How do spatial characteristics influence well-being and mental health? Comparing the effect of objective and subjective characteristics at different spatial scales

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A B S T R A C T

The impact of spatial characteristics on well-being has received increasing attention over the past decade. In most studies, however, the emphasis has been on either cognitive well-being (life satisfaction) or mental health. In addition, studies differ in terms of using objective or subjective characteristics, and in terms of the spatial scale of spatial variables (neighbourhood vs. the wider urban environment). This paper first discusses these differences from a theoretical point of view, and then compares model estimates based on different well-being conceptualisations and using objective and subjective spatial variables. To this end, a survey was held in the Utrecht province in the Netherlands that focused on this issue. We find that significant differences in cognitive and affective wellbeing and mental health are observed between neighbourhoods, which can be explained from both neighbourhood characteristics and personal characteristics of the inhabitants. We find that life satisfaction and affective well-being are more affected by subjective spatial variables, and mental health more by objective variables. In particular, life satisfaction and affective well-being are mostly affected by neighbourhood attractiveness and social safety, whereas mental health is positively associated with a newer housing stock. In general neighbourhood characteristics appear to have greater impact on different forms of well-being than accessibility variables on the urban level.

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1. Introduction

The past decades have seen a steady increase in the number of studies addressing the underlying factors of individuals' well-being and how individuals' well-being can be increased by interventions of public authorities, employers and schools (e.g., Dolan et al., 2008; Frey and Stutzer, 2010). Factors that have been found to influence individuals' well-being include personality traits, working status, age, household composition, social interactions, physical health status, engagement in meaningful activities and religion. Increasingly, also the residential and urban environment is receiving attention as a potential influential factor of well-being. According to Leyden et al. (2011), the neighbourhood and the city one lives in will influence individuals' well-being as they form the stage where one interacts with other individuals' to participate in social activities that contribute to happiness. Others (See Wang and Wang, 2015 for a review) have found that issues such as safety and accessibility, quality of urban facilities and exposure to

noise and air quality in urban areas may influence human flourishing and well-being.

Relevant studies (discussed in detail in Section 2) come from different domains, such as geography, land use and transportation studies, sociology and psychology. As a consequence, research approaches differ significantly in terms of spatial scale and measurement methods. The level of spatial resolution used in various studies ranges from whole cities (e.g., Leyden et al., 2011) to quality of the dwelling (Evans, 2003), with most studies focusing on the neighbourhood level. In addition, some studies (e.g., Morris, 2011) test the effect of objective neighbourhood characteristics and accessibility indicators on well-being, whereas others (e.g., Sirgy and Cornwell, 2002) investigate the impact of subjective evaluations of the urban environments on well-being. Finally, definitions of well-being and corresponding measurement scales differ between studies. Whereas many studies apply straightforward measures of self-reported well-being or happiness (e.g., Brereton et al., 2008), others have used more elaborate conceptualisations of subjective well-being (e.g., Delbosc and Currie, 2011) or focused also on mental health aspects (e.g., Van den Berg et al., 2010).

As a result, it is difficult to compare studies and draw conclusions about the impact of objective and subjective factors,

the spatial scale of influential factors and the implications for different specifications of well-being. The current study aims to add to the state of the art in this area by investigating the relationship between environmental characteristics and well-being based on a single data set, but using different definitions of well-being, comparing models based on objective and subjective urban characteristics, and using variables relating to both the immediate neighbourhood as well as the wider urban surroundings. The emphasis is on physical characteristics of neighbourhoods and urban areas, rather than on the social networks embedded in them, which we will use as a control variable measured in a more abstracted way.

By comparing various specifications, conclusions can be drawn regarding the impact of variables on different spatial scales and to what extent subjective evaluations have a different impact on well-being than objective characteristics. Analyses are carried out on data collected in the Utrecht region in The Netherlands in 2013.

The paper is organised as follows. Section 2 discusses theoretical issues with respect to the operationalisation of well-being, spatial scale and objective and subjective spatial factors. Section 3 describes the measurement tools and the survey. Section 4 discusses the data collection effort and sampling procedure. Section 5 presents descriptive results as well as multivariate models of well-being as a function of (amongst others) spatial variables. Section 6 draws conclusions regarding the findings and addresses avenues for further research.

2. Theory and state-of-the-art

2.1. Subjective well-being

According to Frey and Stutzer (2010), subjective well-being is a meaningful indicator to assess life conditions and the outcome of policies. Diener and Suh (1997) proposed that subjective well-being consists of three components: a cognitive judgment of satisfaction with life as a whole, positive affect (PA), and negative affect (NA). Life-satisfaction judgments are often measured using the 5-item *Satisfaction With Life Scale* (SWLS) (Diener et al., 1985), where five self-report statements (e.g., "I am satisfied with my life") are rated on 7-point Likert scales ranging from "totally disagree" to "totally agree". Life satisfaction is also measured by a single-item judgment such as Cantril's *Self-Anchoring Scale* that asks participants to rate their current life on a "ladder" from 0 "the worst possible life for you" to 10 "the best possible life for you" (Kahneman and Deaton, 2010). Although life satisfaction items may refer to feelings (e.g., 'I am content with my life', 'I would not change a thing'), the items tap a cognitive assessment of agreement with these items, rather than a direct question of how one feels, and are therefore considered cognitive measures.

The affective components (PA and NA) are assessed by different methods including instantaneous self-reports of specific emotions and moods (*Experience Sampling Method* (ESM), Stone et al., 1999) or recalled past emotions or moods (*Day Reconstruction Method* (DRM), Kahneman et al. 2004). Scales to measure positive and negative affect include the *Positive Affect and Negative Affect Scale* (PANAS, Watson et al., 1988) and the *Swedish Core Affect Scale* (SCAS, Västfjäll et al., 2002; Västfjäll and Gärling, 2007).

Mental health is a concept that is related (and sometimes equated) to well-being, but usually used in a more medical sense as the presence/absence of specific symptoms of mental disorders, such as stress and fear. As pointed out by Keyes (2006), absence of mental illness can be regarded as a necessary but not sufficient condition for psychological well-being, since life circumstances and events happening to mentally healthy individuals may lead to lower levels of well-being. Thus, mental health scales may miss

factors leading to deterioration of life circumstances for healthy people. On the other hand, mentally unhealthy individuals may be more sensitive to environmental factors such as age of buildings, presence of graffiti, amount of recreation area and unused buildings (Weich et al., 2002). Thus, the effects of neighbourhood characteristics on mental health may differ from the effects on cognitive or affective well-being. However, various mental health scales exist. Some scales, such as WEMWBS (Tennant et al., 2007), measure individuals' mental functioning in a way rather similar to cognitive well-being scales. Other scales, such as the K10 (Furukawa et al., 2003) or SCL (Strand et al., 2003) tap specific symptoms of mental illness such as anxiety and depression. In this paper we define mental health in term of the presence or absence of such symptoms.

2.2. Conceptualising well-being and urban environment

One approach in conceptualising the effect of the urban environment on well-being is to assume that overall life-satisfaction is affected by satisfaction with certain domains in life, such as one's family life or professional life (Sirgy and Wu, 2013). In a similar vein Sirgy and Cornwell (2002) found empirical support for the fact that life satisfaction is influenced by neighbourhood satisfaction and housing satisfaction, which are influenced by evaluations of specific characteristics such as upkeep of houses and yards, noise and crowding, perceived crime and experienced safety. McCrea et al. (2005) proposed a model in which life satisfaction is influenced by satisfaction with urban living, which in turn is influenced by community, neighbourhood and housing satisfaction. Cao (2015) empirically showed that life satisfaction is influenced by personal characteristics and residential satisfaction. Residential satisfaction is in turn influenced by accessibility and nuisance factors. Taken together, these studies suggest that the effect of urban environmental characteristics on well-being is channelled via the satisfaction with specific life domains. However, models confirming such hierarchical structures are based on the subjective assessment of overall life satisfaction and satisfaction with certain domains, making it difficult to disentangle the mutual causalities. For example, it is difficult to assess whether someone is more satisfied with her life because she is more satisfied with her neighbourhood, or whether she is more satisfied with her neighbourhood because she is happier with her life in general.

At the other end of the spectrum we find studies assuming that individual urban characteristics (e.g., distance to facilities, population density or upkeep of houses) bear a direct impact on life satisfaction. As discussed by Leyden et al. (2011) the urban environment may directly influence our daily functioning and our feelings about it, so that we can trade off the importance of the environmental factor (e.g., noise) against other factors influencing our well-being (Brereton et al., 2008), and even might be able to put a price tag on it. In the current paper we will adopt the latter approach to investigate the impact of neighbourhood and urban characteristics and assume that they can exert a direct effect on individuals' well-being.

2.3. Objective vs. subjective urban characteristics

An important distinction between studies of the impact of urban environments on well-being concerns the use of objective vs. subjective assessment of urban factors. Subjective evaluations involve assessments by respondents themselves of the quality of characteristics such as upkeep, safety, nearness of facilities and street lighting. Objective measurements are usually based on official statistics and land use data. Due to the different sources of these variables, their nature also differs. Subjective assessments are not respondents' estimate of a factual characteristic (e.g., population

density), but an evaluation of it (e.g., their experience of crowding). As a consequence, the subjective assessment is by definition biased towards one's preferences, and is therefore more likely to better predict subjective well-being.

In addition, there is a risk that the evaluation of urban characteristics is influenced by one's life satisfaction. That is to say, those who are happier in general may be more positive about specific aspects of their environment. As a consequence, one might expect subjective assessments of urban characteristics to be better predictors of well-being. Although our paper does not include a meta-analysis of the impact of urban characteristics on well-being, the studies we encountered are in line with this hypothesis. Sirgy and Cornwell (2002) explained 48% of observed variation in well-being using a model including only subjective assessment of urban characteristics and intermediate constructs as explanatory factors. McCrea et al. (2005) explained 23% of observed life satisfaction in a similar approach. Significant explanatory variables included respondents' satisfaction with regional costs and services, social interaction, transport facilities, crime and neighbourhood services, as well as housing characteristics.

Gandelman et al. (2012) used only objective factual land use data to explain life satisfaction in Uruguay. They found that access to electricity, running water, street lighting, absence of noise, together with income, explain 8% of variation in life satisfaction. Brereton et al. (2008) tested a large list of objective land use characteristics extracted with GIS to explain life satisfaction, and found that these explained 12% of variation in life satisfaction. Factors contributing to life satisfaction included not living in Dublin, proximity to landfill, coast and airport, voter turnout, and longer distance to main roads. Morris (2011) investigated how individuals' satisfaction with life depends on objective spatial factors, controlled for factors such as occupation, health and income. He concluded that the effect of residential setting on well-being is limited to access to rail transport, population density, neighbourhood safety and access to leisure facilities. However, as compared to income, occupational and household characteristics, characteristics of the neighbourhood were much less important to one's well-being.

Thus, the reviewed studies suggest that objective and subjective urban characteristics constitute fundamentally different concepts in terms of meaning and measurement. As a result, subjective measures can be expected to predict more of the variance in well-being in explanatory multivariate models. However, there is considerable uncertainty about the extent to which subjective assessments correspond with objective characteristics that may be influenced by policies and to what extent subjective assessments are at least partly an expression of the match between an individuals' preferences and the environment.

2.4. Spatial scale

A second dimension on which studies differ is the spatial scale at which spatial characteristics are measured. In the remainder we will distinguish between the scales of the neighbourhood and the accessibility and presence of facilities on the larger, urban scale, termed neighbourhood and urban characteristics respectively. Sirgy and Cornwell (2002) included only subjective neighbourhood characteristics in their model. Likewise, Gandelman et al.'s (2012) study included only spatial characteristics directly pertaining to the neighbourhood. Leyden et al. (2011) and Cloutier et al. (2014) compared life satisfaction of inhabitants of different cities as a function of subjective service variables of cities as a whole (including access to public transport) and the extent to which cities score well on sustainability indices.

McCrea et al. (2005) made a more deliberate distinction between factors at different spatial scales, ranging from the house to the city beyond the neighbourhood. Being one of few studies comparing the impact of spatial variables at different scales, they found that housing characteristics and urban characteristics (including transport) were considerably more important than neighbourhood characteristics in explaining life satisfaction. Arifwidodo and Perera (2011) also included spatial characteristics on different scales to explain life satisfaction and found that both perceived neighbourhood safety and accessibility of urban facilities influenced well-being. Cao (2015) used subjective characteristics pertaining to both the neighbourhood (e.g., presence of parks and open space, safe play facilities, crime rate) and the wider urban area (e.g., distance to work or the central city, distance to a mall) and found that both significantly influenced life satisfaction through the mediating constructs of accessibility and nuisance.

The importance of the urban factor is underpinned by studies of transport disadvantage and social exclusion which have emphasised the relationship between accessibility and well-being (Currie and Delbosc, 2010; Delbosc and Currie, 2011). These studies showed that transport disadvantage depends on the location of facilities (work, education, stores, care) and places for social interaction relative to the residence, and on the transport facilities (e.g., transit lines) connecting these locations.

Thus, existing work suggests that both neighbourhood and urban characteristics influence life satisfaction, although the relative impact of factors at different spatial scales differs between studies. These differences may be due to differences in geographical contexts, but also to differences in measurement (e.g., objective vs. subjective) and the choice of variables included. In addition, it is noted that sensitivity to characteristics at different spatial scales differs between individuals. Vallée et al. (2011) showed, for instance, that those with a smaller action space (i.e. having fewer mobility options and being more bound to the neighbourhood) were more influenced by neighbourhood characteristics.

2.5. Well-being measures

The majority of studies investigating the relationship between the urban environment and well-being have measured well-being in terms of cognitive SWB. More precisely, straightforward life satisfaction measures are commonly used (e.g., Sirgy and Cornwell, 2002; Brereton et al., 2008). Thus, it is assumed that characteristics of one's neighbourhood and facilities and amenities at the urban level influence one's conscious assessment of how good one's life is. This makes sense, since one may regard the neighbourhood one lives in and access to urban facilities as relevant indicators of how pleasant or successful one's life is. However, one may also argue that exposure to one's residential conditions (e.g., litter, well maintained parks, traffic jams) and use of facilities (e.g., theatres, sports facilities) may as well evoke direct emotional responses, which influence affective well-being. A limited literature in environmental psychology and favourite places (Isaacs, 2001; Van Hagen et al., 2008; Ettema & Smajic, 2015; Kytta, 2004) suggests, for instance, that architectural design and stimuli such as colour and light may influence one's mood. Hence, daily exposure to the residential environment is likely to also influence affective well-being. However, studies relating residential location to affective well-being are scarce. In a very specific application, Currie and Delbosc (2010) found that lack of accessibility of urban functions was associated with more frequent negative emotions. Schwanen and Wang (2014) investigated how activity participation in various places was related to affective well-being, but did not relate such emotional responses to the residential location. As mentioned by Wang and Wang (forthcoming), the impact of

neighbourhood and urban characteristics on affective well-being require more attention.

Also in research on mental health, the effects of residential location have been investigated. In general, it is found that mental health problems occur more frequently in urban settings (Verheij et al., 2008). This effect was attributed to the need for restoration that emerges in response to receiving many stimuli as part of an 'urban lifestyle', which can be met by exposure to green environments. In confirmation of this, Maas et al. (2006) found evidence that availability of green space (both in urban and rural areas) leads to lower frequency of mental health problems. However, a study by Van den Berg et al. (2010) found only marginally significant effects of green space. Another study into determinants of mental health (Araya et al., 2006) found that controlled for socio-demographic variables, the only neighbourhood characteristics that influenced mental health were social cohesion and trust. In an overview article of built environment influences on mental health, Evans (2003) mentioned factors related to the dwelling (such as floor level, crowding, housing quality, indoor air quality and lighting) as well as factors related to the neighbourhood. Factors with a negative impact on mental health included poor neighbourhood quality (signs of decay, abandoned houses) and traffic noise, whereas positive effects on mental health emerged from the presence of facilities for vulnerable inhabitants and places for restoration.

In conclusion, evidence exists that cognitive and affective well-being and mental health may all be influenced by neighbourhood and urban characteristics. However, the factors influencing each of them may be different in character.

3. Approach and methods

To investigate the relationship between neighbourhood and urban characteristics and well-being we combined survey data with objective data about neighbourhood characteristics obtained from the Netherlands Statistics Bureau (CBS). A survey was held among residents of neighbourhoods in the Utrecht region differing in spatial and accessibility characteristics and social composition. The survey asked respondents about the following concepts.

3.1. Well-being and mental health

Cognitive well-being was measured using the Satisfaction with Life Scale (SWLS) (Diener et al., 1985), which is considered to be one of the standard scales in this domain. The SWLS consists of 5 items, which are rated on a 1–7 scale, implying that scores theoretically vary between 7 and 35. Scores between 5 and 9 indicate that the respondent is extremely dissatisfied with life, whereas scores ranging between 31 and 35 indicate that the respondent is extremely satisfied with life. Scores between 21 and 25 represent slightly satisfied, and scores from 15 to 19 are interpreted as falling in the slightly dissatisfied range.

Affective well-being was measured using the Scale of Positive And Negative Experience (SPANE) (Diener et al., 2010). SPANE is a 12 item scale that includes general feelings and emotions (including low arousal but important feelings, such as being contented) that cover the full emotional spectrum and give a reliable estimate of affective well-being. In addition, it weights feelings by their relative duration which is considered to be more realistic than focusing on intensity of feelings. SPANE consists of 6 items measuring positive affect and six items measuring negative affect, which are balanced by subtracting the negative scores from the positive scores. Since all items are measured on a 1–5 scale, SPANE stretches between −24 and 24, with 24 representing someone who only experiences positive emotions at all times.

To measure mental health, we used the SCL-10 (Strand et al., 2003), which includes 10 items on a 1–4 scale specifically asking for symptoms of mental disorder such as faintness, problems falling asleep, hopelessness, feeling tensed or afraid. The average over these items is then computed. This scale contrasts the well-being scales, which focus on more neutral feelings and assessment of quality of life. We preferred SCL over scales like WEMWBS (Tennant et al., 2007), which focuses on mental well-being using more general items that bear resemblance to the cognitive and affective well-being scales. Since the SCL-10 measures the extent to which one experiences symptoms of mental malfunctioning, a higher score means greater mental distress. Mentally healthy people will score under 1.85, whereas higher scores indicate mental problems.

3.2. Physical neighbourhood characteristics

Neighbourhood characteristics were measured as subjective evaluations, implying that scores may differ between individuals in the same neighbourhood, for instance depending on their circumstances and needs. Based on the literature review, neighbourhood characteristics included the presence of facilities in the neighbourhood (stores, schools, health facilities, green space) and the location of the neighbourhood relative to transportation systems (road and public transport) and higher level facilities and work opportunities outside the neighbourhood. A set of 37 items, based on previous studies, was used to tap evaluations of neigh-

Table 1
Factors obtained for subjective and objective spatial variables.

	% Explained variance
Subjective factors	
Attractiveness	12.4
Facilities and public space	9.6
Accessibility	8.3
Traffic safety	6.6
Car accessibility	6.4
Social safety	6.0
Schools	5.7
Nuisance	5.4
Cleanliness	4.6
Total	64.9
Objective factors	
Socio-demographic composition of the postcode	
Many families with young children	30.1
Many non-western immigrants	25.1
Many elderly	25.0
Many divorced and non-western	11.6
Total	91.8
Composition of housing types, tenure and age of housing	
Many cheap rented multifamily dwellings	36.4
Many empty dwellings	23.2
Many new dwellings	16.4
Much commercial renting	14.7
Total	90.7
Income distribution in the postcode area	
Low income	83.1
Presence of firms in the postcode area	
Many firms	79.1
Accessibility of urban facilities (distance to the nearest facility)	
Basic facilities (shops, healthcare, kindergarten)	29.2
Urban amenities (theatre, cinema, stores, restaurants)	23.3
Medical/educational facilities	18.0
Rail access	9.9
Child care	8.5
Total	8.8

bourhood quality, amenities, safety, upkeep and accessibility. Respondents indicated on a 1–5 scale to what extent they agreed with descriptions of their neighbourhood. A principal component analysis, applying Varimax rotation, was used to reduce the set of items to 9 factors (see Appendix 1 and Table 1).

3.3. Social support in the neighbourhood and social network

To tap to what extent people experience social cohesion and access to social support, they were asked to indicate to what extent they agreed on a 1–5 scale with the following statements about social support in their neighbourhood:

1. In case of practical problems I can count on neighbours or people in the neighbourhood;
2. In case of personal problems I can count on neighbours or people in the neighbourhood.

To measure interaction with one's social network in general respondents were asked how many friends and family members they meet at least once per week.

3.4. Standard personal characteristics

This list included age, gender, household composition, education level, tenure, health, car ownership, working status. Health was measured as a single item self-assessment of one's physical health on a 10 point scale ranging from very unhealthy to very healthy.

3.5. Objective spatial characteristics

The survey data was enriched with data obtained from CBS (2015). Per postcode area, data were obtained regarding:

a. Socio-demographic composition of the postcode.
b. Composition of housing types, tenure and age of housing.
c. Income distribution in the postcode area.
d. Presence of firms in the postcode area.
e. Accessibility of urban facilities, measured in distance to the nearest facility.

To obtain a manageable number of variables, factor analyses (principal component analyses with Varimax rotation) were carried out on variables in each class, resulting in 15 factors in total, which indicate objective neighbourhood and accessibility characteristics. Appendices 1–5 summarise the factor analyses as well as their more substantive interpretation. Factors are summarised in Table 1.

To test to what extent subjective and objective characteristics of the neighbourhood and the wider environment influence well-being and mental health in addition to other personal characteristics, hierarchical regression models were estimated. Starting from a model in which well-being or mental health was explained by only personal characteristics and social support of the neighbourhood, subjective or objective neighbourhood characteristics were added stepwise. In case objective variables were added, there occasionally occurred high correlations between neighbourhood characteristics. Therefore, variables were added stepwise, retaining only significant variables (if any). This procedure provides insight in the relative increase in the goodness-of-fit (adjusted R^2) of specific types of variables and therefore their importance in explaining well-being or mental health. It is recognised that the subjects are clustered in a limited number of neighbourhoods, which might lead to correlations between the error terms of individuals living in the same neighbourhood. To test for this, we performed fixed effects multilevel regressions. These revealed that the neighbourhood level error component was by no means significant in any of the models. Therefore, we present the results of linear regression models.

4. Data collection

Data was collected using an online survey. Non-personalised letters with an invitation to participate and a link to the questionnaire were sent by regular mail to random addresses in the study area in June 2013, inviting the household head with the soonest birthday to fill out the questionnaire. The invitation letter was distributed in 5 areas in the city of Utrecht (316,725 inh.): the central city area (with a high density and good access to urban amenities), Overvecht and Zuid-Oost (areas with lower levels of mental health according to an earlier study by the municipality), Oost (a high income, lower density neighbourhood with more green space) and Leidsche Rijn (a recently built area with high quality housing but on greater distance of urban amenities. In addition, invitations were sent to random addresses in three other municipalities: Zeist (61,235 inh.), a lower density municipality adjacent to Utrecht, but more spacious and with access to green space, and Doorn (9935 inh.) and Maarn (5890 inh.), which are smaller municipalities more remote to urban amenities in Utrecht, but situated in a very green environment and with low population density. The questionnaire was sent to 3541 addresses in the chosen neighbourhoods in Utrecht (593 in central city area, 672 in Leidsche Rijn, 632 in Oost, 819 in Overvecht and 825 in Zuidwest) and has further been sent to 567 addresses in Zeist, 439 in Doorn and 204 in Maarn. 212 letters were returned since they could not be delivered. Eventually 258 questionnaires were returned leading to a response rate of 7.8%. This low response rate can partially be explained from a technical problem that occurred in the web questionnaire, preventing some from filling out the questionnaire. There was no information that this problem occurred more frequently for specific groups in specific areas. After correction for missing values 226 questionnaires were used for analysis.

Sample characteristics and population characteristics (if available) are summarised in Table 2. These suggest that the sample consists of 53.5% males and 46.5% females. This differs from gender distribution of the population which includes 48.8% males and 51.2% females. All age categories are well represented, with the largest category (41.9%) being between 45 and 64 years. This category is overrepresented compared to the population, whereas those younger than 25 are underrepresented. Respondents are also well distributed across municipalities and neighbourhoods, suggestion sufficient variation in neighbourhood characteristics and accessibility profiles. As compared to the population, we find that our sample contains more home owners (66.4% against 45.0% in the population), and includes fewer individuals living alone (36.1% against 46.1% in the population). In terms of education level, the sample seems to be skewed towards higher educated levels.

5. Results

5.1. Descriptive results

Descriptives of well-being indices are summarised in Table 3. The average levels of well-being and mental health suggest that the sample has a reasonable level of well-being and mental health, given the theoretical minima and maxima. Also there is a fair amount of variation in each indicator. The average SWLS score suggests a life satisfaction between slightly and extremely satisfied. The SCL-10 score of 1.46 suggest that on average, respondents fall clearly below the critical threshold of 1.85. Correlations between the indices are high and range (in absolute sense) between 0.55

Table 2
Sample characteristics.

	Sample (%)	Population (%)
Gender		
Female	46.5	51.2
Male	53.5	48.8
Age		
<15		
15–24	4.3	17.2
24–44	34.0	36.9
45–64	41.9	28.3
65	19.8	17.6
Area		
Binnenstad	16.1	11.5
Zuidwest	14.1	16.9
Overvecht	10.4	17.3
Oost	19.3	18.3
Leidsche Rijn	10.8	12.5
Zeist	13.3	16.3
Doorn	9.6	4.6
Maarn	6.4	2.6
Education		
Higher vocational	33.7	
University	43.9	
Other (lower)	22.4	
Tenure		
Renter	33.6	55.0
Owner	66.4	45.0
Household composition		
Single	36.1	46.1
Single parent	3.1	
Couple without children	38.4	
Couple with children	19.2	
Other	3.2	
Social contacts		
Number of family contacted > once a week	3.97	
Number of friends contacted > once a week	4.67	
Social support from neighbourhood		
Can rely on n'hood members for practical problems (1–5)	3.33	
Can rely on n'hood for personal problems (1–5)	2.82	
Car access and driver's license		
Has access to a car	72.5	
Has driver's license	91.5	
Work status		
Part time	27.6	
Full time	36.2	

Table 3
Descriptives of well-being indicators.

	Mean	Standard deviation	Cronbach's alpha	Correlations	
				SPANE	SCL-10
SWLS	26.14	5.56	0.82	0.72	−0.55
SPANE	9.33	5.84	0.81		−0.66
SCL-10	1.46	0.41	0.88		

and 0.72. This is as expected, but at the same time suggests that they are not identical and may respond differently to neighbourhood characteristics.

Descriptives of well-being indices and neighbourhood assessments per neighbourhood are summarised in Table 4. The results suggest that there are significant differences between the various study areas in terms of cognitive well-being (SWLS). Cognitive well-being is lowest in Overvecht, a relatively deprived neighbourhood, and highest in Zeist, which is more affluent and with good access to both urban and green facilities. Affective well-being (SPANE), which represents emotional experience, shows a

comparable pattern, with Overvecht showing lowest affective well-being and Zeist, Leidsche Rijn and Maarn showing the highest levels. However, the differences are not significant at $\alpha = 0.05$ according to an ANOVA. This is due to the relatively larger variance in affective well-being, which is in accordance with the literature stating that cognitive well-being is more stable and less affected by incidental experiences (in this case during the past 4 weeks) (Xu & Schwartz, 2009). Regarding mental health, Table 4 suggests again a similar pattern, with mental health problems being more prevalent in Overvecht, and least common in Leidsche Rijn. The difference between areas is significant at $\alpha = 0.01$. However, all areas score on average well under the critical threshold value of 1.85.

Regarding the evaluations of neighbourhood characteristics, we find that attractiveness is rated highest in rural municipalities such as Doorn and Maarn, and lowest in relatively deprived neighbourhoods such as Zuidwest and Overvecht. It is noted that attractiveness is an indicator of neighbourhood quality, based on items regarding upkeep, vandalism, trust and the extent to which the neighbourhood meets one's demands. The latter is considered an expression of the extent to which the respondent appreciates his/her neighbourhood in a general sense.

Presence of facilities is rated highest in urban locations such as the Utrecht inner city and Overvecht, and lowest in the rural village of Maarn and new town Leidsche Rijn. With respect to overall accessibility and traffic safety, some differences are observed, but these do not turn out to be significant at $\alpha = 0.05$. Car accessibility is higher in rural municipalities and a suburb like Leidsche Rijn, but also in the Utrecht neighbourhoods Zuid-West. Logically, car accessibility is lowest in the Utrecht inner city. Social safety is highest in the Utrecht inner city, new town Leidsche Rijn, and lowest in the deprived neighbourhood Overvecht. However, also the rural municipalities Doorn and Maarn score below average. No significant differences are found in the evaluation of availability of schools. Regarding nuisance, we find that this is more experienced in urban settings (Binnenstad, Zuid-West, Overvecht) than in suburban or rural settings. Finally, the inner city and the urban neighbourhood Overvecht are evaluated as less clean, whereas new town Leidsche Rijn is considered cleanest.

Taken together, the results suggest significant difference in well-being levels (cognitive affective and mental health) between neighbourhoods and cities. These differences are intuitively plausible in terms that more affluent neighbourhoods display higher levels of well-being, more deprived areas show lower well-being levels. In addition, greener and less urban areas seem to display higher well-being levels. However, given the differences between neighbourhoods in well-being and in evaluation of neighbourhood characteristics, the question remains to what extent differences in well-being can be explained from differences in objective and subjective neighbourhood characteristics and from individual differences. This issue is addressed in Section 5.2.

5.2. Regression analyses

5.2.1. SWLS

The regression analyses (Table 5) suggest that various socio-demographic variables influence life satisfaction. In particular, women and higher educated subjects have a higher life satisfaction. In line with the literature we also find that life satisfaction increases with physical health, which is highly significant. Those living in a rental dwelling have a lower life satisfaction than those who own their house. This may be related to the fact that owned houses are usually larger and of higher quality than rented houses. It may also reflect a sense of independence and success associated with owning one's house. In addition, it is found that full time workers report a higher life satisfaction than part time workers or non-workers. None of the variables related to the social

Table 4
Well-being, neighbourhood evaluations and objective characteristics by area.

	Binnenstad	Zuid-West	Overvecht	Oost	Leidsche Rijn	Zeist	Doorn	Maarn	Total	Sign.
Well-being indicators										
SWLS	25.08	25.66	22.96	26.35	27.11	28.06	26.75	27.31	26.10	0.025
SPANE	8.63	9.40	7.00	9.54	10.85	10.15	9.42	10.31	9.37	0.366
SCL10	1.38	1.49	1.69	1.51	1.25	1.46	1.50	1.43	1.46	0.010
Subjective neighbourhood evaluations										
Attractiveness	0.11	−1.09	−0.86	0.28	0.09	0.30	0.72	0.84	0.01	0.00
Facilities and public space	0.43	0.10	0.29	0.02	−0.67	0.03	−0.02	−1.00	−0.02	0.00
Accessibility	0.09	0.33	−0.04	−0.01	−0.36	−0.02	−0.18	0.00	−0.01	0.37
Traffic safety	0.10	0.22	−0.27	0.01	−0.05	−0.19	0.05	0.03	0.00	0.69
Car accessibility	−1.10	0.05	0.72	−0.26	0.30	0.06	0.48	0.70	−0.01	0.00
Social safety	0.15	−0.13	−0.69	0.16	0.32	0.10	−0.14	−0.19	−0.01	0.01
Schools	0.36	−0.21	−0.01	0.01	−0.12	0.11	0.00	−0.55	0.00	0.14
Nuisance	−0.34	0.07	−0.20	−0.13	0.16	0.34	0.44	−0.22	−0.01	0.02
Cleanliness	−0.46	0.19	−0.27	0.11	0.81	−0.20	0.00	−0.03	0.01	0.00
Objective spatial characteristics										
Socio-demographic composition										
Families with young children	−1.36	−0.32	−0.09	−0.67	1.86	0.55	0.37	0.88	−0.04	0.00
Non-western immigrants	−0.44	0.84	1.94	−0.42	0.70	−0.49	−0.79	−1.17	0.03	0.00
Elderly	−0.67	0.02	0.41	−0.53	−1.48	0.68	1.54	1.05	−0.02	0.00
Divorced and non-western	0.37	0.05	0.84	−0.76	−0.51	0.25	−0.14	0.49	0.00	0.00
Housing composition										
Cheap rented multi family	0.64	0.67	1.63	−0.12	−0.46	−0.75	−0.92	−0.99	0.05	0.00
Many empty dwellings	0.18	−0.32	−0.30	−0.45	−0.33	−0.54	0.81	2.87	0.02	0.00
New dwellings	−0.40	0.00	−0.36	−0.36	2.67	−0.36	−0.32	−0.54	0.01	0.00
Commercial renting	1.35	−0.05	−1.33	0.71	−0.29	−0.34	−0.57	−0.61	0.04	0.00
Income distribution										
Low income	0.15	0.32	1.56	−0.21	−1.33	−0.77	−0.45	−0.23	0.04	0.00
Presence of firms										
Many firms	0.03	0.29	−0.64	0.25	−0.37	−0.29	−0.77	−0.37	−0.15	0.00
Distance to facilities										
Basic facilities (shops, healthcare, kindergarten)	−0.28	−0.33	−0.45	−0.40	−0.70	−0.41	2.51	1.36	−0.02	0.00
Urban amenities (theatre, cinema, stores, restaurants)	−1.04	−0.64	−0.02	−0.45	2.31	0.37	0.42	0.42	−0.01	0.00
Medical/educational facilities	0.13	0.15	−0.77	−0.74	−0.25	0.40	−0.95	2.48	−0.09	0.00
Rail access	−0.65	−0.03	1.59	0.45	−0.52	−1.09	−0.45	1.29	−0.02	0.00
Child care	−0.66	−0.34	−0.51	0.42	−0.93	1.44	0.35	−1.33	−0.09	0.00

structure of the neighbourhood or the social network is found to have a significant effect on satisfaction with life. This finding is in contrast with earlier studies, that found that contacts with family members, friends and neighbours add to one's wellbeing (Ryan and Deci, 2000). In bivariate analyses, we find that contacts with friends and being able to rely on neighbours and other in the neighbourhood are positively correlated to well-being. Apparently, these factors are confounded with personal characteristics.

With respect to objective neighbourhood and urban characteristics, we find that life satisfaction increases with increasing distance to urban amenities such as department stores, bars and restaurants, cinemas and theatres. Although visiting such facilities in itself may be a pleasant experience, living close to them may have negative effects due to crowding or nuisance of visitors of these amenities at inconvenient times. This finding mirrors findings of mental health studies (Verheij et al., 2008) that mental problems occur more often in urban settings and similar outcomes in life satisfaction studies (Berry and Okulicz-Kozaryn, 2011) suggesting that those in denser urban settings report lower life satisfaction.

This effect was not reported in the studies summarised in Section 2 that reported positive effects of access to rail infrastructure and leisure facilities, safety indicators, street lighting, nearness to sea and landfills on life satisfaction. This suggests at least that the effects of objective neighbourhood and accessibility indicators is context specific. For some points (e.g., street lighting), it is easy to see that they may be distinctive in one context (Uruguay) but not in another (Utrecht region).

Finally, when adding subjective neighbourhood characteristics to the model, we find that neighbourhood attractiveness and social safety positively add to life satisfaction, and that traffic safety has a marginally positive effect. Looking at the increase in goodness-of-fit, these factors exert a considerable effect on life satisfaction. Note that after adding subjective spatial characteristics, the objective distance to urban amenities becomes insignificant. This suggests that this factor is mediated by subjective attractiveness and social safety, and that locations further away from urban amenities are more attractive and safer. Similar to the effect of tenure, living in an attractive neighbourhood may be associated to social status, being successful and achieving one's goals, which all benefit to satisfaction with life. However, also the fact of enjoying the appearance of the neighbourhood and experiencing trust in others, may add to life satisfaction. Social safety is likely related to a feeling of independence and autonomy, which has been found to be beneficial for well-being (Ryan and Deci, 2000). Notably, and in contrast with earlier studies, factors related to facilities and accessibility do not turn out to significantly affect life satisfaction. Likewise, nuisances and cleanliness did not affect life satisfaction. This may be an indication that although these assessments differ between areas (see Table 4), this variation is not such that it impacts on life satisfaction.

5.2.2. SPANE

Affective well-being, as measured with SPANE, is affected by a few socio-demographic characteristics (see Table 5). It is found that a better physical health leads to a higher affective

Table 5

Results of regression models.

	Life satisfaction (SWLS)						Affective well-being (SPANE)						Mental health (SCL-10)					
	Coeff.	p	Coeff.	p	Coeff.	p	Coeff.	p	Coeff.	p	Coeff.	p	Coeff.	p	Coeff.	p	Coeff.	p
Constant	14.61	0.00	13.31	0.00	15.93	0.00	−5.65	0.03	−5.60	0.03	−2.83	0.29	2.39	0.00	2.39	0.00	2.29	0.00
Sociodemographics																		
Age (ref: > 60)																		
Age < 35	0.09	0.94	−0.23	0.85	0.33	0.79	1.46	0.28	1.02	0.45	1.75	0.21	−0.01	0.89	0.04	0.71	−0.01	0.92
Age 35–60	−1.48	0.10	−1.66	0.06	−1.10	0.22	−1.14	0.25	−1.39	0.16	−0.76	0.45	0.10	0.17	0.12	0.09	0.10	0.17
Rental dwelling	−1.95	0.01	−1.83	0.02	−1.54	0.04	−0.05	0.96	0.11	0.90	0.43	0.62	0.09	0.14	0.07	0.25	0.06	0.37
Physical health	0.95	0.00	0.97	0.00	0.74	0.00	0.99	0.00	1.01	0.00	0.78	0.00	−0.09	0.00	−0.09	0.00	−0.08	0.00
Male	−1.61	0.02	−1.72	0.01	−1.85	0.01	−0.85	0.27	−1.02	0.19	−1.22	0.11	−0.06	0.26	−0.04	0.51	−0.02	0.72
Owning a car	0.91	0.32	0.77	0.40	0.85	0.33	1.46	0.15	1.26	0.21	1.44	0.15	−0.03	0.68	−0.02	0.77	−0.05	0.52
Drivers license	1.79	0.17	1.98	0.13	2.25	0.08	0.84	0.56	1.11	0.44	1.40	0.32	−0.16	0.13	−0.18	0.09	−0.20	0.06
Education (ref: lower levels)																		
Higher vocational	1.77	0.05	1.70	0.06	1.15	0.20	1.79	0.08	1.69	0.10	1.11	0.28	−0.03	0.71	−0.02	0.82	0.01	0.88
University degree	2.31	0.01	2.39	0.01	1.69	0.06	1.25	0.21	1.36	0.16	0.56	0.57	−0.03	0.64	−0.03	0.67	0.01	0.87
Working status (ref: not working)																		
Full time working	2.02	0.04	1.94	0.05	1.84	0.06	1.59	0.14	1.48	0.17	1.23	0.26	−0.09	0.24	−0.08	0.33	−0.05	0.53
Part time working	0.69	0.46	0.52	0.58	0.42	0.65	0.47	0.66	0.23	0.83	0.07	0.95	−0.07	0.35	−0.05	0.47	−0.06	0.46
Single	−1.27	0.07	−1.19	0.08	−1.33	0.05	−0.85	0.27	−0.75	0.33	−0.87	0.25	0.08	0.17	0.08	0.14	0.08	0.15
Social context																		
# Family contacts	0.13	0.39	0.10	0.51	0.12	0.40	0.19	0.26	0.15	0.38	0.19	0.25	0.00	0.89	0.00	1.00	−0.01	0.60
# Friends contact	0.20	0.09	0.23	0.05	0.26	0.04	0.25	0.06	0.30	0.03	0.30	0.04	−0.01	0.37	−0.01	0.17	−0.01	0.47
Help with practical problems	0.11	0.84	0.13	0.80	−0.25	0.62	0.23	0.68	0.26	0.64	−0.13	0.81	0.03	0.42	0.03	0.52	0.04	0.36
Help with personal problems	0.64	0.17	0.59	0.20	0.60	0.19	0.80	0.12	0.73	0.16	0.74	0.15	−0.07	0.09	−0.06	0.12	−0.05	0.18
Objective spatial factors																		
Distance to urban amenities			0.56	0.08	0.45	0.24			0.77	0.03	0.59	0.18						
New housing stock															−0.07	0.00	−0.08	0.01
Subjective spatial factors																		
Attractiveness					1.06	0.00					1.10	0.01					−0.05	0.10
Facilities and public space					0.37	0.26					0.34	0.36					0.01	0.85
Accessibility					0.32	0.30					0.04	0.91					0.02	0.37
Traffic safety					0.56	0.07					0.62	0.08					−0.02	0.38
Car accessibility					0.34	0.30					0.29	0.44					0.02	0.38
Social safety					0.81	0.01					1.06	0.00					−0.05	0.09
Schools					0.36	0.24					0.18	0.60					−0.02	0.47
Nuisance					−0.21	0.50					−0.13	0.70					−0.03	0.25
Cleanliness					0.28	0.38					0.26	0.48					0.04	0.18
R^2	0.360		0.366		0.411		0.261		0.274		0.315		0.206		0.234		0.243	

well-being. Also, people with a higher vocational education report a higher affective well-being, but this effect is only marginally significant. Regarding social network and social interaction variables, it turns out that having more regular friends leads to better affective well-being (at $\alpha = 0.06$). Assuming that meeting friends is a pleasant activity that improves mood, it is logical that this has a direct effect on affective well-being, although the effect is not seen for cognitive well-being (life satisfaction) which is a more reasoned assessment of circumstances rather than of experiences or mood.

When adding objective neighbourhood and accessibility indicators to the model, it turns out that only one factor influences affective well-being. As for life satisfaction, affective well-being increases with increasing distance to urban amenities, suggesting that nearness to these amenities (bars, restaurants, stores, cinemas, theatres) invokes negative emotional responses. Again, this is in line with findings in the domain of mental health and well-being studies in general.

When adding the subjective physical neighbourhood characteristics, the estimation results indicate that neighbourhood attractiveness and social safety have a positive effect on affective well-being, and that traffic safety has a marginally positive effect. Also in this case does the increase in goodness-of-fit suggest that subjective neighbourhood characteristics have a considerable effect on well-being. The effect of the objective distance to urban amenities becomes insignificant, suggesting that also for affective well-being, this factor is mediated by subjective spatial characteristics. Thus, locations further away from urban amenities are probably more attractive and offer higher social and traffic safety. The positive effect of subjective neighbourhood attractiveness suggests that a better neighbourhood indeed leads to better experiences (aesthetics, trust) which invoke more positive emotions. In a similar vein, experiencing social safety is likely to avoid negative emotions and therefore lead to improved affective well-being. Also, a better traffic safety leads to a better affective well-being by avoiding dangerous events which cause negative emotions.

5.2.3. SCL-10

The regression models (see Table 5) suggest that none of the socio-demographic variables has a significant effect on having mental problems. Thus, mental health problems are equally likely to appear among people of different age, gender and education level. Only physical health has a strong and significant effect. Logically, a better health is associated with fewer mental problems. Physical health problems may lead to feelings of anxiety, stress and uncertainty that are indicators of mental health problems. Regarding indicators of social network and social structure of the neighbourhood, we find that if one can rely on neighbours for help with personal problems, this diminishes mental health problems, but the effect is only marginally significant. This seems a logical outcome, since being able to talk about one's problems may help to relieve them.

Adding objective neighbourhood characteristics to the equation, we find that living in a neighbourhood with more new dwellings (i.e. built after 2000), is associated with fewer mental health problems. While we may not rule out the option that differences in architectural style (e.g., more adventurous (post)-modern styles vs. monotonic post-war architecture) or difference in upkeep (older houses being more likely to be worn down) influence people's mental health, the causality may also be reversed. It might be the case that vulnerable groups suffering from mental health problems are more likely to end up in older, less attractive neighbourhoods.

Finally, when adding subjective neighbourhood evaluations, we find that neighbourhood attractiveness and social safety have only a marginally significant positive effect on mental health. The effect of subjective factors on mental health is less than the effect of

objective age of the neighbourhood, as indicated by the increase in goodness-of-fit.

6. Conclusion

In this paper we have tested the impact of objective and subjective spatial characteristics on different conceptualisations of well-being, controlled for socio-demographic characteristics of subjects, their health status, and social connections inside and outside the neighbourhood. We find that physical health is a key influence on satisfaction with life, affective well-being and mental health. The effects of socio-demographics we find are mostly in line with outcomes reported by other authors. It is noted, though, that according to our models, mental health is not influenced by socio-demographics.

In addition, we find that social context influences well-being, although differently for different forms of well-being. While not affecting life satisfaction, meeting friends has a positive effect on affective well-being, which can be understood from the positive emotions it invokes. If one can rely on neighbours for personal problems, this diminishes mental health problems as measured by the SCL10. Since SCL10 focuses, other than SPANE, only on negative emotions, it is logical that it is affected by circumstances that relieve these negative emotions. This finding confirms outcomes of earlier studies that stated that social cohesion had a significant impact on mental health (Araya et al., 2006). It also implies that social cohesion in neighbourhoods is important for well-being, especially of vulnerable groups amongst whom mental problems occur more frequently.

We find that, in line with the literature we encountered, subjective spatial characteristics have a greater impact on well-being than objective spatial characteristics for life satisfaction and affective well-being, as indicated by the increase in the goodness-of-fit of the models. As mentioned before, this may be due to the fact that subjective evaluations already account for the match between the individual and her environment or the reversed causality by which those with higher well-being levels are more positive about their environment. Further research into these relationships is necessary and may have implications for the way subjective factors are used to inform policy makers. If the above mechanisms would hold, this would imply that subjective assessments would overestimate the effect of changes in the environment on inhabitants' well-being, and that objective indicators would give a more reliable indication of the effect of policies. However, we find that mental health is explained to a lesser extent by subjective variables, suggesting that factors explaining different types of well-being may differ considerably. Another conclusion is that while the objective characteristics we tested had little impact on well-being, there may be objective characteristics that have an effect. For instance, more detailed characteristics related to design and upkeep may be extracted from street plans, databases of outdoor furniture and green facilities or systematic inventories using checklists. Creating such datasets is time intensive, but may reveal more concrete indicators of what urban environments foster well-being.

Regarding spatial scale, our study finds that neighbourhood characteristics exert a stronger influence on well-being than accessibility of urban facilities. The nearness of urban amenities that influenced life satisfaction and affective well-being is regarded as an indicator of nuisance rather than indicating a lack of access in certain areas. With respect to physical neighbourhood characteristics, we find that all types of well-being are affected in the same direction by neighbourhood attractiveness and social safety. Apparently, attractive and safe neighbourhoods diminish mental problems (although marginally significant) and negative emotions,

Appendix 1
Factor analysis of subjective neighbourhood characteristics.

	Attractiveness	Facilities and public space	Accessibility	Traffic safety	Car accessibility	Social safety	Schools	Nuisance	Cleanliness
Neighbourhood meets requirements	0.652								
Neighbourhood is quiet	0.741								
Neighbourhood looks attractive	0.809								
Houses are well maintained	0.664								
There is no vandalism	0.521								
I trust the people in my neighbourhood	0.756								
There are sufficient shops for daily use		0.794							
There sufficient non-daily shops		0.752							
There is a health centre		0.556							
There are enough other facilities		0.687							
There are enough bars/restaurants		0.586							
There is enough public space		0.668							
Neighbourhood is accessible by public transport			0.626						
Neighbourhood is accessible by bicycle			0.774						
Neighbourhood is accessible on foot			0.795						
City centre is well accessible			0.640						
Work location is well accessible			0.598						
Traffic in neighbourhood is safe				0.740					
Traffic is safe for cyclists				0.786					
Traffic is safe for pedestrians				0.696					
Neighbourhood is accessible by car					0.671				
There is sufficient parking space					0.668				
There is enough green space					0.553				
Sufficient street lighting						0.533			
I am not afraid to go out by myself at night						0.738			
It is safe to cycle in the dark						0.789			
There are sufficient elementary schools							0.894		
There are sufficient secondary schools							0.898		
There is no noise nuisance from traffic								0.844	
There is no nuisance from air pollution								0.830	
There is no graffiti									0.663
There is no litter									0.606
Nuisance of other residents									
There are enough play gardens									
Children can play safely									
There is a small chance of burglary									
There are many people in the street									
Explained variance (%)	12.4	9.6	8.3	6.6	6.4	6.0	5.7	5.4	4.6

Factor loading < 0.5 are not displayed.

evoke positive emotions and lead to better conscious evaluation of life circumstances. The increases in goodness-of-fit of the models suggest that this effect is substantial. These findings are in line with studies by Cao (2015) and Morris (2011), who also found safety and attractiveness to be determinants of life satisfaction. Since trust is one of the components of the attractiveness factor, it also confirms findings in mental health research, that trust is a determinant of mental health. Obviously, one can debate the causality of these relationships. While studies in environmental psychology (e.g., Clark & Uzzel, 2002) have demonstrated the impact of the environment on affect and stress, it may also be the case that those with a higher life satisfaction (which is correlated with affective well-being and the absence of mental problems) due to a higher education and a higher income are more likely to be able to afford living in attractive neighbourhoods. This process has been described as selective migration theory (Verheij et al., 2008) in the context of mental health.

In our sample, the land-use transport system did not appear to be a limiting factor, given that accessibility characteristics of the residential neighbourhood (with the exception of distance to urban amenities) did not influence well-being. In different contexts, where urban sprawl is combined with poor public transport options, or where people face excessive commute times, this may however become a problem (Delbosc and Currie, 2011; Stutzer and Frey, 2008). Our study does not confirm earlier findings about the positive effect of green space on mental health. In the factor analysis, the variable greenspace loaded on the same factor with parking space and car accessibility, which may have hidden its effect. However, also when availability of green space was tested as an independent variable in a separate analysis (nor reported here), it did not appear to have a significant effect on mental health.

Finally, we find some indication that spatial characteristics may have a different impact on different well-being conceptualisations. While the effects of subjective characteristics are rather similar, the effect of objective factors differs. Cognitive and affective well-being are negatively affected by nearness of urban amenities, whereas mental health is positively affected by living in newer

Appendix 2
Factor analysis of socio-demographic composition variables.

	Families with young children	Non-western immigrants	Elderly	Divorced non-western
% 0–14 year	0.926			
% Unmarried	−0.690		−0.629	
% Married	0.808			
% Single households	−0.952			
% Households without kids	0.638		0.508	
% Households with kids	0.976			
av. Household size	0.973			
% Non-western		0.978		
% Morrocans		0.933		
% Antillians		0.607		
% Surinamese		0.767		
% Turkish		0.935		
% Other non-western		0.871		
% 25–44 year			−0.840	
% 45–64 year		−0.630	0.528	
% older than 64 year			0.888	
% Widowed			0.891	
Birth rate			−0.797	
Death rate			0.838	
% Divorced				0.768
% 15–24 year	−0.643			−0.706
% Western	−0.578			−0.723
% Explained variance (%)	30.1	25.1	25.0	11.6

Appendix 3
Factor analysis of housing variables.

	Cheap rented multi family	Many empty dwellings	New dwellings	Commercial renting
Average value of dwellings	−0.778			
% Single family dwellings	−0.878			
% Multi-family dwellings	0.887			
% Owned dwellings	−0.960			
% Rented dwellings	0.936			
% Occupied dwellings		−0.910		
% Empty dwellings		0.897		
% Ownership unknown		0.834		
Population density		−0.620		
% Built before 2000			−0.993	
% Built after 2000			0.993	
% Commercial rent				0.933
% Social rent	0.691			−0.685
% Explained variance (%)	36.4	23.2	16.4	14.7

Appendix 4
Factor analysis of income distribution and firms variables.

	Low income
% Non active	0.891
% Households on low income	0.951
% Households on high income	−0.936
Average personal income	−0.865
Explained variance	83.1%

	Firms
Total # of firms	0.993
# Of firms agriculture	0.777
# Of firms industry and energy	0.875
# Of firms trade and restaurants/bars	0.880
# Of firms transport and communication	0.884
# Of firms financial services, real estate	0.881
# Of firms commercial services	0.883
# Of firms culture and leisure	0.927
Explained variance (%)	79.1

Appendix 5
Factor analysis of accessibility variables.

Distance to…	Basic facilities	Urban amenities	Urban/ educational facilities	Rail access	Child care
Family doctor	0.723				
Pharmacy	0.748				
Kindergarten	0.857				
Supermarket	0.751				
Elementary school	0.721				
Main road	−0.764				
Main railway station	0.683				
Cinema	0.681	0.513			
Theatre	0.668	0.546			
Ice ring	0.774				
Daily shopping	0.508	0.781			
Department store		0.602	0.552		
Bar		0.711			
Cafeteria	0.537	0.757			
Restaurant		0.836			
Hotel		0.781	0.346		
Museum		0.837			
Secondary education			0.676		
Gymnasium			0.644		0.553
Swimming pool			0.894		
Railway station				0.870	
Library				0.764	
Child care facility					0.814
Explained variance (%)	29.2	23.3	18.0	9.7	8.5

be differently affected by spatial characteristics than more general well-being conceptualisations.

Appendix

See Appendix 1–5

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neighbourhoods. While these findings deserve further investigation, they give an indication that mental health and symptoms of mental illness constitute specific aspects of well-being, that may

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