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RESEARCH PAPER

Spatial Effects Over Time-Framed Happiness

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Abstract
The article investigates average marginal effects of intra-urban, urban-remote and perceived spatial differences over time-framed happiness. The study is based on a self-report social survey conducted in Adana which includes three different time frames for happiness, namely at present (short-term), in the last week and in the last 4 weeks (global). Over which, the effects of objective, subjective and social spatial variables through socio-economic and social capital variables are measured using logistic regression models. Based on cognitive neuroscience research findings, the expectations are that perceived aspects of life are more likely related to short-term happiness and objective aspects of life are more likely related to global happiness. The analyses reveal that urban-remote difference is more likely related to higher global happiness; vehicle dependent-others difference is more likely related to higher happiness; perceived spatial factors are more likely related to short-term happiness; lower relative income and higher neighborhood inequality are more likely to decrease global happiness; the unemployed and retired urban residents are more likely to feel less happy and related to global happiness; personal characteristics and socio-economic factors are more likely related to one-week happiness. The implications suggest that policies should be towards the city retirees and the unemployeds who feel less happy, and intensive public transportation areas and their residents who are the most unhappy and more disturbed by air pollution. For policy implementation, we recommend that the authorities discuss the public transport, distance to services, air pollution and unemployment issues, and adopt the retirement adjustment law to eliminate the grievances in the pensions of the retirees.

Keywords Happiness · Spatial analysis · Marginal effects · Social capital

1 Introduction

Spatial effects over multiple time-framed happiness have been largely neglected in empirical (subjective) urban happiness research that is based on social surveys. The difficulty to differentiate the intra-urban spatial differences in developing countries due to instability

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of happiness is reported (Wang and Wang 2016). Another reason might be that individual level studies in Western nations show no much fluctuations in happiness over time as predicted by psychological and sociological theories (Ehrhardt et al. 2000). Empirical research shows that intra-urban (micro-spatial) happiness includes objective and subjective spatial aspects of life which are based on personal characteristics and social position. For example, Ala-Mantila et al. (2018) investigated the effects of intra-urban differences over happiness by following the most celebrated happiness researcher Diener et al. (2009) for an adequate time frame.

Distinction between assessment of happiness "at present" and global happiness of longer time periods (e.g. 1 week, 4 weeks) that are based on memory is an important area (Diener et al. 1997). Present happiness by itself is not adequate (Aristotle 1906; Bradburn 1969; Diener et al. 2009). For example, urban-remote neighborhood difference shows significant positive effects over one-week happiness, but it does not show any significance over present happiness except for vehicle dependent-remote difference. Furthermore, assessment of happiness in longer period of time, e.g. last 4 weeks, does not provide any outcome for present happiness although it includes retrospective momentary happy/unhappy experiences. For example, dissatisfaction with access to services relative to other environment perceptions shows significant negative effects over present happiness, but it does not show any significant effects over four-week happiness. On the other hand, satisfaction with neighborhood safety and housing cost relative to dissatisfaction shows more significant positive effects over present happiness than global happiness. These evidences indicate that perceived aspect of life is more likely related to present time that is based on working memory and objective aspects of life are more likely related to events and facts that are based on declarative memory, which are confirmed by cognitive neuroscience (Pulvermüller et al. 2014). Thus present and global happiness are not identical although they are correlated (Diener et al. 1997) and global happiness cannot be captured in single time frame. This clearly shows the importance of multiple time frames to capture objective and subjective spatial aspects of higher happiness.

Space where people live and perceive their physical and social environment determines how happy they feel. The neighbourhood and the city one lives in influence individuals' well-being through social relationships (Leyden et al. 2011). Furthermore, neighborhood safety (Ala-Mantila et al. 2018), greater housing price (D'Acci 2013), relative income (Easterlin 1974), socio-economic status and social capital (Diener and Seligman 2002) contribute to happiness. Happiness captures how people feel about all these values of which perception plays an important role because it is a process by which people give meaning to their environment (Robbins et al. 2010).

Spatial and temporal (spatio-temporal) pairwise differences of happiness, different time-framed happiness in different locations or neighborhoods, perceptions and incomes is neglected in empirical happiness research. Berry and Okulicz-Kozaryn (2011) investigates urban–rural happiness gradient based on Wirth (1938) hypothesis that there should be differences in subjective well-being (SWB), from lowest levels in the cores of largest cities to highest levels in the rural–small-town periphery. However, a spatial analysis with no pairwise differences relative to reference categories is by no means complete unless no pairwise significance is found. Intra-urban pairwise neighborhood differences and environment perception differences sheds light in decision making about where and how to live happier based on what people pursue. Thus it is important to know how pairwise spatio-temporal differences affect higher happiness.

This article aims to shed light on happiness of Adana by focusing on relative effects of spatial pairwise differences over higher happiness at present and higher global happiness, and "at present" is considered as short term. Objective and subjective spatial pairwise differences, extrinsic comparisons (Eren and Taşçı 2017), provide individuals an opportunity to compare all locations and environment perceptions pairwise. In Adana, individuals most seek to live in urban areas where they can have access to quality services (e.g. quality schooling, health care, public transportation) in safer neighborhoods with quality air (e.g. no air pollution, less traffic and noise) at the cost of expensive housing. Thus the extent to which spatial factors affect higher happiness through socio-economic and social capital factors guides people to decide for better space to live (Diener and Suh 1997), and inform urban policies. These policies are important for healthy city, and sustainability of environment and economic development (Blackman 1995).

The article proceeds as follows: Theoretical background section provides a review of previous literature on conceptualization, spatial levels, demographic, socio-economic, social capital and spatial effects on happiness to shed light on mechanisms of how independent variables affect time-framed happiness; the methodology section gives data source and introduces independent and dependent variables; the hypotheses are justified and models are introduced in the hypotheses section; based on these hypotheses, model estimation results are provided; these results are compared to previous literature and their important implications are given in discussion section; and the article concludes with confirmation of the hypotheses and recommendation for policy implementation.

2 Theoretical Background

Temporal differences and assessment parts of theoretical background are given in Appendix 1.

2.1 Conceptualization

In the eighteenth century, it was acknowledged that happiness was difficult to capture due to indefiniteness (Fincham 2016). Earlier in 350 B.C., temporal heterogeneity of happiness was conceptualized in Nicomachean Ethics by "what is happiness differs based on different minds of men at different times" (Aristotle 1906). Different minds are due to object memory in temporal cortex where concepts and meaning are localized, and this area plays an important role for memory and decision (Pulvermüller et al. 2014). Hence, heterogeneity of conceptual referent for a happy life plays an important role in the judgement of life and in the appraisal of happiness (Rojas 2005). Many philosophical and religious traditions teach that happiness (feelings or emotions) is to be found by living in the moment (Killingsworth and Gilbert 2010). On the other hand, definition of happiness, current moods or feelings in a specific period of time (Eid and Diener 2004), the sum of pleasures minus pains (Bentham 1970), positive and negative effects (Diener et al. 1997) refer to a time frame for global judgement based on retrospective experiences. These effects change over time based on personality and social position (Ehrhardt et al. 2000) regardless of variability of an individual's standard for positive effects (Bremner 2011). In empirical research, subjective happiness is assessed by asking participants how happy they are (Kahneman 1999; Seligman and Royzman 2003), which is based on distinct psychological state embedded in their mindsets (Larsen and Ketelaar 1991; DeNeve and Cooper 1998; Angner 2010). Despite all heterogeneities and change, people always value themselves by feeling and being relatively better. These values include hedonic, subjective and objective happiness. These are all theories of happiness as the prudential good; that is, what is "good-for" a person (Fabian 2017), and they are more about the achievement, possession and choice paradigms of happiness reported by Holden (2009). Moreover, they can be desribed as a synthesis of pleasent life, good life and meaningful life (Seligman and Royzman 2003) within a spatio-temporal order.

2.2 Spatial Levels

Recent research focuses more on micro-spatial (intra-urban) effects over happiness and life satisfaction and includes intra-urban (Wang and Wang 2016; Weziak-Bialowoska 2016; Ala-Mantila et al. 2018), intra-metropolitan (Morrison and Weckroth 2018), and intra-suburb neighborhood level factors (Cramm et al. 2012). Previous research focused more on macro-spatial effects (Cummins 1995; Diener et al. 1995; DeNeve and Cooper 1998; Helliwell 2003; Stanca 2010; Easterlin et al. 2011; Neira et al. 2018). Extensive review of previous literature indicates the potential importance of space (Camfield and Skevington 2008; Brereton et al. 2008; Aslam and Corrado 2012; Ballas 2013; Bernini et al. 2013; Weziak-Bialowoska 2016; Ala-Mantila et al. 2018) in determining happiness and well-being. Intra-city distances (Brereton et al. 2008), density, zones (Ala-Mantila et al. 2018), cities (Florida et al. 2013), counties (Lawless and Lucas 2011), states (Yakovlev and Leguizamon 2012) are objective micro-spatial and cross-countries are objective macro-spatial levels. Some studies used geographic information system for spatial analysis (Brereton et al. 2008; Ala-Mantila et al. 2018).

2.3 Demographic and Socio-economic Variables

There are numerous studies which investigate how demographic (age, gender, marital status) and socio-economic control variables (income, employment, health) are related to happiness in the spatial assessment. For example, Bilgin and Şengül (2010) investigate how individual socio-economic level affects individual level happiness. Most researchers agree on the effects of age, gender, marital status, income, unemployment, education and health on happiness. For example, the relationship between age and happiness was mostly found to be u-shaped (Akın and Şentürk 2012; Caner 2014; Dumludağ et al. 2015; Blanchflower and Oswald 2008; Ala-Mantila et al. 2018; Asadullah et al. 2018; Neira et al. 2018). Stanca (2010) finds age to be negatively related to happiness. On gender differences, women are found to be happier than men (Asadullah et al. 2018), but insignificant effect is also reported (Okun and George 1984). Furthermore, there are some evidences showing no gender differences (Neira et al. 2018). Empirical research also seem to agree on the effects of marital status on happiness, indicating that married people are happier than the divorced and other status (Blanchflower and Oswald 2004; Dolan et al. 2008; Stanca 2010; Cramm et al. 2012; Luhmann et al. 2013; Ala-Mantila et al. 2018; Asadullah et al. 2018; Yang et al. 2019; Neira et al. 2018). Extensive review of previous literature indicates the potential importance of income (Easterlin 1995; Ferrer-i-Carbonell 2005; Dolan et al. 2008; Asadullah and Chaudhury 2012; Asadullah et al. 2018). Poverty and the determinants of poverty in urban area of Adana have been studied (Şengül and Fisunoğlu 2012). General findings on the effects of income on happiness indicate that people with higher income are happier (Asadullah et al. 2018). Recent happiness research focuses on happiness inequality. Yang et al. (2019) find that an increase in people's income reduces happiness inequality. Empirical research indicates that income is a stronger socio-economic determinant of happiness. For example, Easterlin et al. (2011) reports that the effect of income is stronger than education and occupation. However, the effect of income on well-being is stronger in countries with lower GDP per capita (Stanca 2010). Ala-Mantila et al. (2018) reports that adequate income is a strong predictor of higher happiness, which supports the macro-spatial finding that in the US and Europe happiness does not significantly increase by income after an adequate income (Easterlin 1995). There are some evidences which show that the effects of income higher than adequate income are negative. For example, McBride (2001) finds that the probability of being very happy decreases by about 8% when the logarithm of average income increases by one. Empirical research also suggest that being unemployed has negative and significant effects over happiness (Clark and Oswald 1994; Lelkes 2006; Brereton et al. 2008; Dolan et al. 2008; Stanca 2010; Selim 2012; Atay 2012; Yang et al. 2019), but Winkelmann (2009), Cramm et al. (2012) and Liltsia et al. (2014) found no significant relation. The research on the effect of unemployment needs more care in unemployed job seeker and unemployed hopeless separation. This issue surfaces when industry leaves a large city of a developing country and the city stays neglected in all aspects for decades. Health is another factor as important as unemployment in determining happiness. However, in the above mentioned context unemployment becomes more important than health. Poor health has negative and significant effects over happiness (Dolan et al. 2008; Ala-Mantila et al. 2018). Conversely, happier individuals are healthier and live longer on average (Diener and Chan, 2011; Lyubomirsky et al. 2005). Empirical research suggest that the effect of education over happiness is positive. For example, Yakovlev and Leguizamon (2012) reports that that higher education has a relatively strong positive effect on state-level happiness even after controlling for income and health. Ruiu and Ruiu (2019) reports that on average there is a positive effect of education on happiness after a discussion about complexity of the relationship through income expectations. Stanca (2010), Bülbül and Giray (2011), Atay (2012), Dumludağ (2013) and Florida et al. (2013), Kangal (2013), Eren and Aşıcı (2017), Asadullah et al. (2018), Yang et al. (2019) find that individuals who have higher education levels report relatively higher happiness. There are some evidences showing otherwise. For example, Neira et al. (2018), Akın and Şentürk (2012), and Bozkuş et al. (2006) report that higher educational levels do not seem to be happier relative to lower educational levels. This can be explained by higher stress levels in the pursue of success and social position.

2.4 Social Capital

Extensive review of previous literature indicates the potential importance of social capital (Helliwell 2003; Dolan et al. 2008; Sachs 2015). The effect of lack of social contact is negative and significant over happiness (Dolan et al. 2008; Ala-Mantila et al. 2018). Additionally, social trust is the strongest predictor of happiness (Ala-Mantila et al. 2018). Mavruk and Kıral (2019a) find the same results for both social contact and trust over higher quality of life. Winkelmann (2009) finds that social capital components have significant positive effects on happiness levels. Akaeda (2019) confirms that contextual social trust reduces happiness inequality due to education. Neira et al. (2018) maps the spatial distribution of the regional means for the five components of social capital, indicating that social trust is more likely related to higher happiness than the other components. There is substantial evidence that social relationships are a major cause of SWB (Diener and Seligman 2002), but high SWB also improves social relationships (Diener et al. 2017). This evidence supports the Harvard University longitudinal study which shows the importance of social capital as Waldinger, a professor of psychiatry at Harvard Medical School, reports that "our relationships and how happy we are in our relationships has a powerful influence on our health". A similar result is also found by Mavruk and Kıral (2019b) based on a social survey study.

2.5 Objective Spatial

Empirical spatial research shows that objective spatial pairwise differences are limited to urban–rural or rural–urban differences. Objective spatial variable is defined as intra-city zones and densities, and its relationship to happiness is investigated in a time frame and with a reference category (Ala-Mantila et al. 2018). Other intra-urban pairwise differences over multiple time frames remain to be further investigated and explored. In European/Western context or developed countries, studies have shown that people living outside the city area are happier than those living in the city area (Ferrer-i-Carbonell and Gowdy 2007; Brereton et al. 2008; Easterlin et al. 2011; Ala-Mantila et al. 2018; Asadullah et al. 2018; Morrison and Weckroth 2018; Neira et al. 2018). More specifically, Ala-Mantila et al. (2018) found that living in a car-oriented zone relative to remote was related to higher happiness. One of the reasons Morrison and Weckroth (2018) suggest is that residents in metropolitan centers disproportionately identify with those specific human values which correlate negatively with SWB. There are also evidences which show no urban–rural differentials in individuals' happiness based on personal characteristics such as age, income, and marriage, with some variation by level of development (Berry and Okulicz-Kozaryn 2011).

2.6 Subjective Spatial

Perceived environment shows a negative relationship with happiness (Duarte et al. 2010; Kyttä et al. 2016; Ala-Mantila et al. 2018). The perceived environment safety and dissatisfaction with high housing cost both in the capital region are found to be the most important issues related to lower happiness. Satisfaction with safety of neighborhood was more important than housing cost for four-week happiness. Furthermore, subjective spatial factors are more important for happiness than objective spatial factors, in the same manner as socio-economic and social capital factors are more important than spatial factors overall (Ala-Mantila et al. 2018).

2.7 Social Spatial

Marx (1847) described the importance of socio-spatial inequality: A house may be large or small; as long as the neighbouring houses are likewise small, it satisfies all social requirements for a residence. Empirical research seem to support Marx in neighborhood inequality. Ala-Mantila et al. (2018) used the Gini coefficient to estimate neighborhood inequality, indicating that the Gini coefficient was negative and significant only in the model where socio-economic, social capital, urban zone and perceived spatial characteristics are controlled for. The Gini coefficient estimation is based on population percent of individuals and individual income reported for each region. The coefficient ranges from 0 (complete equality) to 1 (complete inequality) and has been shown to be valid and reliable (Kawachi et al. 1997). The choice of income inequality indicator such as the percentile ratios, the generalized entropy indices, the Gini coefficient and the Atkinson index is unlikely to influence results of empirical tests (Kawachi and Kennedy 1997). Asadullah et al. (2018) reports that having wealthier neighbours lowers reported happiness based on the estimations, indicating that individuals who report their economic position to be lower than others in the community also report being less happy. Easterlin (1974) finds that in the US, individuals of higher socio-economic status had 1.1 points higher in self-reported happiness than individuals from lower socio-economic status (on a scale from 0 to 10). Luttmer (2005) found that an increase in the logarithm of neighbours earnings of 1 unit would reduce happiness by 4.13% for married individuals.

3 The Methodology

3.1 Data Source

A social survey conducted in February 2018 included 535 randomly selected residents in Adana. The single self-report survey with simple random sampling technique was completed in about 4 weeks. Survey includes happiness, demographic, socio-economic (SE), social capital (SC) and spatial questions. Demographic items are gender, age, marital status and the number of people are living together with family. Spatial items are locations of residence as objective spatial (OS), environment perceptions as subjective or perceived spatial (PS) and income inequality as social spatial (SS). Social capital items are seeing relatives or friends and trust in human. Study covers the four most heavily populated districts, namely Seyhan, Yuregir, Cukurova and Sarıcam with a total of 294 neighborhoods and a population of 1.75 million people. Appropriate sample size, reliability and validity of data is provided in Appendix 3.

3.2 Dependent Variables

Happiness at present (PHAP), one-week happiness (1WHAP) and four-week happiness (4WHAP) are included as dependent variables in logistic regression models. All dependent variables are based on single item questions with different number of categories. Category levels can accurately communicate degrees of subjective value (Parducci 1984).

The four-week happiness question was adapted from Ala-Mantila et al. (2018): "How much of the time you felt happy in the last 4 weeks?" The six-point scale is 0 = none, 1 = somewhat, 2 = sometimes, 3 = good amount of time, 4 = most of the time, 5 = everytime. For present happiness, a nine point scale question "how would you define your happiness at present?" was asked. The nine-point scale is 1 = extremely unhappy, 2 = very unhappy, 3 = unhappy, 4 = somewhat unhappy, 5 = neither unhappy nor happy, 6 = somewhat happy, 7 = happy, 8 = very happy, 9 = extremely happy. A two point scale question for happiness in the last week is "Did you feel happy during the last week?" The choices are "yes" or "no".

3.3 Independent Variables

SE, SC, OS, PS and SS variables are included as independent variables. All independent variables in this article are dummy variables.

SE variables are education status, employment status, monthly income and health status. For marital status, respondents were allowed four status to be selected from 1 = single, 2 = married, 3 = divorced or separated, 4 = widowed. For education status, respondents were allowed seven status to be selected from 1 = illeterate, 2 = primary school, 3 = high school, 4 = 2 year college, 5 = university, 6 = graduate. For employment status, respondents were allowed eight status to be selected from 1 = paid employee, 2 = not working at the moment, 3 = unpaid family worker, 4 = unemployed for less than 12 months, 5 = unable to work due to illness and disability, 6 = retired, 7 = housewife, 8 = student. For health status, respondents were asked “how is your health status?” and they were allowed five status to be selected from 1 = very poor, 2 = poor, 3 = neither poor nor good, 4 = good, 5 = very good.

OS variables are the residential areas or locations described in Table 12. For residential areas, question was “where do you live?” The respondents were allowed six areas to be marked from 1 = central pedestrian residential neighborhoods, 2 = heavy transit junctions, 3 = secondary pedestrian residential neighborhoods around the city center, 4 = intensive public transport junctions in and around city center, 5 = vehicle dependent residential neighborhoods, 6 = remote neighborhoods.

SC variables were social contact (seeing a relative or a friend) and human trust. A five-point scale question for each was asked: “How much do you trust people in general?” Scales are 1 = never trust, 2 = don’t trust, 3 = neither trust nor distrust, 4 = trust, 5 = trust a lot. To the question “how often do you see a relative or a friend?” scales were 1 = never, 2 = less than once a month, 3 = one-three times a month, 4 = one-two times a week, 5 = everyday.

PS variables are environmental disturbance, neighborhood safety and housing cost which are used to determine how residents perceive their environment. For environmental disturbance, residents were asked “what problems do you face most near your home?” by allowing multiple options to be marked from 1 = access to services, 2 = noise and traffic, 3 = bad public transport, 4 = air pollution, 5 = no problem. This question is followed by “to what extent the problem you are experiencing is disturbing you” with the options 0 = very disturbing, 1 = disturbing, 2 = neither nor, 3 = not disturbing, 4 = not disturbing at all. Neighborhood safety and housing cost were measured using five-point scale questions “To what extent are you satisfied with your neighborhood safety” and “To what extent are you satisfied with housing cost”. Five options was allowed: 1 = very unsatisfied, 2 = unsatisfied, 3 = neither satisfied nor unsatisfied, 4 = satisfied, 5 = very satisfied.

SS variables are absolute poverty line and neighborhood income inequality. For poverty line, residents were asked “what is your monthly income level?” by allowing a value to be input. According to Confederation of Public Servants Trade Unions, absolute poverty line (the total amount of food expenditures, clothing, housing, rent, electricity, water, fuel, transportation, education, health and other necessities) was 4589 TRY/four people. Mean household size in Adana is 3.5 based on the survey. Multiplying both and dividing by 4 gives 4015 TRY, which is taken as cutoff point over the sample. Therefore, for poverty, lower income or poor is defined as income level reported below the absolute poverty line (< 4015 TRY) and higher income as above the absolute poverty line (≥ 4015 TRY). For neighborhood income inequality, Gini coefficient is estimated for each defined region using Lorenz function. Estimation results are given in Table 12.

3.4 Hypotheses

There are evidences which show that people living in the city area are happier than those living outside the city area for developing countries. For example, Veenhoven and Ehrhardt (1995) reports that in less-developed countries happiness was greater in urban places but that this urban–rural differential tended to disappear with economic development. Easterlin et al. (2011) reports that, in urban–rural comparison, rural advantage in life satisfaction holds in only three of the 48 less developed countries. Together with these evidences, micro-spatial research suggest that urban-remote difference in a city of a developing country is more likely related to higher global happiness. This hypothesis is tested on urban-remote difference over three time frames for spatial significance through socio-economic and social capital control variables. Furthermore, considering all intra-urban pairwise differences, vehicle dependent-others difference is more likely related to higher global happiness. These hypotheses are tested using logistic regression model

$$W_i^* = \alpha_i + \beta_0 SE_i + \beta_1 OS_i + \beta_2 SC_i + \beta_3 PS_i + \beta_4 SS_i + \varepsilon_i \tag{1}$$

where OS_i is objective spatial variable, PS_i is perceived (subjective) spatial variable, SS_i is socio-spatial variable, SE_i is socio-economic variable, SC_i is social capital variable, ε_i is the random error term and W_i^* is latent present happiness receiving a value from 1 to 3, four-week happiness receiving a value from 0 to 2 or one-week happiness receiving a value 0 or 1. Based on the number of categories, ordered logistic regression models are introduced in Appendix 5.

A large number of research on the large cities of developed countries report negative effect of living in the city centers. Based on the literature findings showing the opposite for the cities of developing countries, we expect the effects on higher happiness to be positive on urban Adana compared with remote Adana and hence that $\partial Pr(W)/\partial OS_i > 0$.

Ala-Mantila et al. (2018) finds that perceived noise and traffic, and poor public transport reduce happiness. In the urban context, feeling distant to services and dissatisfaction with public transport decrease higher happiness (Kyttä et al. 2016; Duarte et al. 2010). These evidences suggest that dissatisfaction with environmental and perceived factors is more likely to reduce happiness, and satisfaction is more likely to increase happiness. Furthermore, perceived aspect of life is more likely related to present happiness based on neuroscience research findings. These hypotheses are tested for objective and social spatial significance through socio-economic and social capital control variables using

$$W_i^* = \alpha_i + \beta_0 SE_i + \beta_1 PS_i + \beta_2 SC_i + \beta_3 OS_i + \beta_4 SS_i + \varepsilon_i \tag{2}$$

where PS_i are access to services, noise and traffic, bad public transport, air pollution, neighborhood safety and housing cost. We expect that people report lower level of happiness due to negative perceptions (noise, traffic, air pollution) in their environment, and hence that the effect of PS_i to be negative, i.e., $\partial Pr(W)/\partial PS_1 < 0$. On the other hand, we expect that they report higher level of happiness due to positive perceptions (satisfaction with neighborhood safety and satisfaction with housing cost), hence that $\partial Pr(W)/\partial PS_1 > 0$.

Residents living in higher neighborhood inequality report lower happiness (Glaeser et al. 2009; Oshio and Kobayashi 2011; Oishi et al. 2011; Ala-Mantila et al. 2018). Ala-Mantila et al. (2018) find that the Gini coefficient was negative and significant. Empirical research suggests that relative income in a given country during a specific period is more important than absolute income (Easterlin 1974; Clark et al. 2008). In neighborhood inequality and relative income, Adana is the second in the nation with a Gini coefficent of 0.402 and with a relative poverty rate of 12.7% according to research findings of 2018 Turkish Statistics Institute on living conditions. These evidences suggest that lower relative income and higher neighborhood inequality are more likely related to lower happiness. Furthermore, social spatial factors are more likely related to global happiness. More generally, objective aspect of life is more likely related to global happiness based on neuroscience research findings. These hypotheses are tested for objective and subjective spatial significance through socio-economic and social capital control variables by

$$W_i^* = \alpha_i + \beta_0 SE_i + \beta_1 SS_i + \beta_2 SC_i + \beta_3 OS_i + \beta_4 PS_i + \varepsilon_i \tag{3}$$

where SS_i is either income inequality or neighborhood inequality. Therefore, we expect that they report lower level of happiness, i.e., the effect of SS_1 to be negative, $\partial Pr(W)/\partial SS_1 < 0$; that residents with higher income report higher level of happiness, i.e., $\partial Pr(W)/\partial SS_1 > 0$; and that the higher neighborhood inequality reports lower happiness, i.e., $\partial Pr(W)/\partial SS_2 < 0$. When the last terms with the coefficient β_4 are added in (1), (2) and (3), the three models become the same.

Empirical research also agrees on negative and significant effects of unemployment on happiness (Dumludağ 2013; Bernini et al. 2013; Ala-Mantila et al. 2018; Asadullah et al. 2018). Stanca (2010) finds that the negative effect of being unemployed on well-being is stronger in countries with higher unemployment rate. These evidences suggest that employment status (the unemployeds, retireds and housewives all vs the employeds) is more likely to decrease higher happiness. This hypothesis is tested through social capital and spatial variables by Model 1 for which the results are given in Table 14 and checked by the correlations given in Table 11.

4 Results

Descriptive results are in line with 2014 Adana Urban Problems Report by Adana Provincial Coordination Board which reports that Adana residents are poor and deprived, which leads to unhappiness (Diener et al. 1995). Descriptive statistics and correlation coefficients are reported in Tables 9, 10 and 11. The results on demographic, socio-economic and social capital effects are given in Tables 13 and 14 and Appendix 6.

4.1 Model Estimations

Three models are estimated for each dependent latent variable of time-framed happiness. Each happiness model itself contains three models to determine spatial effects using socio-economic and social capital control variables. In order to measure OS effects over the dependent variables, Model 1 is run through an SE variable and an OS variable first. Subsequently, SC and PS variables are added, and finally an SS variable is added. Model 2 is run through an SE variable and an PS variable first. Subsequently, SC and OS variables are added, and finally an SS variable is added. Model 3 is run through an SE variable and an SS variable first. Subsequently, SC and OS variables are added, and finally a PS variable is added. Three logistic regression models, Binary Logit Model (BLM), Ordered Logit Model (OLM) and Generalized Ordered Logit Model (GOLM) are used for the assessment of happiness. Differences between GOLM and Multinom Logit Model (MLM) results were small, but in favor of GOLM. Roughly speaking significance of Average Marginal Effects (AME) in both models remained the same except for borderline cases. AME differences were within 5% and standard errors within 1%. For this reason, GOLM is used for the marginal effect estimations of spatial variables when test of parallel lines (OLM) assumption is violated. The marginal effects were estimated as a discrete change in the probability of being in nonreference category. Logistic regression models are introduced in Appendix 5.

4.2 OS Variables and Time-Framed Happiness

The estimates of $\partial Pr(W)/\partial OS_i$ using Model 1 confirms the first hypothesis that urban-remote difference in a city of a developing country is more likely related to higher global happiness.

Table 1 shows that vehicle dependent areas are more likely related to higher PHAP. Considering all pairwise differences in PHAP, vehicle dependent-public transport difference shows the strongest effect. Residents living in intensive public transport areas are more likely to feel less happy than those living in the other neighborhoods.

Table 2 shows that pairwise differences of 1WHAP are not statistically significant except for urban-remote differences. Spatial effects over higher 1WHAP are positive and significant ($p < .005$), indicating that urban-remote difference is more likely related to higher 1WHAP.

Table 3 shows that the effects of transit junctions-remote and transit junctions-public transport differences are stronger in explaining 4WHAP.

The effect of living in vehicle dependent neighborhoods is stronger in explaining PHAP, the effect of living in central pedestrian areas is stronger in explaining 1WHAP and the effect of living at transit junctions is stronger in explaining 4WHAP. Urban-remote difference is more significant in explaining 1WHAP and 4WHAP than PHAP. More detailed results are given in Appendix 7.

4.3 PS Variables and Time-Framed Happiness

The estimates of $\partial Pr(W)/\partial PS_1$ using Model 2 confirms our expectation that residents report lower level of happiness when they have negative perceptions in their environment and that they report higher level of happiness when they are satisfied with their perceptions. Tables 4 and 7 show $\partial Pr(W=1)/\partial PS_1 < 0$ for negative perceptions and $\partial Pr(W=3)/\partial PS_1 > 0$ for positive perceptions on PHAP. The results in Tables 4, 5, 6 and 7 indicate that perceived spatial disturbance is more related to lower happiness. Based on the coefficients, the spatial effect is stronger in explaining higher PHAP than higher 1WHAP and higher 4WHAP. This confirms the second hypothesis that perceptions of environment is more likely related to short-term happiness.

Tables 4, 5 and 6 show that the residents who report poor public transport and feel distant to services are more likely to feel less happy than those who report noise, traffic, air pollution and no problem. Table 7 shows that satisfaction with housing cost is more likely related to PHAP based on the coefficients ($p < .0001$). More results are given in Appendix 8.

4.4 SS Variables and Time-Framed Happiness

Table 8 results confirm the third hypothesis that lower relative income and higher neighborhood inequality is more likely related to lower happiness. The estimates of $\partial Pr(PHAP=2)/\partial SS_1 < 0$, $\partial Pr(1WHAP=1)/\partial SS_1 < 0$, $\partial Pr(4WHAP=3)/\partial SS_1 < 0$ and $\partial Pr(1WHAP=1)/\partial SS_2 < 0$ are confirmed using Model (3). The SS effect is stronger and more significant in explaining 1WHAP ($p < .05$), suggesting that residents in lower income category and in higher neighborhood inequality are related to lower 1WHAP. Thus neighborhood inequality shows stronger and more significant spatial effects over global happiness than present happiness. More results are given in Appendix 9.

5 Discussion

Most intensive public transport areas are in older city settlements where people are distressed with traffic, noise, air pollution and insufficient parking areas. Considering all pairwise difference effects of residential areas, living in intensive public transport areas

Table 1 OS pairwise differences of higher short-term happiness

OS	Central pedestrian			Secondary pedestrian			Transit junctions			Public transportation			Vehicle dependent			Remote		
Central P				.194** (.070)	.138 (.075)	.134 (.075)	.034 (.074)	−.025 (.073)	−.028 (.072)	.247** (.070)	.209** (.071)	.206** (.071)	−.039 (.058)	−.081 (.057)	−.086 (.057)	.216 (.117)	.182 (.120)	.172 (.120)
Second. P	−.194** (.070)	−.138 (.075)	−.134 (.075)				−.159* (.079)	−.163* (.081)	−.162* (.080)	.054 (.075)	.070 (.079)	.072 (.079)	−.278** (.064)	−.219** (.067)	−.220** (.067)	.023 (.120)	.044 (.124)	.038 (.124)
Transit J	−.034 (.074)	.024 (.073)	.028 (.072)	.159* (.079)	.163* (.081)	.162* (.080)				.213** (.078)	.233** (.077)	.234** (.076)	−.118 (.068)	−.056 (.066)	−.058 (.064)	.182 (.122)	.207 (.122)	.199 (.121)
Public T	−.247** (.070)	−.209** (.071	−.206** (.071)	−.054 (.075)	−.070 (.079)	−.072 (.079)	−.213** (.078)	−.233** (.077)	−.234** (.076)				−.331** (.063)	−.290** (.062)	−.292** (.063)	−.031 (.119)	−.026 (.120)	−.035 (.121)
Vehicle D	.084 (.058)	.081 (.057)	.086 (.057)	.278** (.064)	.219** (.067)	.220** (.067)	.118 (.068)	.056 (.066)	.058 (.064)	.331** (.063)	.290** (.062)	.292** (.063)				.300** (.113)	.263* (.113)	.258* (.113)
Remote	−.216 (.117)	−.182 (.120)	−.172 (.120)	−.023 (.120)	−.044 (.124)	−.038 (.124)	−.182 (.122)	−.207 (.122)	−.199 (.121)	.031 (.119)	.026 (.120)	.035 (.121)	−.300** (.113)	−.263* (.113)	−.258* (.113)			
SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
PS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
SS	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
N_S	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535
LR χ^2	55.42	105.3	107.6	55.42	105.3	107.6	55.42	105.3	107.6	55.42	105.3	107.6	55.42	105.3	107.6	55.42	105.3	107.6
Pseudo R^2	.054	.100	.102	.054	.100	.102	.054	.100	.102	.054	.100	.102	.054	.100	.102	.054	.100	.102

**Significant at 1%, *Significant at 5%. Differences are row versus column. Average marginal effects*100 are percentage points. Robust standard errors are in paranthesis. N_S is sample size

Table 2 OS pairwise differences of higher one-week happiness

OS variables	Remote		
Central pedestrian	.385** (.134)	.377** (.143)	.359* (.148)
Secondary pedestrian	.278* (.141)	.316* (.148)	.306* (.151)
Transit junctions	.322* (.139)	.318* (.148)	.306* (.151)
Public transport	.278* (.143)	.314* (.149)	.298* (.143)
Vehicle dependent	.329* (.132)	.288* (.141)	.279 (.152)
SE	Yes	Yes	Yes
SC	No	Yes	Yes
PS	No	Yes	Yes
SS	No	No	Yes
Sample size	535	535	535
LR χ^2	55.02	74.77	79.73
Pseudo R^2	.089	.145	.153

**Significant at 1%, *Significant at 5%. Differences are row vs column. Average marginal effects*100 are percentage points. Robust standard errors are in paranthesis. N_S is sample size

showed the lowest happiness at present relative to the other neighborhoods. This result is more likely related to air pollution and the retirees based on the interaction effects. The second is in line with Graham et al. (2004). In Turkey, those who are retired after the year 2008 have been receiving a monthly pension of less than 1000 TL (roughly 150 US dollars on average) due to new pension system. The period in which the survey was conducted coincided with the period when the new pension law was discussed extensively.

The respondents living in vehicle dependent neighborhoods report higher levels of happiness, which is consistent with Ala-Mantila et al. (2018). Vehicle dependent neighborhoods are new settlements with higher socio-economic status, availability of quality services, larger space, available parking places, less air pollution due to higher geographic location, lower traffic noise compared to other areas. Pairwise effects over present happiness show that vehicle dependent-public transport and vehicle dependent-remote differences have strong effects. However, vehicle dependent-remote difference effect is stronger in explaining one-week happiness, for which pairwise difference of urban areas were not significant except for urban-remote difference. Central pedestrian areas are in and around old city center and still in high demand to live in despite high housing cost. Central pedestrian residents dissociated themselves from the other neighboorhoods by reporting the strongest positive effect over one-week happiness when compared to remote neighborhoods. This was perhaps the most obvious finding that distinguished happiness of a large city in a developing country from that in a developed country where Morrison and Weckroth (2018) found the opposite that residents of the metropolis exhibited lower levels of well-being. This result is similar to that in Ferrer-i-Carbonell (2005), who find individuals living in inner London to be less happy, and in Brereton et al. (2008) who find those living in all areas outside Dublin have a higher life satisfaction, everything else being equal.

Social capital was highly significant in explaining higher happiness over all time frames. Seeing a relative or a friend one-three times a month or everyday relative to less than a

Table 3 OS pairwise differences of higher four-week happiness

OS variables	Central pedestrian			Secondary pedestrian			Transit junctions			Public transport			Vehicle dependent			Remote		
Central P				.073 (.056)	.035 (.061)	.030 (.061)	−.048 (.067)	−.079 (.065)	−.083 (.064)	.119* (.052)	.095 (.052)	.091 (.052)	−.030 (.050)	−.008 (.047)	−.014 (.048)	.190** (.057)	.181** (.058)	.173** (.059)
Second P	−.073 (.056)	−.035 (.061)	−.030 (.061)				−.121 (.067)	−.113 (.070)	−.113 (.069)	.046 (.052)	.060 (.060)	.060 (.060)	−.103* (.050)	−.043 (.056)	−.045 (.056)	.117* (.058)	.146* (.061)	.143* (.061)
Transit J	.048 (.067)	.079 (.065)	.083 (.064)	.121 (.067)	.113 (.070)	.113 (.069)				.167** (.064)	.173** (.065)	.174** (.065)	.018 (.063)	.070 (.062)	.069 (.061)	.238** (.068)	.260** (.068)	.256** (.067)
Public T	−.119* (.052)	−.095 (.052)	−.091 (.052)	.103 (.050)	−.060 (.060)	−.060 (.060)	−.167** (.064)	−.173** (.065)	−.174** (.065)				−.148** (.045)	−.103* (.047)	−.105* (.047)	.072 (.053)	.086 (.056)	.083 (.057)
Vehicle D	.030 (.050)	.008 (.047)	.014 (.048)	.103* (.050)	.043 (.056)	.045 (.056)	−.018 (.063)	−.070 (.062)	−.069 (.061)	.148** (.045)	.103* (.047)	.105* (.047)				.220** (.052)	.189** (.053)	.187** (.053)
Remote	−.190** (.057)	−.181** (.058)	−.173** (.059)	−.117* (.058)	−.146* (.061)	−.143* (.061)	−.238** (068)	−.260** (.068)	−.256** (.067)	−.072 (.053)	−.086 (.056)	−.083 (.057)	−.220** (.052)	−.189** (.053)	−.187** (.053)			
SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
PS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
SS	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
N_S	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535
LR χ^2	34.09	66.76	68.79	34.09	66.76	68.79	34.09	66.76	68.79	34.09	66.76	68.79	34.09	66.76	68.79	34.09	66.76	68.79
Pseudo R^2	.027	.059	.062	.027	.059	.062	.027	.059	.062	.027	.059	.062	.027	.059	.062	.027	.059	.062

**Significant at 1%, *Significant at 5%. Differences are row vs column. Average marginal effects*100 are percentage points. Robust standard errors are in paranthesis. N_S is sample size

Table 4 PS pairwise difference effects of higher present happiness

PS variables	Distance to services			Noise and traffic			Poor public transport			Air pollution			No problem		
Distance to services				−.217* (.087)	−.165 (.096)	−.159 (.096)	.019 (.094)	.048 (.103)	.049 (.103)	−.209* (.097)	−.146 (.103)	−.148 (.103)	−.274** (.084)	−.199* (.093)	−.191* (.093)
Noise and traffic	.217* (.087)	.165 (.096)	.159 (.096)				.235** (.076)	.212** (.076)	.208** (.080)	.008 (.080)	.018 (.075)	.011 (.075)	−.058 (.063)	−.034 (.061)	−.032 (.061)
Poor public transport	−.019 (.094)	−.048 (.103)	−.049 (.103)	−.235** (.076)	−.213** (.076)	−.208** (.076)				−.228** (.087)	−.194* (.082)	−.197* (.083)	−.293** (.073)	−.247** (.072)	−.241** (.072)
Air pollution	.209* (.097)	.146 (.103)	.148 (.103)	−.008 (.080)	−.018 (.075)	−.011 (.075)	.228** (.087)	.194* (.082)	.197* (.083)				−.065 (.076)	−.052 (.070)	−0.44 (.070)
No problem	.274** (.084)	.199* (.093)	.191* (.093)	.058 (.063)	.034 (.061)	.032 (.061)	.293** (.073)	.247** (.072)	.241** (.072)	.065 (.076)	.052 (.070)	.044 (.070)			
SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
OS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
SS	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
N_S	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535
LR χ^2	54.86	105.3	107.6	54.86	105.3	107.6	54.86	105.3	107.6	54.86	105.3	107.6	54.86	105.3	107.6
Pseudo R^2	.051	.100	.102	.051	.100	.102	.051	.100	.102	.051	.100	.102	.051	.100	.102

**Significant at 1%, *Significant at 5%. Differences are row vs column. Average marginal effects*100 are percentage points. Robust standard errors are in paranthesis. N_S is sample size

Table 5 PS pairwise differences of higher one-week happiness

PS variables	Distant to services			Noise and traffic			Poor public transport			Air pollution			No problem		
Distance to services				−.192* (.094)	−.130 (.095)	−.120 (.093)	.105 (.111)	.156 (.109)	.159 (.108)	−.148 (.100)	−.099 (.098)	−.100 (.096)	−.188* (.092)	−.125 (.092)	−.114 (.090)
Noise and traffic	.192* (.094)	.130 (.095)	.120 (.093)				.297** (.081)	.286** (.081)	.279** (.082)	.043 (.067)	.031 (.067)	.020 (.067)	−.187 (.092)	.004 (.055)	.006 (.055)
Poor public transport	−.105 (.111)	−.156 (.109)	−.159 (.108)	−.297** (.081)	−.286** (.081)	−.279** (.082)				−.254** (.089)	−.255** (.088)	−.259** (.088)	−.292** (.079)	−.281** (.080)	−.273** (.081)
Air pollution	.149 (.100)	.099 (.098)	.100 (.096)	−.043 (.067)	−.031 (.067)	−.020 (.067)	.254** (.089)	.254** (.088)	.259** (.088)				−.039 (.063)	−.026 (.064)	−.013 (.063)
No problem	.188* (.092)	.125 (.090)	.114 (.090)	−.005 (.054)	−.004 (.055)	−.006 (.055)	.292** (.079)	.281** (.080)	.273** (.081)	.039 (.063)	.026 (.064)	.013 (.063)			
SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
OS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
SS	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
N_S	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535
LR χ^2	69.36	79.47	80.61	69.36	79.47	80.61	69.36	79.47	80.61	69.36	79.47	80.61	69.36	79.47	80.61
Pseudo R^2	.121	.145	.153	.121	.145	.153	.121	.145	.153	.121	.145	.153	.121	.145	.153

**Significant at 1%, *Significant at 5%. Differences are row vs column. Average marginal effects*100 are percentage points. Robust standard errors are in paranthesis. N_S is sample size

Table 6 PS pairwise differences of higher four-week happiness

PS variables	Distance to services			Noise and traffic			Poor public transport			Air pollution			No problem		
Distance to services				−.106	−.081	−.079	.046	.059	.058	−.043	−.010	−.014	−.148*	−.092	−.088
				(.065)	(.071)	(.072)	(.068)	(.072)	(.073)	(.071)	(.072)	(.073)	(.070)	(.074)	(.075)
Noise and traffic	.105	.081	079				.152**	.140**	.137*	.063	.071	.065	−.042	−.011	.008
	(.065)	(.071)	(.072)				(.053)	(.053)	(.054)	(.056)	(.057)	(.057)	(.054)	(.053)	(.053)
Poor public transport	−.046	−.059	−.058	−.152**	−.140**	−.137*				−.089	−.069	−.072	−.194**	−.151**	−.146*
	(.068)	(.072)	(.073)	(.053)	(.053)	(.082)				(.060)	(.060)	(.060)	(.059)	(.059)	(.059)
Air pollution	.043	.010	.014	−.063	−.071	−.065	.089	.069	.072				−.105	−.082	−.074
	(.071)	(.072)	(.073)	(.056)	(.057)	(.057)	(.060)	(.060)	(.060)				(.061)	(.061)	(.061)
No problem	.148*	.092	.088	.042	.011	−.008	.194**	.151**	.146*	.105	.082	.074			
	(.070)	(.074)	(.075)	(.054)	(.053)	(.053)	(.059)	(.059)	(.059)	(.061)	(.061)	(.061)			
SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
OS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
SS	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
N_S	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535
LR χ^2	24.80	66.76	68.79	24.80	66.76	68.79	24.80	66.76	68.79	24.80	66.76	68.79	24.80	66.76	68.79
Pseudo R^2	.025	.059	.062	.025	.059	.062	.025	.059	.062	.025	.059	.062	.025	.059	.062

**Significant at 1%, *Significant at 5%. Differences are row vs column. Average marginal effects*100 are percentage points. Robust standard errors are in paranthesis. N_S is sample size

Table 7 Average marginal effects of PS variables over PHAP and 4WHAP using GOLM, and 1WHAP using BLM

PS variables	PHAP			1WHAP			4WHAP		
Satisfaction with neighborhood safety	.286** (.041)	.236** (.041)	.237** (.041)	.218** (.038)	.195** (.038)	.196** (.038)	.208** (.039)	.181** (.038)	.187** (.038)
N_S	535	535	535	535	535	535	535	535	535
LR χ^2	63.33	101.40	103.42	68.02	72.46	77.46	48.55	85.12	92.19
Pseudo R^2	.070	.111	.115	.118	.143	.153	.045	.079	.085
Satisfaction with housing cost	.331** (.041)	.265** (.043)	.262** (.043)	.225** (.037)	.206** (.038)	.203** (.038)	.204** (.040)	.161** (.040)	.161** (.040)
N_S	535	535	535	535	535	535	535	535	535
LR χ^2	77.18	104.76	105.82	67.71	74.77	79.73	44.29	76.99	82.63
Pseudo R^2	.080	.116	.119	.120	.145	.153	.041	.071	.076
SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
OS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
SS	No	No	Yes	No	No	Yes	No	No	Yes

**Significant at 1%. Robust standard errors in paranthesis. AME is for "higher happiness". SE control variable is employment status. For PS variables, the reference category is "dissatisfied". N_S is sample size

month or never increased probability of happiness. The effect was slightly stronger over short-term happiness. On the other hand, the effect of human trust increases as time frame widens, indicating that trust in people does not establish in a short time, but it emerges over time. There is substantial evidence that social relationships are a major cause of SWB (Diener and Seligman 2002). Furthermore, lack of social contact has negative and significant effects over happiness (Dolan et al. 2008).

Perceived variables show significant spatial effects over time-framed happiness. Satisfaction with housing cost was more important than safety of neighborhood for short-term happiness and one-week happiness, but the result was the opposite for four-week happiness. The last is consistent with Ala-Mantila et al. (2018). The effects of perceived variables are stronger in explaining short-term happiness than global happiness. Satisfaction with neighborhood safety and housing cost in secondary pedestrian areas relative to the other neighborhoods are more likely to increase lower short-term happiness. Happiness of the respondents was in the direction of the perception of their living environment. The effects of poor public transport over higher present happiness relative to other perceptions were all negative and significant ($p < 0.01$) except for distance to services. In Adana, very few public transport vehicles stationed in Seyhan district cross the Girne bridge to East bound (Yüreğir district). On the other hand, public transport vehicles stationed in Yüreğir cross the Girne bridge towards the city center (Seyhan) but bound to less than one km to West and make a loop around the city center to come back on the same path to Yüreğir. No Yüreğir stationed bus or minibus is allowed in Seyhan to pass nearby Airport, hospitals (Seyhan State, Acıbadem, Ortopedia, Güney, Metro, Medline, Seyhan Başkent), train station, government offices (governership and social security buildings), civil court, stadium, shopping malls, shops along E5, fairground. Furthermore, within Yüreğir no direct public transport available from South to North of E5 where Yüreğir and Sarıçam hospitals (Yüreğir State, Yüreğir Başkent, Yüreğir Kışla Başkent, Adana City, Balcalı) and Town Halls are located. Furthermore, no transfer

Table 8 Average marginal effects of SS variables over PHAP, 1WHAP and 4WHAP using GOLM, BLM, OLM

SS variables	PHAP			1WHAP			4WHAP		
Income below the poverty line	− .094 (.054)	− .091 (.051)	− .098* (.049)	− .128** (.047)	− .117* (.047)	− .119** (.046)	− .094 (.049)	− .089* (.046)	− .099* (.045)
SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
OS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
PS	No	No	Yes	No	No	Yes	No	No	Yes
N	535	535	535	535	535	535	535	535	535
LR χ^2	22.84	86.35	132.79	49.85	63.12	77.46	14.81	57.65	79.30
Pseudo R^2	.021	.087	.121	.082	.115	.153	.015	.053	.079
Gini[a]	− 1.989 (1.062)	− 12.13 (11.547)	− 12.74 (11.492)	− .268 (1.07)	− 22.58 (11.81)	− 23.9* (11.77)	1.042 (.848)	− 11.60 (7.246)	− 13.00 (7.132)
SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
OS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
PS	No	No	Yes	No	No	Yes	No	No	Yes
N_S	535	535	535	535	535	535	535	535	535
LR χ^2	24.21	83.65	86.39	47.15	60.59	74.77	14.03	56.42	68.32
Pseudo R^2	.023	.084	.087	.072	.106	.145	.012	.049	.067

**Significant at 1%, *Significant at 5%

[a] AMEs of Gini coefficient for PHAP are for "moderate happiness", the other AMEs are for "higher happiness"

For income inequality, the reference category is "income above the poverty line"

SE control variable is employment status in all models

PS control variable for Gini coefficient is housing cost and for income inequality is neighborhood safety

Robust standard errors in paranthesis. N_S is sample size

tickets are issued on the rides. Metro line is another story. In future studies, Adana public transportation system must be discussed in more detail. The effects of feeling distant to services relative to other perceptions were negative and significant except for poor public transport. The effects of all negative perceptions relative to no problem are negative, and significant only for poor public transport and distance to services. The effects of all perceptions over three time-framed happiness relative to poor public transport are positive, and significant except for distance to services over the first two time frames and significant except for distance to services and air pollution over the last time frame. In all pairwise comparisons over all time frames relative to poor public transport, significance and positive effect of air pollution through OS and SS both increase from present to one-week happiness and both dissappears in four-week happiness. Thus in the urban context, feeling distant to services and dissatisfaction with public transport decreased higher happiness, which is in line with Kyttä et al. (2016) and Duarte et al. (2010). Poor public transport-noise&traffic difference shows the strongest negative effect over one-week happiness compared to other time frames. Distance to services—no problem difference show spatial significance and negative effect only over present happiness. Poor public transport—no problem difference show spatial significance and negative effect over all time frames. Other perceptions—no problem differences show no spatial significance.

We found that the Gini coefficient was negative and significant only in the global happiness (1WHAP) model where socio-economic, social capital, urban areas and perceived spatial characteristics are controlled for. This result is consistent with Ala-Mantila et al. (2018) who used 4WHAP for global happiness. On relative income and neighborhood inequality we found that residents living below national poverty line and in higher neighborhood inequality report lower happiness. The latter is in line with Glaeser et al. (2009), Oshio and Kobayashi (2011), Oishi et al. (2011) and Ala-Mantila et al. (2018).

Results on socio-economic and demographic effects are also within expectations and consistent with previous research. Education is highly significant over higher one-week happiness and higher four-week happiness, but stronger in explaining one-week happiness and not significant over short-term happiness as expected. University graduates reported higher happiness relative to primary school or no school graduates. Happiness increased by level of education, which is in line with Florida et al. (2013). Health shows stronger effects than education but decreases by time. The respondents in good health status reported higher happiness relative to those in poor health status, which is in line with Dolan et al. (2008) and Ala-Mantila et al. (2018). Happiness increased as health status increased from poor to moderate and from poor to good. Conversely, happier individuals are healthier and live longer on average (Diener and Chan, 2011; Lyubomirsky et al. 2005). The effects of marital status were negative and significant over one-week happiness. This result was in line with Cramm et al. (2012). The effects of being divorced or separated, retired, unemployed are substiantially stronger over higher one-week happiness than four-week happiness. All these effects are stronger in explaining global happiness except for health. The effect of being divorced vs married was negative and significant over one-week happiness, which is in line with Blanchflower and Oswald (2004), Dolan et al. (2008) Luhmann et al. (2013) and Ala-Mantila et al. (2018). Unemployment is a contextual factor for Adana and needs further investigation based on culture and political affiliation. In this study, being unemployed relative to being employed showed negative and significant effects over happiness, which is in line with the findings of Dolan et al. (2008) and Ala-Mantila et al. (2018). Gender difference was negative but insignificant over happiness, which is consistent with Okun and George (1984). A statistically significant U-shape in happiness by age estimated by Blanchflower and Oswald (2008) and Ala-Mantila et al. (2018) was also confirmed for Adana. Household size effect was negative and significant only over short-term happiness.

6 Conclusion

This article investigated average marginal effects of objective, subjective and social spatial factors over present and global happiness. We have found that perceived aspects of life are more likely related to present happiness, and objective aspects of life are more likely related to global happiness. These findings are consistent with cognitive neuroscience research based on memory and judgement.

Previous studies in large cities of developed countries reported lower happiness in urban–rural difference. However, the finding was on the contrary for Adana. No previous study has investigated intra-city happiness of Adana on different time frames. The expectations on short-term and global happiness were based on neuroscience findings and conceptualizations of happiness (Eid and Diener 2004; Killingsworth and Gilbert 2010; Pulvermüller et al. 2014; and Davidson and Schuyler 2015).

We have found that personal characteristics and socio-economic factors are more likely related to global happiness but stronger in explaining one-week happiness than four-week happiness as social capital findings are mixed. Being divorced or separated, unemployed and retired will more likely decrease happiness and are related to global happiness are confirmed. Overall, spatial factors are more significant than socio-economic and social capital factors for time-framed happiness.

The effects of urban-remote difference are more significant and stronger in explaining higher global happiness than present happiness, which confirmed that urban areas are more likely related to higher global happiness. Among all intra-urban pairwise differences, vehicle dependent-other neighborhoods difference is more likely related to higher happiness is confirmed. However, two intra-urban pairwise differences show more significant effects over present happiness when compared to four-week happiness while one-week happiness shows no intra-urban pairwise significance. Further investigation is needed with larger sample size. Individuals' perceptions of environment to be more likely related to short-term happiness was confirmed by showing that perceived spatial factors are more significant than objective and social spatial factors for short-term happiness. Lower relative income and higher neighborhood inequality are more likely to decrease happiness is also confirmed.

An important conclusion for urban policy is that the residents feel less happy due to poor public transport and distance to services. The implications further suggest that policies should be towards the city retirees and the unemployeds who feel less happy, and intensive public transport area residents who are the most unhappy and more disturbed by air pollution. For policy implementation, we recommend that the authorities discuss the public transport, distance to services, air pollution and unemployment issues, and adopt the retirement adjustment law to eliminate the grievances in the pensions of the retirees after the year 2000.

Appendix 1

More on Theoretical Background

Neither does one day nor a short time make someone blessed and happy (Aristotle 1906). SWB perspective, have taken temporal differences into consideration by distinguishing (long-term) life satisfaction from (short-term) affect, but the relations between the short-term and long-term dimensions are often not adequately conceptualised (Nordbakke and Schwanen 2014). Dominance of present happiness in Western culture is claimed to underestimate both past and future (Şimşek 2009). The reference period of the last 4 weeks is argued to provide an adequate sample of feelings and experiences, rather than focusing on a short term that might be non-representative (Bradburn 1969; Diener et al. 2009; Ala-Mantila et al. 2018). On perception of time, Dolan (2014) reports that the perceived distance between now and 1 week from now is about the same as the perceived distance between one week from now and 4 weeks from now. In social surveys, respondents provide an evaluation of their past experiences, which is the judgements of a collection of various affects (Bremner 2011). The retrospective summary judgment of happiness Seligman and Royzman (2003) call it. The summary may include accomplishments and right choices which are important indicators of possible but uncertain future happiness. Hence, a time perspective should be included in social survey studies in order to capture retrospective judgements of respondents. These judgements are reliable and valid (Frey and Stutzer 2002; Kahneman and Krueger 2006; Diener et al. 2009) regardless of respondents being well educated or not. Diener et al. (2017) sheds some light to uncertainty of future happiness by indicating that circumstances and the choices people make in life influence their long-term SWB.

Researchers seem to avoid happiness assessment perhaps due to the implicit assumption that the key relationships are broadly similar across countries and regions (Stanca 2010) or due to fluctuations of happiness which make it difficult to differentiate the spatial difference (Wang and Wang 2016). Thus, they turn to Diener et al. (1985) satisfaction with life scale (Easterlin et al. 2011; Cramm et al. 2012; Aslam and Corrado 2012; Wang and Wang 2016; Ettema and Schekkerman 2016; Akaeda 2019), or to European social survey life satisfaction scale. On the contrary, in Western nations, studies at the cross-country and individual level show that happiness have considerable constancy (without much fluctuation) over time (Veenhoven 2006; Ehrhardt et al. 2000). It seems also that researchers combine happiness and life satisfaction assessments. Aşıcı and Eren and Asici (2017) used TURKSTAT life satisfaction scale “All things considered, how happy are you with your life?”. Ferrer-i-Carbonell (2005) used “How happy are you at present with your life as a whole?” for satisfaction with life in general assessment as subjective well being. Chyi and Mao (2011) and Asadullah et al. (2018) used “Generally speaking, how do you personally feel about your life?” on a scale of 1 to 5, where 1 = very unhappy, 3 = neither happy nor unhappy, and 5 = very happy. These three questions are trying to assess happiness based on general life. “all things considered”, “as a whole nowadays” and “generally about your life” seem to be non-instructive and unclear to respondents. Instead, depending on the focus of a study, specific time frames should be placed in the questions of happiness. For example, if “all things” means all important life experiences, then the assessment should be about life satisfaction. Happiness cannot capture “all things”, “whole nowadays”, “at present as a whole” or “generally about life” at the time of a social survey because happiness can not be measured as life satisfaction. On the contrary, life satisfaction can be measured based on happiness. Thus “how happy are you at present with your life as a whole?” is a vague question because it is asking how a person is happy with his/her life satisfaction. It expects respondents to remember momentary experiences in their life and make a subjective judgement, which is in contradiction with happiness definition of Kahneman (1999), and Seligman and Royzman (2003). However, this may have a particular importance to older people who remember only the most important turns in their lives such as weddings, born of children, accidents, deaths, buying a large house, finding good job. In that respect, Chyi and Mao (2011) seem to have the right question. Otherwise, “how happy are/were you [time frame]” (Ala-Mantila et al. 2018) and “how satisfied are you with your life” (Ehrhardt et al. 2000) are the right types of questions for the assessment of happiness and life satisfaction.

Appendix 2

Descriptive Statistics

Table 9 indicates that reported happiness decreases by time frame. Survey participants report higher mean happiness at present or short-term happiness.

Pairwise Pearson correlations between measures of happiness are presented in Table 10. These correlations are in the range of 0.33–0.49, indicating a moderate to large overlap between the three measures. The lowest overlap is between 1WHAP and 4WHAP, and the highest overlap is between PHAP and 4WHAP.

Table 11 reports correlations between time-framed happiness and independent variables. The significant correlations were low to moderate 0.0966-0.3826. PHAP shows the highest overlap with satisfaction with housing cost, 1WHAP with employment status and 4WHAP with health.

Table 9 Descriptive statistics for SWB components

	N	Minimum	Maximum	Mean	Std. Deviation
Happiness at present	535	1	3	2.26	.734
Happiness—1 week	535	0	1	.66	.475
Happiness—4 weeks	535	0	2	1.11	.684

Table 10 Pearson correlations among three measures of happiness

	4WHAP[a]	PHAP[c]	1WHAP[d]
4WHAP[a]	1	.490**	.328**
PHAP[b]	.490**	1	.391**
1WHAP[c]	.328**	.391**	1

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

[a]4 week-happiness, [b]Happiness at present, [c]One-week happiness

Table 11 Correlations between time-framed happiness and independent variables

	PHAP	1WHAP	4WHAP
Gender			
Age		−0.1470**	
Monthly income		0.1383**	0.1115**
Health status	0.3100**	0.2660**	0.3826**
Marital status			
Employment status	−0.1585**	−0.2914**	−0.1380**
Household size	−0.1381**		
Education level		0.2410**	0.1868**
Frequency of seeing relative or friend	0.1745**	0.1286**	0.2033**
Human trust	0.2317**	0.1393**	0.1873**
Safety of neighborhood	0.3128**	0.2304**	0.2555**
Housing cost	0.3390**	0.2286**	0.2353**
Perception of environment		−0.1453**	
Gini coefficient			
Absolute poverty line		0.1281**	0.0966*

**Significant at 1%, *Significant at 5%, Empty cells are insignificant.

Table 12 Summary statistics for neighborhood income inequality

Region	Gini coefficient
1 central pedestrian areas (Atatürk St, Ziyapasa Blvd, Gazipasa Blvd, Baraj Rd & Kenan Evren Blvd.)	0324
2 intensive public transport areas (Atilla Altıkat, Cemalpaşa Groseri, Hospitals, İller Bank, Seyhan Municipality, Small clock tower and Cumhuriyet regulator bridge)	0341
3 secondary pedestrian areas (Old stadium, Along Sular St, Tepebag, Resatbey, Kurtulus, Meydan&Metro, Saydam St.&Metro, Alidede-Big clock tower)	0291
4 intensive transit junctions (Dortyol, Hospitals, Iller Bank, Optimum, Mavi Blvd-Groseri, Kurttepe Anadolu High School, Cetinkaya-Seyhan Municipality, Metro Rd-Sular-Train station, Bus terminal arounds)	0358
5 vehicle dependent neighborhoods (Cukurova Huzurevleri, Turgut Özal Blvd, Yuzuncuyıl houses, Kurttepe and outer nbhds, Sarıçam outer nbhds, Yuregir outer nbhds ve Seyhan outer nbhds)	0343
6 remote neighborhoods and small towns (Alihocalı, Kokluce, Havutlu, Dogankent, Solaklı, Kuçukdikili, İncirlik, Kurkçuler, Salbas etc.)	0353

Appendix 3

Sample Size, Reliability and Validity of Data

To find the sample size (n) required for the survey, the following formula is used:

$$n = \frac{\chi^2 Npq}{d^2(N-1) + \chi^2 pq} \tag{1}$$

where χ^2 is table value (3.841 for 5% significance), N population size, p population ratio assumed to be 0.50 and d accuracy degree (margin of error) taken as 0.05. Substituting the values in (1) gives

$$n = (3,841(1747000)(0.5)(0.5))/((0.05)^2(1747000-1) + 3,841(0.5)(0.5)) \approx 385.$$

Sample size should be minimum 385 with 5% margin of error. The minimum sample size requirement was met with 535 residents participating in the survey.

Cronbach alpha reliability test is conducted using SPSS to measure reliability of the questionnaire with 20 items (questions). Cronbach alpha reliability value is 0.903 which is acceptable. Removing a few corrected item-total correlation values (between 0.10 and 0.20) would not significantly increase the reliability value.

Construct validity was tested by principal component analysis applied to the questionnaire consisting of 20 questions. The rotation matrix was obtained by varimax method. KMO value $0.801 > 0.60$ indicates that there are sufficient questions for each factor. The Barlett test significance level $p = 0.000 < 0.001$ shows that the correlation matrix is significantly different from the zero matrix. Total explained variance was 62%.

Table 13 Average marginal effects of socio-demographic variables over time-framed happiness

Control variables		PHAP			1WHAP			4WHAP		
Gender-male		−.028	−.004	−.011	−.070	−.059	−.067	−.019	−.008	−.017
Reference: female		(.041)	(.040)	(.040)	(.040)	(.040)	(.040)	(.034)	(.032)	(.033)
N_S		535	535	535	535	535	535	535	535	535
LR χ^2		36.00	93.37	96.27	19.67	44.96	54.04	34.09	66.21	70.30
Pseudo R^2		.037	.096	.099	.030	.077	.092	.027	.062	.069
	30–41	.068	.036	.034	.061	.036	.027	.066	.049	.042
		(.049)	(.047)	(.047)	(.046)	(.045)	(.045)	(.042)	(.039)	(.040)
Age	42–53	.123*	.098	.086	−.005	−.016	−.039	.042	.050	.033
		(.060)	(.057)	(.058)	(.060)	(.056)	(.058)	(.053)	(.051)	(.051)
Reference:18–29	54–65	−.089	−.126*	−.126*	−.270**	−.310**	−.308**	−.096	−.106*	−.108*
		(.068)	(.060)	(.060)	(.075)	(.073)	(.073)	(.047)	(.044)	(.044)
	65+	−.003	−.059	−.083	−.135	−.184	−.212	.091	.016	−.008
		(.133)	(.118)	(.121)	(.146)	(.130)	(.131)	(.126)	(.119)	(.110)
N_S		535	535	535	535	535	535	535	535	535
LR χ^2		55.42	100.09	101.72	33.97	58.72	68.58	28.68	72.16	75.83
Pseudo R^2		.054	.107	.109	.056	.110	.121	.026	.071	.077
Marital status	Single	−.088*	−.060	−.054	−.004	.030	.034	−.030	−.002	.002
		(.045)	(.043)	(.044)	(.043)	(.042)	(.042)	(.037)	(.037)	(.037)
Reference: married	Divorced or separated[a]	.180*	.161*	.164*	−.242**	−.230*	−.239**	−.060	−.024	−.030
		(.045)	(.082)	(.082)	(.045)	(.094)	(.090)	(.067)	(.062)	(.062)
	Widowed	−.018	−.031	−.018	−.053	−.066	−.045	−.047	−.039	−.029
		(.068)	(.078)	(.078)	(.085)	(.085)	(.084)	(.066)	(.057)	(.057)
N_S		535	535	535	535	535	535	535	535	535
LR χ^2		43.27	97.97	101.72	23.23	47.82	53.61	22.66	68.17	72.39
Pseudo R^2		.044	.096	.109	.036	.087	.099	.019	.063	.069
Household size		−.030*	−.031*	−.032*	−.013	−.013	−.015	−.007	−.004	−.005
		(.014)	(.013)	(.013)	(.013)	(.013)	(.013)	(.012)	(.011)	(.010)
N_S		535	535	535	535	535	535	535	535	535
LR χ^2		45.27	103.02	106.00	18.50	58.72	68.58	28.68	68.63	74.17

Table 13 (continued)

Control variables	PHAP			1WHAP			4WHAP		
Pseudo R^2	.044	.104	.108	.028	.110	.121	.026	.064	.071
OS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
PS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
SS	No	No	Yes	No	No	Yes	No	No	Yes

**Significant at 1%, *Significant at 5%

Robust standard errors in paranthesis. N_S is sample size. [a]Effects over PHAP are for lower happiness

Table 14 Average marginal effects of socio-economic variables over time-framed happiness

Socio-economic Control Variables	PHAP			1WHAP			4WHAP		
Education-university graduate	.059	.082	.070	.250**	.270**	.251**	.150**	.152**	.138**
Reference: primary or no school graduate	(.057)	(.057)	(.057)	(.059)	(.048)	(.057)	(.041)	(.040)	(.042)
N_S	535	535	535	535	535	535	535	535	535
LR χ^2	39.46	99.68	100.41	37.76	66.29	69.20	37.52	77.24	79.88
Pseudo R^2	.040	.101	.103	.057	.112	.118	.033	.079	.083
Health-good health	.393**	.362**	.355**	.374*	.326**	.307**	.333**	.302**	.296**
Reference:poor health	(.058)	(.062)	(.063)	(.086)	(.080)	(.079)	(.030)	(.034)	(.034)
N_S	535	535	535	535	535	535	535	535	535
LR χ^2	80.55	124.24	125.88	43.38	65.97	71.40	83.02	56.42	107.49
Pseudo R^2	.083	.139	.140	.070	.110	.117	.090	.049	.123
Employmant status-unemployed	−.103*	−.116**	−.108*	−.253**	−.249**	−.238**	−.108**	−.111**	−.105**
Reference:employed	(.046)	(.044)	(.045)	(.045)	(.044)	(.044)	(.036)	(.034)	(.034)
Employment status-retired	−.145*	−.178**	−.176**	−.327**	−.350**	−.350**	−.125*	−.139**	−.139**
Reference:employed	(.070)	(.060)	(.060)	(.074)	(.071)	(.070)	(.053)	(.050)	(.048)
N_S	535	535	535	535	535	535	535	535	535
LR χ^2	55.42	104.76	105.50	55.02	74.77	74.77	34.09	68.32	69.06
Pseudo R^2	.054	.116	.119	.089	.145	.145	.027	.067	.072
OS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SC	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
PS	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
SS	No	No	Yes	No	No	Yes	No	No	Yes

**Significant at 1%, *Significant at 5%

Robust standard errors in paranthesis. N_S is sample size. [a]Effects over PHAP are for lower happiness

Appendix 4

Gini Coefficient

Coefficient values in Table 12 indicates that neighborhood inequality is the lowest in secondary pedestrian areas and the highest in intensive transit junctions.

Appendix 5

Logistic Regression Models

Binary logistic regression model (BLM) used for one-week happiness W_i in all models can be written as ln(p/(1-p)) where p is the probability of being happy. In these models, we assume that there exists an unobservable (latent) variable W^* where W represents the observed (respondent's answer) dichotomous dependent variable. Cases with positive values of W^* are observed as $W=1$, while cases with negative or zero values of W^* are observed as $W=0$. The idea of a latent W^* is that an underlying propensity to well-being generates the observed state. While the propensity cannot directly be observed, at some point a change in W^* results in a change in what is observed (Long and Freese 2001). In logit models, the marginal effect for categorical variables indicates how $P(W=1)$ changes as the categorical variable changes from 0 to 1, keeping all other variables constant (at their values or averages). So, the marginal effect for a categorical variable x_k is $P(W=1|X, x_k=1)$–$(P(W=1|X, x_k=0)$ (Williams 2012). Logistic regression assumes that the observations are a random sample from a population (i.e., i.i.d.) where the model is expressed as in (1), (2) or (3). Goodness of fit of a binary logistic regression model is tested by *estat gof* command (Archer and Lemeshow 2006) using Stata/IC 14.2. Marginal effects of x_k is calculated by $\partial Pr(w=1)/\partial x_k = Pr(w=1)*Pr(w=0)*\beta_k$ (DeMaris et al. 1990:273) where x_k are OS_i, PS_i, SS_i, SE_i and SC_i, $x\beta = \sum_k \beta_k x_k$ and $Pr(w=1) = 1/(1+exp(-x\beta))$.

Ordinal regression model (logit) or ordered logit model (OLM) which essentially gives treshold estimates and a test of proportional odds assumption is run. α_i in (1) gives threshold values for $i=1$ to $j-1$ where j is number of categories and i is the number of independent variables. Model specification is based on the test of parallel lines violation. Literature suggests to use either Generalized Ordered Logit Model (GOLM) or Multinom Logit Model (MLM) in case the assumptions of ordinal logit model are violated (Williams 2006). 4WHAP is explained by OLM which has a form $logit[Pr(W \le j) = \alpha_j - \sum \beta_i x_i$. The strength of the relationship is measured by McFadden's pseudo R^2 statistics, which is based on the log-likelihood function for the model with the estimated parameters and the log-likelihood with the thresholds. Since pseudo R^2 values tend to be quite small compared to R^2 in multiple regression, values of 0.2 to 0.4 for rho-squared represent excellent fit (McFadden 1979). The higher pseudo R-squared indicates which model better predicts the outcome. Hence, increasing McFadden's pseudo R^2 values as spatial variables added indicate improvement in model likelihood over the null model (Hemmert et al. 2018).

The use of a latent variable framework controls for measurement error in the dependent variable (Brereton et al. 2008) and for multicollinearity problems. Collinearity diagnostics is checked based on all correlations, significance of t-stat and F, variance inflation factor (vif), correlation matrix and, eigenvalues and condition index using SPSS, and robustness of standard errors is checked using Stata/IC 14.2.

Appendix 6

Demographic, Socio-Economic and Social Capital Variables over Time-Framed Happiness

Survey evidence suggests that attributes such as gender, age, marital status, income, employment, health and education are important indicators of SWB. Weakness of explanatory power of socio-demographic factors is well-known in the literature of SWB. In this study, socio-demographic factors explained about 12% of happiness.

The effects of human trust were more significant on higher 1WHAP. Human trust has a stronger effect than seeing relatives or friends more than 1–2 times a week on higher 1WHAP and on higher 4WHAP. The effect of seeing relatives or friends more than 1–2 times a week versus less than once a month was the weakest in explaining higher 1WHAP. Table 13 shows average marginal effects of socio-demographic variables over time-framed happiness. Results indicate that gender effect is not significant in explaining time-framed happiness. The effect of age category 54–65 relative to 18–29 shows spatial significance over 1WHAP. This effect is negative, stronger and more significant than PHAP and 4WHAP. The effect of being divorced or seperated relative to being married decreases the probability of 1WHAP by 23.9 pp when all spatial variables are included in the model. Household size shows no spatial significance.

The relationship between locations and 4WHAP shows that health status was the most significant SE variable to explain 4WHAP. Hence, health status is included in all models of 4WHAP as a SE variable. SC is human trust, PS is the safety of neighborhood and SS is poverty or neighborhood inequality. The marginal effects of these explanatory variables over 4WHAP are calculated. The results indicate that a change from poor health to neutral status increases the average probability of being happy by 0.094 points or 9.4 pp; a change from poor health to good health status increases the probability of being happy by 30.7 pp. A change from "no human trust" to "human trust" increases the probability of being happy by 13.1 pp. A change from "being unsatisfied with neighborhood safety" to "being satisfied with neighborhood safety" increases the probability of happiness by 13.5 pp.

Table 14 shows that being unemployed versus currently employed and being retired versus currently employed are negative and significant in explaining time-frame happiness. When poverty line was replaced by Gini coefficient, the effects of employment status over time-framed happiness did not significantly change.

Appendix 7

Objective Spatial Variables and Time-Framed Happiness

Residential area effects account for 5.4–10.2% of the variance in present happiness, for 8.9–15.3% of the variance in one-week happiness and 2.7–6.2% of the variance in four-week happiness.

City residence through health was more significant on 1WHAP than that through employment status, hence city residence effects were predicted through health. However, neighborhood safety and poverty effects were predicted through employment status due to higher significance. Overall, explanatory power was higher with employment status included in Models 1 of 1WHAP. Logistic model goodness of fit for 1WHAP with 535 observations and 315 covariates indicates that Pearson $\chi^2(301)$ is 332.79 and χ^2 probability value is 0.1003. This test suggests that the model is a good fit.

Relative to reference category "remote neighborhoods", the signs of AME where significant are as desired for PHAP and for 1WHAP. In Model 1, the marginal effects of OS over PHAP, as shown on the first column of Table 1 which are obtained from GOLM, indicates that, on average, those living in vehicle dependent neighborhoods are about 30% points (pp) more likely than those living in remote villages and towns to be happy at present. In other words, living in vehicle dependent neighborhoods increases the probability of being in higher PHAP by 0.300. The marginal effect of OS over 1WHAP, as shown on the first column of Table 2 obtained from BLM, shows that, on average, those moving from remote neighborhoods to intensive public transport areas increases the probability of being happy by 0.278. This increase slightly goes up when perceived spatial variable is added and goes down when social spatial variable is added. Moving from remote neighborhoods to any urban neighborhood increases the probability of being happy or very happy in the last week, i.e. Pr(W = 3).

Table 3 gives the outcomes for 4WHAP using OLM. The first column under 4WHAP indicate AMEs of the areas over higher four-week happiness through SE, the second column through SE, SC and PS, and the third column through SE, SC, PS and SS. The marginal effect of OS over 4WHAP, on the sixth column of Table 3, shows that, on average, those living in intensive transit junctions are 26 pp more likely than those living in remote neighborhoods to say they are happy in the last 4 weeks. Alternatively, spatial effects of moving from remote neighborhoods to intensive transit junctions increase the probability of higher happiness in the last 4 weeks by 0.26.

Health status reports lower spatial significance but higher explanatory power than employment status on 4WHAP. Through employment status higher 4WHAP shows the same spatial significance (< .001) in all regions except intensive public transport areas. However, spatial effect is around 5 pp stronger in each region except in secondary pedestrian areas where the effects are about the same. Through health 4WHAP shows higher spatial significance at intensive transit junctions ($p < .01$) and in secondary pedestrian areas ($p < .05$). In either way urban areas compared to remote are more related to 4WHAP on which the effects were predicted through health status for the sake of explanatory power.

Appendix 8

Environment Dissatisfaction, Perceived Spatial Variables and Time-Framed Happiness

All PS pairwise difference effects over time-framed happiness through control variables are reported in Tables 4, 5, 6 and 7.

Environment dissatisfaction effects account for 5.1–10.2% of the variance in present happiness, for 12.1–15.2% of the variance in one-week happiness and 2.5–6.2% of the variance in four-week happiness. Perceived spatial effects account for 7.0–11.9% of the variance in present happiness, 11.8–15.3% of the variance in one-week happiness and 4.1–8.5% of the variance in four-week happiness.

Table 4 shows the average marginal effects of environment dissatisfaction pairwise differences over higher PHAP. The pairwise effects of environment disturbances on higher PHAP relative to "no problem" are all negative as desired. Of which only distance to services—no problem (AME = −.274, −.199, −.191; $p<.01,<.05,<.05$) and poor public transport—no problem differences (AME = −.293, −.247, −.241; $p<.01$ all) are significant. On average, poor public transport versus no problem decreases the probability of being in happy or very happy category by 29.3 pp. Similarly, distance to services—air pollution (AME = −.209; $p<.05$) and poor public transport—air pollution differences (AME = −.228, −.194, −.197; $p<.01,<.05,<.05$) are significant. The effects of environment disturbances relative to "poor public transport" are all positive, and significant except for distance to services—poor public transport difference. Of which noise and traffic—poor public transport (AME = .235, .212, .208; $p<.01$ all), air pollution—poor public transport (AME = .228, .194, .197; $p<.01,<.05,<.05$) and no problem—poor public transport (AME = .293, .247, .241; $p<.01$ all) are significant. The effects of distance to services—noise and traffic difference (AME = −.217; $p<.05$) and poor public transport—noise and traffic difference (AME = −.235, −.212, −.208; $p<.01$ all) are negative and significant. The effects of environment disturbances relative to "distance to services" are all positive, and significant except for poor public transport—distance to services difference. The effects of noise and traffic-distance to services difference (AME = .217; $p<.05$), air pollution-distance to services difference (AME = .209; $p<.05$) and no problem-distance to services difference (AME = .274, .199, .191; $p<.01,<.05,<.05$). are positive and significant.

Table 5 shows the average marginal effects of environment dissatisfaction pairwise differences over higher 1WHAP. Significance of the pairwise effects of PHAP weakens or dissappears when compared to 1WHAP. Distance to services—no problem difference significance drops to $p<.05$ from $p<.01$ and to no significance from $p<.05$. AME increases 8.6 pp (from AME = −.274 to AME = −.184). The other pairs on this column remains insignificant. On air pollution column significance of distance to services—air pollution difference dissapears. However spatial significance of poor public transport—air pollution difference increases from $p<.05$ to $p<.01$ and but AME decreases about 2.6–6.0%. The other pairs on this column remains insignificant. On the poor public transport column, spatial significance of air pollution increases from $p<.05$ to $p<.01$, and positive spatial AME increases about 6 pp. Spatial significance of noise and traffic remains the same but positive spatial AME increases 7.1–7.4 pp. Spatial significance of no problem remains the same but positive spatial AME increases 3.1–3.4 pp. On the noise and traffic column, spatial significance of poor public transport remain the same, but negative spatial AME increases 7.1–7.3 pp. On the distance to services column, spatial significance of "no problem" dissappears.

Table 6 shows the average marginal effects of environment perception pairwise differences over higher 4WHAP. Significance of the pairwise effects of 1WHAP weakens or dissappears when compared to 4WHAP. Distance to services and air pollution columns show no spatial significance. On noise and traffic column, 1WHAP relative income significance of poor public transport-noise and traffic difference drops one level from $p<.01$ to $p<.05$, and negative spatial AME increases (from −27.9 pp to −13.7 pp) substantially 14.2 pp. This shows contribution of relative income to higher 4WHAP compared to 1WHAP. On poor public transport column, 1WHAP relative income significance of noise and traffic—poor public transport and no problem—poor public transport differences drops to $p<.05$. 1WHAP significance $p<.01$ of air pollution dissappears. On "no problem" column, 1WHAP relative income significance of poor public transport-no problem difference drops one level from $p < .01$ to $p < .05$, and negative spatial AME increases (from -27.3 pp to -14.6 pp) substantially 12.7 pp.

Table 7 shows the average marginal effects of perceived spatial pairwise differences over higher PHAP higher 1WHAP and higher 4WHAP. All higher happiness show positive spatial effects and significance of satisfaction with housing cost ($p < .01$) and satisfaction with neighborhood safety ($p < .01$). On average, being satisfied with housing cost versus dissatisfied increases the probability of being happy or very happy at present by 26.2 pp., and that of higher one-week happiness by 20.3 pp and that of higher four-week happiness by 16.1 pp. This shows that the probability decreases over time. The same can be said for satisfaction with neighborhood safety with a decrease at lower rates. These results indicate that although spatial significance remains the same, the average marginal effects show no contribution from objective and social spatial factors which lower the probability of higher happiness.

Appendix 9

Social Spatial Variables and Time-Framed Happiness

Social spatial effects account for 2.3–12.1% of the variance in present happiness, 7.2–15.3% of the variance in one-week happiness and 1.2–7.9% of the variance in four-week happiness.

Table 8 shows the effects of social spatial variables over time framed happiness. The results indicate that the effects of lower income are negative and significant on PHAP, 1WHAP and 4WHAP. When income changes from higher to lower category through employment status, residence location, social contact and safety of neighborhood, the probabilities of PHAP, 1WHAP and 4WHAP decreases by 9.8 pp, 11.9 pp and 9.9 pp, respectively; i.e. $\partial \Pr(\text{PHAP}=3)/\partial \text{SS}_1 = -0.098 < 0$, $\partial \Pr(\text{1WHAP}=1)/\partial \text{SS}_1 = -0.119 < 0$, and $\partial \Pr(\text{4WHAP}=1)/\partial \text{SS}_1 = -0.099 < 0$. On the other hand, the effect of Gini coefficient on 1WHAP is negative and significant on 1WHAP, suggesting that living in neighborhoods with more inequality is related to lower 1WHAP. More specifically, 1% increase in neighborhood inequality decreases the probability of higher 1WHAP by 23.9 pp. However, the effect of Gini coefficient on PHAP and 4WHAP shows no significance.

Appendix 10

Interaction Effects Over Time-Framed Happiness

The unemployed urban residents are more likely to feel less happy was tested by modelling time-framed happiness as a linear function of the interactions (between place of residence and employment status, and between place of residence and environment perception) for each component:

$$W_i^* = \alpha_i + \beta_0 SE_i + \beta_1 OS_i + \beta_{01} SE * OS_{ij} + \beta_3 SC_i + \beta_4 PS_i + \beta_{41} PS * OS_{ij} + \beta_5 SS_i + \varepsilon_i \quad (2)$$

where $SE*OS_{ij}$ is the i-th employment status in the j-th location and $PS*OS_{ij}$ is the i-th perception in the j-th location.

Due to high unemployment rates in and around the city center, we expect the coefficient of interaction term to be negative, $\beta_{01} < 0$.

The estimates of β_{01} in Model (2) confirms our expectation that being unemployed in or around city center have adverse spatial effects on 1WHAP, i.e. $\beta_{01} < 0$. Unexpectedly, the results also revealed that being retired in or around city center also had adverse spatial effects on 1WHAP. Being unemployed and living in central pedestrian ($p < .005$), secondary pedestrian ($p < .05$) and vehicle dependent ($p < .05$) areas were negative and significant. Being a retired resident in central pedestrian area was negative and significant ($p < .01$) in explaining 1WHAP. Being a retired resident in a intensive public transport area was negative and significant ($p < .05$) in explaining PHAP. There was no significant interaction effects on 4WHAP.

The estimates of β_{41} in Model (2) confirms our expectation that air pollution in intensive public transport areas have adverse spatial effects on 1WHAP, i.e. $\beta_{41} < 0$. Noise and traffic in secondary pedestrian areas was negative and significant ($p < .01$) in explaining PHAP. Distance to services in intensive public transport areas was negative and significant ($p < .01$) in explaining 4WHAP. Satisfaction with neighborhood safety in central pedestrian area and satisfaction with housing cost in heavy transit junctions both were positive and significant ($p < .10$) in explaining 4WHAP.

Using logistic models or OLS more interaction effects were investigated. Being in poor and moderate health status in central pedestrian areas, and being in moderate health status in transit areas have significant ($p < .05$ for all) adverse effects on PHAP. Only one age*location interaction effect was significant on PHAP. The coefficient was positive. One category increase in age (from 18–29 to 30–41 yrs) and a change of location from remote to transit area increases PHAP by 1.3 categories.

No interaction of any other demographic or socio-economic variable with residential area has significant effect over time-framed happiness. Human trust*65 + age interaction was negatif and significant ($p < .05$) on 4WHAP and human trust*54–65 age interaction was positive and significant ($p < .05$) on PHAP. Human trust*higher income interaction was negative and significant ($p < .05$) on 1WHAP. High income individuals who hesitate to trust people are less happy than low income people who do not trust people.

Appendix 11

Spatial Heterogeneity of Time-Framed Happiness

Spatial heterogeneity of time-framed happiness was tested by Model 1 based on significance and strength of spatial effects. We expect micro-level spatial heterogeneity, i.e., different time-framed happiness in different residential areas and different perceptions in different residential areas. The spatial heterogeneity of time-framed happiness was confirmed by the results that the higher short-term happiness is more likely in vehicle dependent neighborhoods; the higher one-week happiness is more likely in central pedestrian areas; and the higher four-week happiness is more likely in transit junctions. The estimates of interaction effects also confirms that air pollution in intensive public transport areas, noise and traffic in secondary pedestrian areas, distance to services in intensive public transport areas all have negative and significant effects over one-week, short-term and four-week happiness respectively. Satisfaction with neighborhood safety in central pedestrian area and satisfaction with housing cost in heavy transit junctions both were positive and significant in explaining four-week happiness. Satisfaction with housing cost was more related to short-term happiness and neighborhood safety was more related to four-week happiness.

Tables 1, 2 and 3 which also show different spatial effects on different time-framed happiness confirm that intra-urban time-framed happiness is spatially heterogeneous.

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