanites would rather stay in an area like a park, city centre or situation like in transit while in a state of attentional fatigue (Frerichs, 2004; Staats, van Gemerden & Hartig, 2010, as cited in Hajrasoulih et al., 2018). From the studies above we can tell that people participating in a different activity in a well-planned urban nature environment helps with relieving stress as well as restoring attention, in the end contributing to subjective well-being.

2.4 Socio-economic factor in Sense of Place and Subjective Wellbeing

Sense of place and subjective wellbeing cannot be interpreted by only considering the effect of physical environment, but the socio-economic status of the residents themselves are of crucial importance, too. Williams and Kitchen (2012) conducted research in Hamilton, Ontario to study the relationship between sense of place, socio-economic status (SES) and health, proving the strong correlation between being a homeowner and higher level of health-related sense of place. Howell and

Howell (2008, as cited in Navarro-Carrillo et al., 2020) found that there is, even though not as strong, but still existing, relation between objective SES and personal wellbeing. It was also argued that a deeper sense of place and place attachment will naturally derive with the time invested in certain place. Smaldone et al. (2008) presented in their findings that the duration of association with certain place affect the possibility of an individual to regard certain place a "special" one. Same research also reveals that the feelings of certain place change not only overtime but also to the accumulation of experiences in the place (Smaldone et al, 2008). Fried (2000) suggested that continually living in one place can foster sense of place both collectively and individually. The research reveals that time as an influencing factor is meaningful to sense of place in a temporal and experiential context.

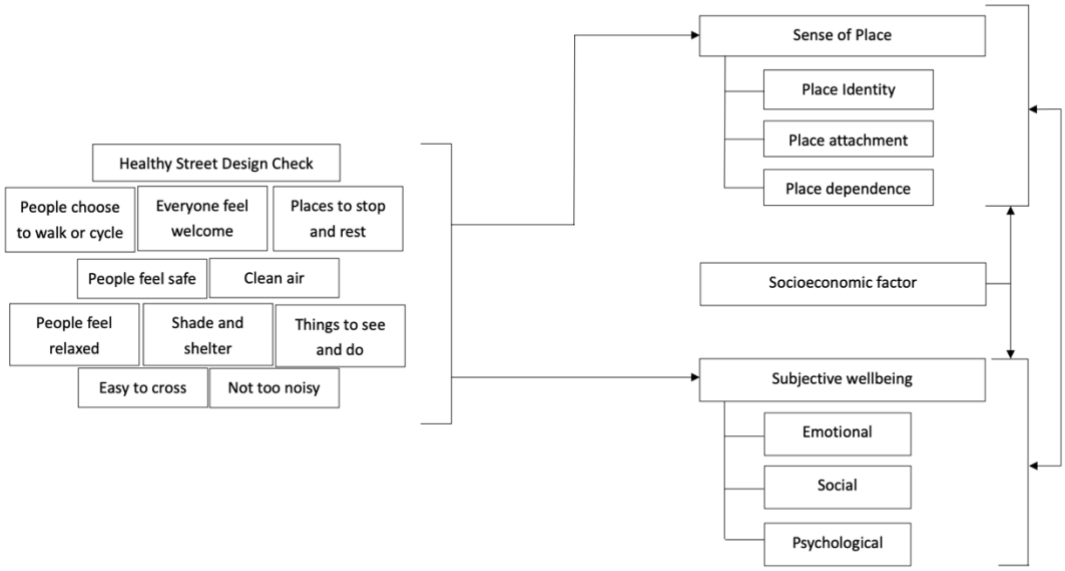

Fig. 2, Conceptual model.

2.5 Hypothesis

Based on the previous findings and predictions, a few hypotheses are proposed:

1. There is a positive relationship between qualities of street and sense of place.
2. Sense of place is positively correlated with subjective wellbeing.
3. Longer duration of residency contributes to stronger sense of place.

3. Methodology

The research aims to explore how street design, sense of place and subjective wellbeing are interrelated with each other. To look at what qualities of street may affect sense of place and subjective wellbeing the most, streets are the primary object to study. The study follows the quantitative research done by Ng et al (2021). As the aim of study is to obtain general opinion of residents resides in the three types of street, quantitative research methods is better than qualitative one in terms of objectivity and ability to reflect general pattern of population than qualitative research. The objectivity also serves better in terms of removing researcher's bias of interpretation and improving reliability of the result obtained. Quantitative research also serves better in terms of communicating and being compared with previous study.

3.1 Area of study

Three types of streets are identified in this study. Each street type represents a unique feature while they share the common feature of having a residential function as part of or the main function of the street. The three street types represent 3 unique street types in an urban context. It is expected that each street type generates unique responses that reflect the effect different qualities of streets have on different variables. Traffic calming street represents the unique Dutch residential street design that values residents' and pedestrians' experience on the street by physical design. A street with a large area of greenery/next to a park represents a built environment in the vicinity of an urban park environment that can positively affect the eudaemonic sense of place. Finally, the street within the city center reflects the situation of normal urban dwellers living in the area with extensive mixed land use.

3.1.1 Type 1: Traffic calming street

Woonerf, also known as a living street, was introduced back in the 70s in Delft (Ben-Joseph, 1995). The design concept is known for a leap in designing residential streets, and for its effort put into restricting vehicles with physical design to promote pedestrian safety and the social function of streets. A typical woonerf usually carries one or more of the following features: chicane, shared space, paved road and sidewalk with no levelling, large area of landscaping feature, and low-speed limit of around 15-30 km/h (Ben-Joseph, 1995). All the above features contribute to a pedestrian-friendly common public space that fosters communication and creative usage of the street, by providing a sufficient amount of landscaping and walking

space, while limiting the traffic of vehicles. Polderstraat and Jacobstraat in Oosterpoortbuurt with features of woonerf are selected to represent the street with the design of traffic-calming.

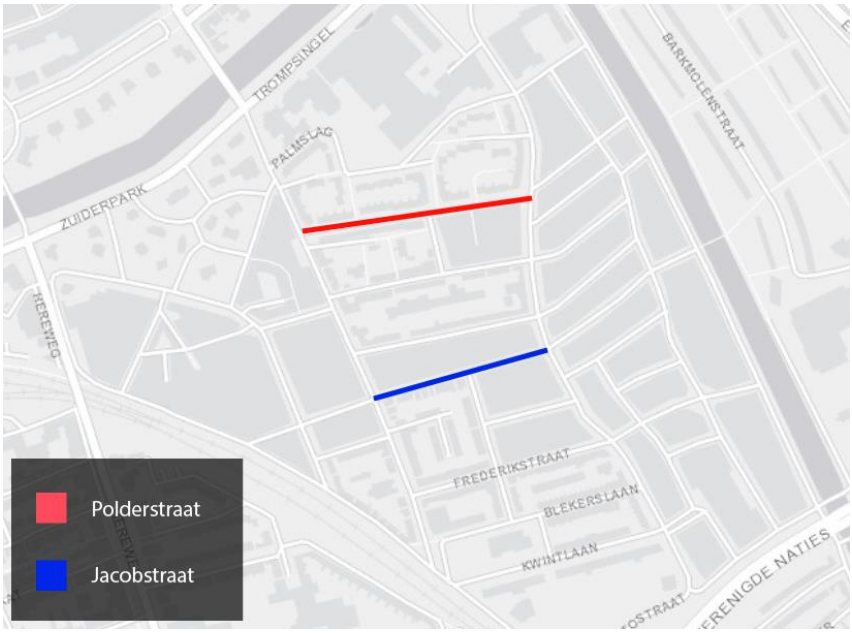

Fig. 3, map showing two streets in Oosterpoortbuurt with traffic-calming feature.

3.1.2 Type 2: Street with large area of greenery / next to a park

4 streets around Noorderplantsoen are selected to represent street design includes extensive amount of greenery. Researches show that urban greenery has positive relationship with sense of place. For example, urban green space can improve the perceived social safety (Maas et al., 2009). Perceived naturalness also affect sense of place in a way that higher perceived naturalness result in stronger attachment towards place and better wellbeing (Knez et al., 2018).

Fig. 4, map showing the 4 streets around Noorderplantsoen.

3.1.3 Type 3: Streets in city centre

Streets inside city centre are significantly different to the other 2 types of street in terms of level of mix-use and amount of traffic. Due to the urban fabric of Groningen and cycling-friendly design, bicycle traffic takes up a large portion of traffic in the city. To better reflect the unique feature of city centre, only 9 streets that are seen with significant mix-use of land are selected. Other streets in the city are omitted due to lack of mix land-use, for example there might not be enough residential units, or the street is primarily residential, and no shops or restaurants are seen on the street.

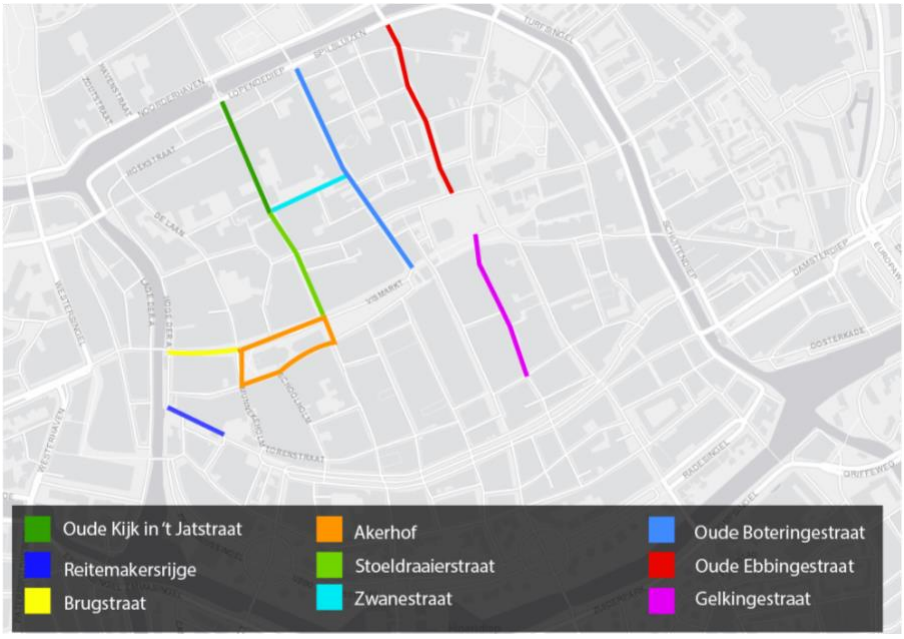

Fig. 5, map showing 9 streets in city centre.

3.2 Survey Composition

3.2.1 Qualities of street with Qualitative Assessment Tool (QS)

Respondent's perceived qualities of street are collected by using the Qualitative Assessment Tool. This is a set of question provided by Healthy Street, a private institute based in the UK promoting healthy street design and management, for the use of assessing streets by different Healthy Street Indicators (QS1-10) through numbers of open-end questions. A series of question that fits the best with context of research were picked and slightly modified to better reflect the perceived qualities of street by respondents (Appendix 7.1). Respondents' answers are recorded in a Likert scale from 1 to 6 (strongly disagree to strongly agree). Questions to each indicator will be grouped, and means will be calculated for further comparisons.

3.2.2 Sense of Place (SOP)

In this research the scale for measuring individual's sense of place (Appendix 7.2) is largely adopted from Ng et al. (2021). The sense of place scale is designed based on 3 types of sense of place sub-categories (SOP1-3), being the Functional/Cognitive, affective, and behavioral sense of place. A few wordings were amended to better fit with the research context. All three area of sense of place are evaluated with 3 subsets, 14 questions in total. Respondents' answers are recorded in Likert scale ranging from 1 to 6 (strongly disagree to strongly agree). The mean for each subset will thus be the score for the respective area of sense of place for subsequent analysis.

3.2.3 Subjective Wellbeing (SWB)

Keyes' Mental Health Continuum Short Form (MHC-SF) is adopted in this research to know about respondent's subjective wellbeing (Appendix 7.3). Three aspects of subjective wellbeing (SWB1-3) are evaluated using 14 items to access the mental health situation of respondents. Respondents are asked to provide the repetitiveness of the listed emotions and thoughts towards themselves and the society in a Likert scale from 1-6, from never to everyday, in the past month.

3.3 Participant's recruitment

Respondents of the survey are recruited primarily by researcher visiting the streets selected as area of study, with online distribution through WhatsApp as supplementary method. Researcher visited each household on the target streets and invited the residents to take part in the survey (Appendix 7.4). In case there is no resident responding, a flyer with a QR code linked to the survey will be distributed in the mailbox. To avoid technological bias, printed version of the survey is distributed upon request.

3.4 Data analysis scheme

Before conducting statistical test, mean of responses under each sub-category of variable has to be first calculated. The mean score of each variable represents the overall result of the sub-category according to the grouping shown in appendix 7.1-7.3. The above action result in a list of new variables, ranging from Mean_QS(1-10), Mean_SOP(1-3), and Mean_SWB(1-3). The mean under same group of variables will

be averaged again to obtain the mean score of the variable itself, i.e. QS_Qualities of street, SOP_sense of place, and SWB_Subjective well-being.

Firstly, descriptive statistics is generated to have an overview of the dataset. Secondly, one-way ANOVA is run to test if there is a significant difference for the three types of streets in terms of qualities of street, sense of place and subjective well-being. After which, correlation test is run to know if there is a significant relationship between qualities of street, sense of place and subjective well-being. Regression analysis is adopted to test the interrelationship between qualities of street, sense of place and subjective well-being. Models of regression and the corresponding hypothesis to test can be found below in table 1. Regarding regression model 6, the data of years of residence is obtained from demographic question Q. 33 in nominal form. The data is then processed by researcher, by transforming answers from nominal value to numeric presentation, as well as putting answers less than a year into decimal place for calculation purposes. The data of Q.33 is also transformed and recoded into aged group ranging from below 1 years to 31 years or above, with each group spanning across 10 years. The recoding of years of residence is for the better presentation of demographic information.

Model	Independent variable	Dependent variable	Hypothesis tested
1	QS_Qualities of street	SOP_Sense of place	1
2	QS_Qualities of street	SWB_Subjective wellbeing	1
3	QS_(1-10)	SOP_Sense of place	1
4	QS_(1-10)	SWB_Subjective wellbeing	1
5	Sense of place	Subjective wellbeing	2
6	Sense of place	Years of residence	3

Table 1, table showing the regression model used to test different hypothesis.

	No. of categories	No. of questions	Scoring
QS	10	25	1-6 (strongly disagree, disagree, somewhat disagree, somewhat agree, agree, strongly agree)
SOP	3	14	1-6 (strongly disagree, disagree, somewhat disagree, somewhat agree, agree, strongly agree)

SWB	3	14	1-6 (never, once or twice, about once a week, about 2 or 3 times a week, almost every day, everyday)

Table 2, types of data used and their scoring method.

3.5 Research Ethics

Ethics of research is achieved by ensuring the anonymity and voluntary nature of survey participation. Researcher included lucky draw of online platform coupon as encouragement of survey participation. Participants are free to choose whether they would like to provide their email for lucky draw purposes. Data collected are used solely for academic purposes and will be destroyed after finishing the study.

4. Result

A total of 151 responses were recorded in the survey tool Qualtrics. Out of the 154 responses, 38 of them were incomplete and thus needed to be removed. The result is a total of 113 valid cases in the dataset.

4.1 Demographics

	Traffic-calming residential street		Street with large area of greenery/next to a park		Street inside City centre		Full sample	
	n	%	n	%	n	%	n	%
Age group								
18-24	7	21.90%	11	29.70%	20	45.50%	38	33.60%
25-34	9	28.10%	10	27.00%	19	43.20%	38	33.60%
35-44	5	15.60%	3	8.10%	1	2.30%	9	8.00%
45-54	4	12.50%	6	16.20%	0	0.00%	10	8.80%
55-64	1	3.10%	3	8.10%	2	4.50%	6	5.30%
65+	6	18.80%	4	10.80%	2	4.50%	12	10.60%
Gender								
Male	14	43.80%	20	54.10%	18	40.90%	52	46.00%
Female	18	56.30%	17	45.90%	26	59.10%	61	54.00%
Marital status								
Single	22	68.80%	25	67.60%	39	88.60%	86	76.10%
Married	9	28.10%	9	24.30%	3	6.80%	21	18.60%
Divorced / Separated	0	0%	2	5.40%	1	2.30%	3	2.70%
Widowed	1	3.10%	1	2.70%	1	2.30%	3	2.70%
Type of housing								
Room	3	9.40%	3	8.10%	7	15.90%	13	11.50%
Apartment	7	21.90%	13	35.10%	26	59.10%	46	40.70%
House	22	68.80%	21	56.80%	5	11.40%	48	42.50%
Others	0	0%	0	0%	6	13.60%	6	5.30%
Type of housing ownership								

Private rental	11	34.40%	14	37.80%	38	86.40%	63	55.80%
Private ownership	20	62.50%	23	62.20%	0	0%	43	38.10%
Public rental	1	3.10%	0	0%	6	13.60%	7	6.20%
Employment status								
Student	9	28.10%	11	29.70%	26	59.10%	46	40.70%
Employed	16	50.00%	22	59.50%	16	36.40%	54	47.80%
Between jobs	2	6.30%	0	0%	0	0%	2	1.80%
Retired	5	15.60%	4	10.80%	2	4.50%	11	9.70%
Years of residence below 1 year	8	25%	9	24.30%	11	25%	28	24.80%
1-10 years	14	43.80%	19	51.40%	24	54.50%	57	50.40%
11-20 years	6	18.80%	3	8.10%	2	4.50%	11	9.70%
21-30 years	3	9.40%	4	10.80%	5	11.40%	12	10.60%
31 years or above	1	3.10%	2	5.40%	2	4.50%	5	4.40%

Table 3, demographic information of the area of study.

One particular thing to mention from the demographic table (table 3) is that street inside city centre stands out in many groups, The sample reflects younger age of the residents, higher rate of being single, larger number of respondents living in an apartment, common ownership of private rental housing, and higher amount of students. An overview of the entire sample also shows a demographic difference to previous study conducted by Ng et al. (2021) in Hong Kong, where differences lie in younger age, more population responded as student, larger proportion of tenants, and shorter duration of residence found in Groningen.

4.2 Descriptive Statistics

Appendix 7.5 shows the descriptive statistics for each sub-categories of qualities of street, sense of place and subjective well-being, as well as the mean of the three variables. To fully utilize the table, it has to be interpreted with the tests below.

4.3 Comparison among three street type

One-way ANOVA test was run to determine if there is a significant difference between the 3 types of streets (Appendix 7.6). Result indicates that the 3 street types are significantly different in terms of qualities of streets and sense of place but not in subjective well-being. Out of the 10 qualities of street only the "Everyone feels welcome" is insignificant (p=0.757). For the sense of place, all components indicate significant difference between street types. For subjective well-being, neither the mean of subjective well-being nor each of the sub-category shows significance. A post-hoc Turkey test was run to further investigate which variable is more significantly different from the other. Result and explanation can be found in discussion.

4.4 Correlation between qualities of street, sense of place and subjective wellbeing

Correlations

		QS_Qualities of street	SOP_Sense of place	SWB_Subjective well-being
QS_Qualities of street	Pearson Correlation	1	.638**	.209*
	Sig. (2-tailed)		<.001	.026
	N	113	113	113
SOP_Sense of place	Pearson Correlation	.638**	1	.425**
	Sig. (2-tailed)	<.001		<.001
	N	113	113	113
SWB_Subjective well-being	Pearson Correlation	.209*	.425**	1
	Sig. (2-tailed)	.026	<.001	
	N	113	113	113

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

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

Table 4, Correlation test result.

Correlation analysis shows the significant positive relationships between the three items (see table 4). There is a strong relationship between qualities of street and sense of place (r=.638, p<.001) as well as sense of place and subjective well-being

(r=.425, p<.001) while relationships between qualities of street and subjective well-being (r=.209, p=.026) is also positive but less significant.

4.5 Interrelations between qualities of street, sense of place and subjective well-being

Result of regression model shows a statistically significant impact on sense of place and subjective well-being brought by qualities of street (appendix 7.7). In regression model 1, the overall mean of sense of place is regressed by the overall mean of qualities of street. Qualities of street significantly predicted sense of place , R^2=.407, F(1, 111)=24.5, p<.001, β =.638. In regression model 2, the overall mean of subjective well-being is regressed by the overall mean of sense of place, leading to the result as follow: R^2=.044, F(1, 111)=5.066, p=.026, β=.209. Statistical significance of qualities of street on subjective well-being can still be seen, but weaker compared with model 1. The result obtained support hypothesis 1, that there is a positive relationship between qualities of street, sense of place and subjective well-being.

Regression model 3 and 4 shows the predictive power of 10 qualities of street on sense of place and subjective well-being. According to regression model 3 (R^2=.448, F(10, 102)=8.295, p<.001), QS3_Easy to cross has the strongest predictive power on sense of place (β =.296, p=002), followed by QS5_Things to see and do (β =.262, p=.011). Similar case also happens on regression model 4(R^2=.181, F(10, 102)=2.256, p=.020), where QS5_Things to see and do is the most prominent predictor (β =.340, p=.007). QS3_Easy to cross has second highest β but a p value exceeding 5%(β =.296, p=.102). QS2_

4.6 Relationships between SOP and SWB

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
5	.425[a]	.181	.173	.78973	2.315

a. Predictors: (Constant), SOP_Sense of place

b. Dependent Variable: SWB_Subjective well-being

Table 5, regression modelsummary of model 5.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
5	(Constant)	2.451	.386		6.348	<.001
	SOP_Sense of place	.471	.095	.425	4.950	<.001

a. Dependent Variable: SWB_Subjective well-being

Table 6, regression coefficient of model5

Regression model 5 (table 5 & 6) indicates that there is significant relationship between sense of place and subjective well-being (R^2= .407, F(1, 111)=24.5, p<.001, β =.425), The result validate hypothesis 2, that sense of place is positively related to subjective wellbeing.

4.7 Duration of residency and sense of place

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
6	.031[a]	.001	-.008	.78988	1.688

Table 7, regression model summary for model 6.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
6	(Constant)	3.960	.090		43.890	<.001	3.781	4.139
	Years of residence	.002	.006	.031	.328	.743	-.011	.015

Table 8, regression coefficient of model 6.

Regression model 6 (Table 7 & 8) has an insignificant result (R^2= .001, F(1, 110)=.108, p=.743, β =.031), so that it cannot validate hypothesis 3, that is with longer duration of residency the sense of place of residents also becomes stronger.

4.8 Discussion

The study aims to unveil the underlying relationship between qualities of street, sense of place and subjective well-being. Methodology of the study draws on various study over the three key components of the study. Groningen as the area of study, has been identified with 3 types of streets, known as traffic calming street, street with large area of greenery/next to a park, and street in city centre. 3 hypotheses are put forward to be validated. The findings are presented as follow.

The One-way ANOVA test and the corresponding post-hoc test along with the aid of descriptive statistics unveil the differences between types of streets. Result suggested that street type 2 has substantially higher value in terms of QS_Qualities of street (the mean of all 10 qualities of streets), while street type 3 scores lowest in most of the qualities of street. Street type 2 and 3 are significantly different in all qualities of street except everyone feels welcome (p=.814) and places to stop and rest (p=.732). The mean value of street type 3 is significantly lower than the other two in areas like easy to cross, people feel relaxed, and shade and shelter. Street type 2 is also significantly different from street type 3 while insignificant with street type 1 in qualities of street like people choose to walk or cycle, people feel safe, not too noisy and clean air. Street type 1 is significantly lower in places to stop and rest. Result shows that street inside city centre has more room of improvement than the other two types of streets, while street type 2 score best in general.

AVONA test of sense of place suggested that street type 2 is significantly different from the other types of streets in terms of the overall mean of sense of place, functional and cognitive SOP, and behavioral sense of place. The findings correlate with previous scholar's findings, that streets with large area of greenery or situated next to a park have positive influence on sense of place (Maas et al, 2009).

There is no statistically significant difference in all areas of subjective well-being. The result can be understood as the result of the relatively higher portion of student reflected in demographics, where 40.7% of sample population is student. There is no available research that directly compares the size of effect between the built

environment and other factors influence subjective well-being. However, research suggested that subjective well-being of students is highly correlate with the level of autonomy and the support of autonomy received by students (Ratelle et al, 2013). Higher level of autonomy and support received to facilitate autonomy result in higher level of happiness and satisfaction (Ratelle et al, 2013). The study can partly explain the irrelevance between types of streets one resides in and his/her subjective-wellbeing.

The research finding support hypothesis 1, which stated that there is a positive relationship between qualities of street, sense of place and subjective well-being. Correlation test shows significant relationship among all three mean variables. The finding correlates with scholar's findings, that qualities of the built environment, sense of place and subjective well-being are positively related (Ng et al, 2021). The limited explanatory effect of regression model 3 and 4 explored the nuanced effect of different qualities of street, by revealing a stronger effect of certain qualities of street over the others, for example things to see and do has second best explanatory power in regression model 3 (R^2=.448, F(10, 102)=8.295, p<.001, β =.262) and the best in model 4 (R^2=.181, F(10, 102)=2.265, p=.020, β =.340). This reveals the importance of the visual qualities of a street, including human activity take place on street, shops and restaurants, the frontage of buildings, street greenery, and street furniture, and its effect on improving people's sense of place and subjective well-being.

Hypothesis 2, sense of place is positively correlated with subjective well-being. The findings echo with the hypothesis that people with stronger attachment towards the street they live in tend to have better subjective well-being. The result matches with previous findings from scholars, that the two concept have a positively related relationship (Ng et al, 2021). Ng et al. (2021) has mentioned in her paper about the abundance of literature studying relationships between built environment and subjective well-being (Hajrasoulih et al., 2018; Frerichs, 2004; Staats, van Gemerden & Hartig, 2010), as well as the relative shortage of literature exploring relationship between sense of place and subjective well-being. This study can hopefully support their viewpoint and help opening the door for corresponding research.

Hypothesis 3, stating the positive relationship between duration of residency and sense of place is not validated in regression model 6. The finding violates scholar's findings, that sense of place is positively relate to the duration of stay in certain place (Smaldone et al, 2008). One of the main reasons could be the population

formation of the study area. As stated above and reported in demographic information, over 40% of sample population are students. According to figures provided by the University of Groningen, in year 2020, 9100 students from the total of 35,000 students (26% of total) are international students (University of Groningen, 2022). The number of Dutch students reside outside Groningen and move here for education is undocumented, but it is still expected to be high. These students usually move to Groningen for higher education and away to the next destination after their study. Thus, their duration of residency is highly dependent on their study progress and personal context, e.g. housing contract. Scholar's findings expose the complexity of sense of place for students on the move, by arguing that students are able to develop a weak connection with the place through various social involvement (Holton, 2015). Student with corresponding interpersonal experience will eventually develop a sort of "superficial, partial" sense of place based on their perceived "place identity" (Holton, 2015; Scannell & Gifford, 2014). Scannell and Gifford's finding exposes the multidimensionality of sense of place, that attachment towards certain place can emerge through interpersonal experiences, further explains the irrelevance between duration of residency and sense of place in student city Groningen (2014).

5. Conclusion

This paper has shown the importance of streets by highlighting scholarly journals. In addition, the less covered interrelations among place qualities, sense of place, and subjective wellbeing have been demonstrated and discussed. In this paper, a quantitative research method is adopted to investigate the different qualities of the streets on the sense of place perceived by residents; and thus, find out the impact on subjective well-being. Through this investigation, 3 hypotheses are answered: first, a positive relationship between Healthy Street Indicators, sense of place, and subjective wellbeing are shown; second, sense of place have a positive relationship with subjective well-being; third, the duration of residents does not positively correlate with subjective wellbeing. As a result, this can open the door for future research based on these 3 elements; and thus, provide new vantage points to make streets more beneficial to citizens.

As discussed above, one of the limitations of this research goes to the limited sample size. A smaller sample size has a weaker explanatory and representative power for the population. There are also survey respondents reflect over the design of the survey, suggesting amending certain question from compulsory to optional. This is due to inadequate adaptation of the survey question tool. The Qualitative

Assessment tool provided by Healthy Street was designed mainly for the UK urban context, and some statement can hardly be integrated into the Dutch context. Development of a universal assessment tool for streets in different countries, designed with different focus and methodology would thus be one possible future point of research. There are still abundant room for research in terms of the interrelationship among the qualities of streets, sense of place and subjective well-being. The research also open rooms of study regarding the parallel nature of interpersonal experience and built environment for students who are on a move to their destination of study.

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7. Appendixes

7.1 Statements describing qualities of streets and their corresponding street indicators.

Healthy Street Indicators	Corresponding question
1. People choose to walk and cycle	- There is enough space for people walking and cycling at the busiest time. - The street does not feel dominated by parked or moving vehicles.
2. Everyone feels welcome	- People on the street reflect the diversity of local community even after dark. - Women walk, cycle and spend time on the street on their own. - Children walk and cycle without adult supervision and play on the street. - The footpath is wide enough to contain range of activities including playing, resting and socializing. - The shops on the street serve the varied needs of the local community.
3. Easy to cross	- I find it easy crossing the street safely at the point I find most direct and convenient. - The moving and static vehicles does not make crossing the street harder. - (If there are formal crossing points) I find the formal crossing points easy and convenient to use.
4. People feel safe	- Different part of the street are well-lit throughout different period of a day. - I am not worried of the vehicles on the street.
5. Things to see and do	- I find the street visually appealing or attractive to me in the following aspects… - Human activity (walking, cycling, socializing, playing, etc.) - Shops and restaurants - Frontage of buildings - Trees, plants and greenery - Street furniture (seating, signage, lighting, etc.)

6. Places to stop and rest	- Seating and/or resting area is available on the street. - The street provide enough space for people to take a rest as they want to. - (If available) I find the seating and resting area on the street appealing to use.
7. People feel relaxed	- I often feel relaxed walking on the street. - I find the street clean and well-maintained. - I seldom find myself being blocked by obstacles on the streets (debris, parked bike, puddles, etc.).
8. Not too noisy	- The sound level of the street is not too noisy and is good to me.
9. Clean air	- I agree that air quality of the street being good enough.
10. Shade and shelter	- There are enough shades and shelter provided on the streets (trees, canopies, awnings, etc.).

7.2 Statements describing residents' attachment towards the street they live in, and their corresponding types of sense of place.

1. Functional and cognitive sense of place	1. The street I live in can fulfil my needs.
	2. As far as I am concerned, there are no better streets to be than at the street I live in.
	3. I think the street I live in is walkable.
	4. My neighbours share similar values with me.
	5. I feel that I am part of the street I live in.
	6. I have positive relationships with my neighbours.
2. Affective sense of place	7. I feel relaxed when I'm at the street I live in.
	8. I feel happiest when I'm at the street I live in.
	9. The street I live in is my most favourite place to be.
	10. I really miss the street I live in when I'm away from it for too long.
3. Behavioural sense of place	11. My neighbours and I share common goals.
	12. I enjoy involving in community affairs of the street I live in.
	13. I am willing to spare my leisure time to help the street I live in.
	14. I am willing to devote my resources to helping the street I live in.

7.3 Keyes' Mental Health Continuum Short Form (MHC-SF)

Q: During the PAST MONTH, how often did you feel…	
1. Hedonic — emotional well-being	
• happy (Item 1)	… happy
• interested in life (Item 2)	… interested in life
• satisfied with life (Item 3)	… satisfied with life
2. Eudaimonic — social well-being	
• Social Contribution (Item 4)	… that you had something important to contribute to society
• Social Integration (Item 5)	… that you belonged to a community (like a social group, or your neighborhood)
• Social Actualization (i.e., Social Growth) (Item 6)	… that our society is a good place, or is becoming a better place, for all people
• Social Acceptance (Item 7)	… that people are basically good
• Social Coherence (i.e., Social Interest) (Item 8)	… that the way our society works makes sense to you
3. Eudaimonic — psychological well-being	
• Self Acceptance (Item 9)	… that you liked most parts of your personality
• Environmental Mastery (Item 10)	… good at managing the responsibilities of your daily life
• Positive Relations with Others (Item 11)	… that you had warm and trusting relationships with others
• Personal Growth (Item 12)	… that you had experiences that challenged you to grow and become a better person
• Autonomy (Item 13)	… confident to think or express your own ideas and opinions
• Purpose in Life (Item 14)	… that your life has a sense of direction or meaning to it

7.4 Survey

Hello! I am a student of Spatial planning and design from the University of Groningen. This is a survey on my bachelor thesis. The survey contains question on qualities of street, sense of place and subjective well-being. The entire survey may take you approximately 10-15 minutes.

There is no right or wrong answer in this survey. The primary objective is to know about your personal opinion to the question asked.

Data collected in this survey will be kept confidential and used only for academic purposes. Result of survey will be presented without identification possible.

*Please note that this survey targets people aged 18 years old or above.
**Participants can register for a lucky draw at the end of the survey. Prize of the lucky draw are 3 Bol.com gift cards that worth €15 each. 3 lucky participants will be drawn and win the gift card.

Please click "Yes" if you understand the text above and are willing to begin with this survey.
(*Survey will be ended if "No" is selected.)

Yes (1)
No (2)

Q23
Which of the following streets do you live in?

1. Traffic-calming residential street
(Oosterpoortbuurt: Polderstraat, Jacobstraat)

2. Street with large area of greenery/next to a park
(Noorderplantsoen: Grachtstraat, Noorderbuitensingel, Boteringesingel, Oranjesingel)

3. Street inside City centre
(Oude kijk in het jatstraat, Brugstraat, Akerhof, Oude boteringestraat, Oude ebbingestraat, Stoeldraaierstraat, Zwanestraat, Gelkingestraat, Reitemakersrijge)

Traffic-calming residential street (1)
Street with large area of greenery/next to a park (2)
Street inside City centre (3)

Q1 To what extent do you agree with the following statement(s) to the street you are living in?

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly agree (6)
There is enough space for people walking and cycling at the busiest time. (1)						
The street does not feel dominated by parked or moving vehicles. (2)						
People on the street reflect the diversity of local community even after dark. (3)						
Women walk, cycle and spend time on the street on their own. (4)						
Children walk and cycle without adult supervision and play on the street. (5)						

The footpath is wide enough to contain range of activities including playing, resting and socializing. (6)	
The shops on the street serve the varied needs of the local community. (7)	
I find it easy crossing the street safely at the point I find most direct and convenient. (8)	
The moving and static vehicles does not make crossing the street harder. (9)	

Q3

To what extent do you agree with the following statement(s) to the street you are living in?

	Strongly Disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly Agree (6)
(If there are designated pedestrian crossing) I find the formal crossing points easy and convenient to use. (1)						

Q4 To what extent do you agree with the following statement(s) to the street you are living in?

	Strongly Disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly Agree (6)
Different part of the street are well-lit throughout different period of a day. (1)						
I am not worried of the vehicles on the street. (2)						

Q5 I find the street visually appealing or attractive to me in the following aspects...

	Strongly Disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly Agree (6)
Human activity (walking, cycling, socializing, playing, etc.) (1)						
Shops and restaurants (2)						
Frontage of buildings (3)						
Trees, plants and greenery (4)						
Street furniture (seating, signage, lighting, etc.) (5)						

Q6 To what extent do you agree with the following statement(s) to the street you are living in?

	Strongly Disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly Agree (6)
Seating and/or resting area is available on the street. (1)						
The street provides enough space for people to take a rest as they want to. (2)						
I find the seating and/or resting area on the street appealing to use. (3)						
I often feel relaxed walking on the street. (4)						
I find the street clean and well-maintained. (5)						
I seldom find myself being blocked by obstacles on the streets (debris, parked bike, puddles, etc.). (6)						
The sound level of the street is						

not too noisy and is good to me. (7)	
I agree that air quality of the street being good enough. (8)	
There are enough shades and shelter provided on the streets (trees, canopies, awnings, etc.). (9)	

Q11 To what extent do you agree with the following statement(s)?

	Strongly Disagree (1)	Disagree (2)	Somewhat disagree (3)	Somewhat agree (4)	Agree (5)	Strongly Agree (6)
The street I live in can fulfil my needs. (1)						
As far as I am concerned, there are no better streets to be than at the street I live in. (2)						
I think the street I live in is walkable. (3)						
My neighbours share similar						

values with me. (4)

I feel that I am part of the street I live in. (5)

I have positive relationships with my neighbours. (6)

I feel relaxed when I'm at the street I live in. (7)

I feel happiest when I'm at the street I live in. (8)

The street I live in is my favourite place to be. (9)

I really miss the street I live in when I'm away from it for too long. (10)

My neighbours and I share common goals. (11)

I enjoy involving in community affairs of the street I live in. (12)

I am willing to spare my leisure

time to help the street I live in. (13)	
I am willing to devote my resources to help the street I live in. (14)	

Q14 During the PAST MONTH, how often did you feel...

	Never (1)	Once or Twice (2)	About once a week (3)	About 2or 3 times a week (4)	Almost every day (5)	Every day (6)
… happy (1)						
… interested in life (2)						
… satisfied with life (3)						
… that you had something important to contribute to society (4)						
… that you belonged to a community (like a social group, or your neighborhood) (5)						
… that our society is a good place, or is becoming a better place, for all people (6)						

… that people are basically good (7)

… that the way our society works makes sense to you (8)

… that you liked most parts of your personality (9)

… good at managing the responsibilities of your daily life (10)

… that you had warm and trusting relationships with others (11)

… that you had experiences that challenged you to grow and become a better person (12)

… confident to think or express your own ideas and opinions (13)

… that your life has a sense of direction or meaning to it (14)

Q24

The survey is almost done! Before completing here are some questions about the basic information.

How old are you?

_____

Q25 What is your gender?

▼ Male (1)
▼Woman (2)
▼Non binary / third gender (3)
▼ Prefer not to say (4)

Q26 What is your marital status?

Single (1)
Married (2)
Divorced / Separated (3)
Widowed (4)

Q27 What type of housing do you live in?

Room (1)
Apartment (2)
House (3)
Others (4)

Q28 What type of housing ownership are you in?

Private rental (1)
Private ownership (2)
Public rental (3)

Q29 What is your employment status?

Student (1)
Employed (2)
Homemaker (3)

Between jobs (4)
Retired (5)

Q33
How many years have you been living in your housing?
*Please indicate only number of years in the box below, e.g. if you have lived for 9 years please type "9".

In case you have lived less than a year, for example 4 months, please type "4 months" for differentiation.

_____

Q34 Including yourself, how many people currently live in your household?

_____

Q35 For those who would like to join the lucky draw of gift card from Bol.com, please leave your email for potential contact.

_____

7.5 Descriptive statistics

7.5.1 Descriptive statistics for whole sample

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
QS_Qualities of street	113	2.31	5.73	3.9725	.63228	-.072	.227
QS1_People choose to walk or cycle	113	1.50	6.00	4.0177	1.14940	-.300	.227
QS2_Everyone feels welcome	113	1.60	5.80	3.9239	.75938	-.043	.227
QS3_Easy to Cross	113	1.00	6.00	4.1077	1.03771	-.525	.227
QS4_People feel safe	113	1.50	6.00	4.2965	.89302	-.342	.227
QS5_Things to see and do	113	1.40	6.00	4.1788	.87029	-.367	.227
QS6_Places to stop and rest	113	1.00	6.00	2.7935	1.29431	.705	.227
QS7_People feel relaxed	113	1.33	6.00	4.2566	.90634	-.404	.227
QS8_Not too noisy	113	1.00	6.00	4.1062	1.42279	-.777	.227
QS9_Clean air	113	1.00	6.00	4.5133	1.08657	-1.097	.227
QS10_Shade and shelter	113	1.00	6.00	4.1150	1.41265	-.710	.227
SOP_Sense of place	113	2.21	6.00	3.9791	.78372	-.171	.227
SOP1_Functional & cognitive SOP	113	2.50	6.00	4.3260	.80684	-.107	.227
SOP2_Affective SOP	113	1.50	6.00	3.9602	1.01141	-.252	.227
SOP3_Behavioural SOP	113	1.00	6.00	3.4779	1.02674	-.249	.227
SWB_Subjective well-being	113	1.79	6.00	4.3262	.86864	-.793	.227
SWB1_Emotional	113	1.67	6.00	4.8112	.92354	-1.543	.227
SWB2_Social	113	1.40	6.00	3.7540	1.05763	-.260	.227

SWB3_Psychological	113	1.67	6.00	4.5605	.94072	-1.026	.227
Valid N (listwise)	113						

7.5.2 Descriptive statistics by street type

Descriptives

						95% Confidence Interval for Mean			
		N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
QS_Qualities of street	Traffic-calming residential street	32	3.8631	.53447	.09448	3.6704	4.0558	2.31	5.16
	Street with large area of greenery/next to a park	37	4.2879	.55155	.09067	4.1040	4.4718	3.23	5.15
	Street inside City centre	44	3.7869	.67148	.10123	3.5828	3.9911	2.56	5.73
	Total	113	3.9725	.63228	.05948	3.8547	4.0904	2.31	5.73
QS1_People choose to walk or cycle	Traffic-calming residential street	32	3.8281	1.03651	.18323	3.4544	4.2018	1.50	5.50
	Street with large area of greenery/next to a park	37	4.4459	1.07228	.17628	4.0884	4.8035	1.50	6.00
	Street inside City centre	44	3.7955	1.21195	.18271	3.4270	4.1639	1.50	6.00
	Total	113	4.0177	1.14940	.10813	3.8035	4.2319	1.50	6.00
QS2_Everyone feels welcome	Traffic-calming residential street	32	3.8750	.77000	.13612	3.5974	4.1526	1.60	5.20
	Street with large area of greenery/next to a park	37	3.8865	.77966	.12818	3.6265	4.1464	2.40	5.60
	Street inside City centre	44	3.9909	.74703	.11262	3.7638	4.2180	2.80	5.80

	Total	113	3.9239	.75938	.07144	3.7824	4.0654	1.60	5.80
QS3_Easy to Cross	Traffic-calming residential street	32	4.5313	.76603	.13542	4.2551	4.8074	2.67	6.00
	Street with large area of greenery/next to a park	37	4.3063	.95703	.15734	3.9872	4.6254	1.00	5.67
	Street inside City centre	44	3.6326	1.10296	.16628	3.2972	3.9679	2.00	6.00
	Total	113	4.1077	1.03771	.09762	3.9142	4.3011	1.00	6.00
QS4_People feel safe	Traffic-calming residential street	32	4.3281	.83868	.14826	4.0258	4.6305	1.50	6.00
	Street with large area of greenery/next to a park	37	4.6351	.84696	.13924	4.3527	4.9175	3.00	6.00
	Street inside City centre	44	3.9886	.87927	.13256	3.7213	4.2560	2.00	6.00
	Total	113	4.2965	.89302	.08401	4.1300	4.4629	1.50	6.00
QS5_Things to see and do	Traffic-calming residential street	32	3.7375	.84615	.14958	3.4324	4.0426	1.40	5.20
	Street with large area of greenery/next to a park	37	4.6378	.76134	.12516	4.3840	4.8917	2.80	5.80
	Street inside City centre	44	4.1136	.80046	.12067	3.8703	4.3570	2.60	6.00
	Total	113	4.1788	.87029	.08187	4.0165	4.3410	1.40	6.00

QS6_Places to stop and rest	Traffic-calming residential street	32	2.1458	.71811	.12694	1.8869	2.4047	1.00	4.00
	Street with large area of greenery/next to a park	37	3.1622	1.28289	.21091	2.7344	3.5899	1.33	6.00
	Street inside City centre	44	2.9545	1.46904	.22147	2.5079	3.4012	1.00	6.00
	Total	113	2.7935	1.29431	.12176	2.5523	3.0348	1.00	6.00
QS7_People feel relaxed	Traffic-calming residential street	32	4.3229	.96715	.17097	3.9742	4.6716	1.33	5.67
	Street with large area of greenery/next to a park	37	4.7117	.74188	.12196	4.4644	4.9591	3.33	6.00
	Street inside City centre	44	3.8258	.79562	.11994	3.5839	4.0676	1.67	5.67
	Total	113	4.2566	.90634	.08526	4.0877	4.4256	1.33	6.00
QS8_Not too noisy	Traffic-calming residential street	32	4.2813	1.37335	.24278	3.7861	4.7764	1.00	6.00
	Street with large area of greenery/next to a park	37	4.4865	1.26099	.20731	4.0661	4.9069	1.00	6.00
	Street inside City centre	44	3.6591	1.49329	.22512	3.2051	4.1131	1.00	6.00
	Total	113	4.1062	1.42279	.13384	3.8410	4.3714	1.00	6.00
QS9_Clean air	Traffic-calming residential street	32	4.3750	.94186	.16650	4.0354	4.7146	2.00	6.00

	Street with large area of greenery/next to a park	37	4.8919	.84274	.13855	4.6109	5.1729	3.00	6.00
	Street inside City centre	44	4.2955	1.28641	.19393	3.9043	4.6866	1.00	6.00
	Total	113	4.5133	1.08657	.10222	4.3107	4.7158	1.00	6.00
QS10_Shade and shelter	Traffic-calming residential street	32	4.6250	1.03954	.18377	4.2502	4.9998	2.00	6.00
	Street with large area of greenery/next to a park	37	4.8378	.98639	.16216	4.5090	5.1667	2.00	6.00
	Street inside City centre	44	3.1364	1.40747	.21218	2.7085	3.5643	1.00	5.00
	Total	113	4.1150	1.41265	.13289	3.8517	4.3784	1.00	6.00
SOP_Sense of place	Traffic-calming residential street	32	3.7902	.64807	.11456	3.5565	4.0238	2.64	4.86
	Street with large area of greenery/next to a park	37	4.3977	.64276	.10567	4.1834	4.6120	2.71	5.64
	Street inside City centre	44	3.7646	.85250	.12852	3.5054	4.0238	2.21	6.00
	Total	113	3.9791	.78372	.07373	3.8331	4.1252	2.21	6.00
SOP1_Functional & cognitive SOP	Traffic-calming residential street	32	4.0521	.51053	.09025	3.8680	4.2361	3.17	5.00
	Street with large area of greenery/next to a park	37	4.8153	.77855	.12799	4.5557	5.0749	2.67	6.00

	Street inside City centre	44	4.1136	.83199	.12543	3.8607	4.3666	2.50	6.00
	Total	113	4.3260	.80684	.07590	4.1756	4.4763	2.50	6.00
SOP2_Affective SOP	Traffic-calming residential street	32	3.9219	.95554	.16892	3.5774	4.2664	1.75	6.00
	Street with large area of greenery/next to a park	37	4.2973	.95350	.15675	3.9794	4.6152	1.50	6.00
	Street inside City centre	44	3.7045	1.03888	.15662	3.3887	4.0204	1.50	6.00
	Total	113	3.9602	1.01141	.09515	3.7717	4.1487	1.50	6.00
SOP3_Behavioural SOP	Traffic-calming residential street	32	3.2656	1.03358	.18271	2.8930	3.6383	1.00	5.00
	Street with large area of greenery/next to a park	37	3.8716	.72318	.11889	3.6305	4.1127	2.25	5.50
	Street inside City centre	44	3.3011	1.15711	.17444	2.9493	3.6529	1.50	6.00
	Total	113	3.4779	1.02674	.09659	3.2865	3.6693	1.00	6.00
SWB_Subjective well-being	Traffic-calming residential street	32	4.2924	.78380	.13856	4.0098	4.5750	2.36	6.00
	Street with large area of greenery/next to a park	37	4.5019	.71775	.11800	4.2626	4.7412	2.36	5.71
	Street inside City centre	44	4.2029	1.02380	.15434	3.8917	4.5142	1.79	5.79
	Total	113	4.3262	.86864	.08172	4.1643	4.4881	1.79	6.00

SWB1_Emotional	Traffic-calming residential street	32	5.0312	.89747	.15865	4.7077	5.3548	1.67	6.00
	Street with large area of greenery/next to a park	37	4.9189	.70011	.11510	4.6855	5.1523	2.67	6.00
	Street inside City centre	44	4.5606	1.05843	.15956	4.2388	4.8824	1.67	6.00
	Total	113	4.8112	.92354	.08688	4.6391	4.9833	1.67	6.00
SWB2_Social	Traffic-calming residential street	32	3.6000	.99158	.17529	3.2425	3.9575	1.80	6.00
	Street with large area of greenery/next to a park	37	4.0541	.88273	.14512	3.7597	4.3484	2.00	5.40
	Street inside City centre	44	3.6136	1.19876	.18072	3.2492	3.9781	1.40	5.60
	Total	113	3.7540	1.05763	.09949	3.5568	3.9511	1.40	6.00
SWB3_Psychological	Traffic-calming residential street	32	4.5000	.83816	.14817	4.1978	4.8022	2.67	6.00
	Street with large area of greenery/next to a park	37	4.6667	.81744	.13439	4.3941	4.9392	1.83	6.00
	Street inside City centre	44	4.5152	1.10660	.16683	4.1787	4.8516	1.67	6.00
	Total	113	4.5605	.94072	.08850	4.3851	4.7358	1.67	6.00

7.6 One-way ANOVA

7.6.1 ANOVA table

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
QS_Qualities of street	Between Groups	5.580	2	2.790	7.830	<.001
	Within Groups	39.195	110	.356		
	Total	44.775	112			
QS1_People choose to walk or cycle	Between Groups	10.109	2	5.054	4.033	.020
	Within Groups	137.856	110	1.253		
	Total	147.965	112			
QS2_Everyone feels welcome	Between Groups	.326	2	.163	.279	.757
	Within Groups	64.260	110	.584		
	Total	64.585	112			
QS3_Easy to Cross	Between Groups	17.133	2	8.566	9.107	<.001
	Within Groups	103.474	110	.941		
	Total	120.607	112			
QS4_People feel safe	Between Groups	8.445	2	4.223	5.743	.004
	Within Groups	80.873	110	.735		
	Total	89.319	112			
QS5_Things to see and do	Between Groups	14.215	2	7.108	11.072	<.001
	Within Groups	70.614	110	.642		
	Total	84.829	112			
QS6_Places to stop and rest	Between Groups	19.593	2	9.797	6.413	.002
	Within Groups	168.033	110	1.528		
	Total	187.626	112			
QS7_People feel relaxed	Between Groups	15.972	2	7.986	11.554	<.001
	Within Groups	76.030	110	.691		

	Total	92.002	112			
QS8_Not too noisy	Between Groups	15.127	2	7.564	3.932	.022
	Within Groups	211.598	110	1.924		
	Total	226.726	112			
QS9_Clean air	Between Groups	8.003	2	4.002	3.543	.032
	Within Groups	124.227	110	1.129		
	Total	132.230	112			
QS10_Shade and shelter	Between Groups	69.796	2	34.898	24.974	<.001
	Within Groups	153.709	110	1.397		
	Total	223.504	112			
SOP_Sense of place	Between Groups	9.649	2	4.825	8.973	<.001
	Within Groups	59.143	110	.538		
	Total	68.793	112			
SOP1_Functional & cognitive SOP	Between Groups	13.244	2	6.622	12.208	<.001
	Within Groups	59.666	110	.542		
	Total	72.911	112			
SOP2_Affective SOP	Between Groups	7.127	2	3.564	3.648	.029
	Within Groups	107.444	110	.977		
	Total	114.571	112			
SOP3_Behavioural SOP	Between Groups	8.552	2	4.276	4.295	.016
	Within Groups	109.517	110	.996		
	Total	118.070	112			
SWB_Subjective well-being	Between Groups	1.848	2	.924	1.229	.296
	Within Groups	82.661	110	.751		
	Total	84.509	112			
SWB1_Emotional	Between Groups	4.742	2	2.371	2.873	.061
	Within Groups	90.786	110	.825		
	Total	95.528	112			

SWB2_Social	Between Groups	4.957	2	2.478	2.266	.109
	Within Groups	120.324	110	1.094		
	Total	125.281	112			
SWB3_Psychological	Between Groups	.625	2	.312	.349	.706
	Within Groups	98.490	110	.895		
	Total	99.115	112			

7.6.2 Post-Hoc Tukey test

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Which of the following streets do you live in?	(J) Which of the following streets do you live in?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
QS_Qualities of street	Traffic-calming residential street	Street with large area of greenery/next to a park	-.42486*	.14410	.011	-.7672	-.0825
		Street inside City centre	.07615	.13868	.847	-.2533	.4056
	Street with large area of greenery/next to a park	Traffic-calming residential street	.42486*	.14410	.011	.0825	.7672
		Street inside City centre	.50102*	.13315	<.001	.1847	.8174
	Street inside City centre	Traffic-calming residential street	-.07615	.13868	.847	-.4056	.2533
		Street with large area of greenery/next to a park	-.50102*	.13315	<.001	-.8174	-.1847

QS1_People choose to walk or cycle	Traffic-calming residential street	Street with large area of greenery/next to a park	-.61782	.27025	.062	-1.2599	.0243
		Street inside City centre	.03267	.26009	.991	-.5853	.6506
	Street with large area of greenery/next to a park	Traffic-calming residential street	.61782	.27025	.062	-.0243	1.2599
		Street inside City centre	.65049*	.24971	.028	.0572	1.2438
	Street inside City centre	Traffic-calming residential street	-.03267	.26009	.991	-.6506	.5853
		Street with large area of greenery/next to a park	-.65049*	.24971	.028	-1.2438	-.0572
QS2_Everyone feels welcome	Traffic-calming residential street	Street with large area of greenery/next to a park	-.01149	.18451	.998	-.4499	.4269
		Street inside City centre	-.11591	.17757	.791	-.5378	.3060
	Street with large area of greenery/next to a park	Traffic-calming residential street	.01149	.18451	.998	-.4269	.4499
		Street inside City centre	-.10442	.17049	.814	-.5095	.3006
	Street inside City centre	Traffic-calming residential street	.11591	.17757	.791	-.3060	.5378
		Street with large area of greenery/next to a park	.10442	.17049	.814	-.3006	.5095

QS3_Easy to Cross	Traffic-calming residential street	Street with large area of greenery/next to a park	.22494	.23414	.603	-.3313	.7812
		Street inside City centre	.89867*	.22533	<.001	.3633	1.4340
	Street with large area of greenery/next to a park	Traffic-calming residential street	-.22494	.23414	.603	-.7812	.3313
		Street inside City centre	.67373*	.21634	.007	.1597	1.1877
	Street inside City centre	Traffic-calming residential street	-.89867*	.22533	<.001	-1.4340	-.3633
		Street with large area of greenery/next to a park	-.67373*	.21634	.007	-1.1877	-.1597
QS4_People feel safe	Traffic-calming residential street	Street with large area of greenery/next to a park	-.30701	.20699	.303	-.7988	.1848
		Street inside City centre	.33949	.19921	.208	-.1338	.8128
	Street with large area of greenery/next to a park	Traffic-calming residential street	.30701	.20699	.303	-.1848	.7988
		Street inside City centre	.64650*	.19126	.003	.1921	1.1009
	Street inside City centre	Traffic-calming residential street	-.33949	.19921	.208	-.8128	.1338
		Street with large area of greenery/next to a park	-.64650*	.19126	.003	-1.1009	-.1921

QS5_Things to see and do	Traffic-calming residential street	Street with large area of greenery/next to a park	-.90034*	.19342	<.001	-1.3599	-.4408
		Street inside City centre	-.37614	.18615	.112	-.8184	.0661
	Street with large area of greenery/next to a park	Traffic-calming residential street	.90034*	.19342	<.001	.4408	1.3599
		Street inside City centre	.52420*	.17872	.011	.0996	.9488
	Street inside City centre	Traffic-calming residential street	.37614	.18615	.112	-.0661	.8184
		Street with large area of greenery/next to a park	-.52420*	.17872	.011	-.9488	-.0996
QS6_Places to stop and rest	Traffic-calming residential street	Street with large area of greenery/next to a park	-1.01633*	.29837	.003	-1.7252	-.3075
		Street inside City centre	-.80871*	.28715	.016	-1.4909	-.1265
	Street with large area of greenery/next to a park	Traffic-calming residential street	1.01633*	.29837	.003	.3075	1.7252
		Street inside City centre	.20762	.27569	.732	-.4474	.8626
	Street inside City centre	Traffic-calming residential street	.80871*	.28715	.016	.1265	1.4909
		Street with large area of greenery/next to a park	-.20762	.27569	.732	-.8626	.4474

QS7_People feel relaxed	Traffic-calming residential street	Street with large area of greenery/next to a park	-.38880	.20070	.133	-.8656	.0880
		Street inside City centre	.49716*	.19315	.030	.0383	.9561
	Street with large area of greenery/next to a park	Traffic-calming residential street	.38880	.20070	.133	-.0880	.8656
		Street inside City centre	.88595*	.18544	<.001	.4454	1.3265
	Street inside City centre	Traffic-calming residential street	-.49716*	.19315	.030	-.9561	-.0383
		Street with large area of greenery/next to a park	-.88595*	.18544	<.001	-1.3265	-.4454
QS8_Not too noisy	Traffic-calming residential street	Street with large area of greenery/next to a park	-.20524	.33482	.813	-1.0007	.5902
		Street inside City centre	.62216	.32223	.135	-.1434	1.3877
	Street with large area of greenery/next to a park	Traffic-calming residential street	.20524	.33482	.813	-.5902	1.0007
		Street inside City centre	.82740*	.30937	.023	.0924	1.5624
	Street inside City centre	Traffic-calming residential street	-.62216	.32223	.135	-1.3877	.1434
		Street with large area of greenery/next to a park	-.82740*	.30937	.023	-1.5624	-.0924

QS9_Clean air	Traffic-calming residential street	Street with large area of greenery/next to a park	-.51689	.25654	.113	-1.1264	.0926
		Street inside City centre	.07955	.24690	.944	-.5070	.6661
	Street with large area of greenery/next to a park	Traffic-calming residential street	.51689	.25654	.113	-.0926	1.1264
		Street inside City centre	.59644*	.23704	.035	.0333	1.1596
	Street inside City centre	Traffic-calming residential street	-.07955	.24690	.944	-.6661	.5070
		Street with large area of greenery/next to a park	-.59644*	.23704	.035	-1.1596	-.0333
QS10_Shade and shelter	Traffic-calming residential street	Street with large area of greenery/next to a park	-.21284	.28537	.737	-.8908	.4651
		Street inside City centre	1.48864*	.27464	<.001	.8361	2.1411
	Street with large area of greenery/next to a park	Traffic-calming residential street	.21284	.28537	.737	-.4651	.8908
		Street inside City centre	1.70147*	.26367	<.001	1.0750	2.3279
	Street inside City centre	Traffic-calming residential street	-1.48864*	.27464	<.001	-2.1411	-.8361
		Street with large area of greenery/next to a park	-1.70147*	.26367	<.001	-2.3279	-1.0750

SOP_Sense of place	Traffic-calming residential street	Street with large area of greenery/next to a park	-.60750*	.17701	.002	-1.0281	-.1869
		Street inside City centre	.02557	.17036	.988	-.3792	.4303
	Street with large area of greenery/next to a park	Traffic-calming residential street	.60750*	.17701	.002	.1869	1.0281
		Street inside City centre	.63307*	.16356	<.001	.2445	1.0217
	Street inside City centre	Traffic-calming residential street	-.02557	.17036	.988	-.4303	.3792
		Street with large area of greenery/next to a park	-.63307*	.16356	<.001	-1.0217	-.2445
SOP1_Functional & cognitive SOP	Traffic-calming residential street	Street with large area of greenery/next to a park	-.76323*	.17779	<.001	-1.1856	-.3408
		Street inside City centre	-.06155	.17111	.931	-.4681	.3450
	Street with large area of greenery/next to a park	Traffic-calming residential street	.76323*	.17779	<.001	.3408	1.1856
		Street inside City centre	.70168*	.16428	<.001	.3114	1.0920
	Street inside City centre	Traffic-calming residential street	.06155	.17111	.931	-.3450	.4681
		Street with large area of greenery/next to a park	-.70168*	.16428	<.001	-1.0920	-.3114

SOP2_Affective SOP	Traffic-calming residential street	Street with large area of greenery/next to a park	-.37542	.23858	.261	-.9423	.1914
		Street inside City centre	.21733	.22961	.612	-.3282	.7629
	Street with large area of greenery/next to a park	Traffic-calming residential street	.37542	.23858	.261	-.1914	.9423
		Street inside City centre	.59275*	.22045	.022	.0690	1.1165
	Street inside City centre	Traffic-calming residential street	-.21733	.22961	.612	-.7629	.3282
		Street with large area of greenery/next to a park	-.59275*	.22045	.022	-1.1165	-.0690
SOP3_Behavioural SOP	Traffic-calming residential street	Street with large area of greenery/next to a park	-.60600*	.24088	.035	-1.1783	-.0337
		Street inside City centre	-.03551	.23182	.987	-.5863	.5153
	Street with large area of greenery/next to a park	Traffic-calming residential street	.60600*	.24088	.035	.0337	1.1783
		Street inside City centre	.57049*	.22257	.031	.0417	1.0993
	Street inside City centre	Traffic-calming residential street	.03551	.23182	.987	-.5153	.5863
		Street with large area of greenery/next to a park	-.57049*	.22257	.031	-1.0993	-.0417

SWB_Subjective well-being	Traffic-calming residential street	Street with large area of greenery/next to a park	-.20952	.20927	.578	-.7067	.2877
		Street inside City centre	.08949	.20140	.897	-.3890	.5680
	Street with large area of greenery/next to a park	Traffic-calming residential street	.20952	.20927	.578	-.2877	.7067
		Street inside City centre	.29901	.19336	.273	-.1604	.7584
	Street inside City centre	Traffic-calming residential street	-.08949	.20140	.897	-.5680	.3890
		Street with large area of greenery/next to a park	-.29901	.19336	.273	-.7584	.1604
SWB1_Emotional	Traffic-calming residential street	Street with large area of greenery/next to a park	.11233	.21931	.866	-.4087	.6334
		Street inside City centre	.47064	.21107	.071	-.0308	.9721
	Street with large area of greenery/next to a park	Traffic-calming residential street	-.11233	.21931	.866	-.6334	.4087
		Street inside City centre	.35831	.20264	.185	-.1231	.8398
	Street inside City centre	Traffic-calming residential street	-.47064	.21107	.071	-.9721	.0308
		Street with large area of greenery/next to a park	-.35831	.20264	.185	-.8398	.1231

SWB2_Social	Traffic-calming residential street	Street with large area of greenery/next to a park	-.45405	.25248	.175	-1.0539	.1458
		Street inside City centre	-.01364	.24299	.998	-.5909	.5637
	Street with large area of greenery/next to a park	Traffic-calming residential street	.45405	.25248	.175	-.1458	1.0539
		Street inside City centre	.44042	.23329	.147	-.1138	.9947
	Street inside City centre	Traffic-calming residential street	.01364	.24299	.998	-.5637	.5909
		Street with large area of greenery/next to a park	-.44042	.23329	.147	-.9947	.1138
SWB3_Psychological	Traffic-calming residential street	Street with large area of greenery/next to a park	-.16667	.22843	.746	-.7094	.3760
		Street inside City centre	-.01515	.21984	.997	-.5375	.5072
	Street with large area of greenery/next to a park	Traffic-calming residential street	.16667	.22843	.746	-.3760	.7094
		Street inside City centre	.15152	.21106	.753	-.3499	.6530
	Street inside City centre	Traffic-calming residential street	.01515	.21984	.997	-.5072	.5375
		Street with large area of greenery/next to a park	-.15152	.21106	.753	-.6530	.3499

*. The mean difference is significant at the 0.05 level.

7.7 Regression analysis QS, SOP & SWB

7.7.1 Regression analysis QS, SOP & SWB – Model summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.638[a]	.407	.402	.60625	1.760
2	.209[a]	.044	.035	.85329	2.144
3	.670	.448	.394	.60989	1.759
4	.426	.181	.101	.82368	2.096

7.7.2 Regression analysis QS, SOP & SWB – Regression coefficient

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	.838	.364		2.299	.023	1	(Constant)
	QS_Qualities of street	.791	.091	.638	8.728	<.001		QS_Qualities of street
2	(Constant)	3.186	.513		6.212	<.001	1	(Constant)
	QS_Qualities of street	.287	.128	.209	2.251	.026		QS_Qualities of street
3	(Constant)	.933	.429		2.176	.032	.082	1.783
	QS1_People choose to walk or cycle	.083	.066	.122	1.257	.212	-.048	.214
	QS2_Everyone feels welcome	.060	.092	.058	.654	.514	-.122	.243
	QS3_Easy to Cross	.224	.072	.296	3.111	.002	.081	.367

	QS4_People feel safe	-.042	.081	-.048	-.526	.600	-.203	.118
	QS5_Things to see and do	.236	.092	.262	2.579	.011	.054	.417
	QS6_Places to stop and rest	.059	.056	.097	1.044	.299	-.053	.170
	QS7_People feel relaxed	.055	.084	.064	.658	.512	-.111	.222
	QS8_Not too noisy	-.025	.051	-.045	-.490	.625	-.126	.076
	QS9_Clean air	.011	.064	.015	.170	.865	-.116	.138
	QS10_Shade and shelter	.099	.046	.178	2.142	.035	.007	.191
4	(Constant)	2.553	.579		4.409	<.001	1.404	3.701
	QS1_People choose to walk or cycle	-.130	.089	-.172	-1.454	.149	-.307	.047
	QS2_Everyone feels welcome	.149	.124	.130	1.199	.233	-.098	.395
	QS3_Easy to Cross	.160	.097	.192	1.651	.102	-.032	.353
	QS4_People feel safe	.074	.109	.076	.675	.501	-.143	.290
	QS5_Things to see and do	.339	.124	.340	2.745	.007	.094	.584
	QS6_Places to stop and rest	-.105	.076	-.156	-1.383	.170	-.255	.046
	QS7_People feel relaxed	-.228	.113	-.238	-2.012	.047	-.453	-.003
	QS8_Not too noisy	.040	.069	.066	.588	.558	-.096	.177
	QS9_Clean air	.040	.087	.050	.459	.647	-.132	.212
	QS10_Shade and shelter	.057	.062	.093	.920	.360	-.066	.181