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THE RELATIONSHIP BETWEEN NATURAL URBAN SURROUNDINGS AND RESIDENTS' WELL-BEING

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Abstract
Access to green space contributes positively to human well-being. One option for inhabitants of urbanized areas is to visit green space within the city borders; another option is to travel beyond them. The former is in favor of ample city arrangements, the latter points in the direction of densely built accumulations. To reveal existing preferences, subjective ratings are contrasted with an objective counterpart: the difference between non-permanent habitable and built-up areas. Equilibrium between natural and urban space receives good ratings. Prevalence of built-up areas within communities is evaluated much worse compared with a bigger urban overhang in the adjacent surrounding.
Keywords: well-being, geographical information system, living environment

1. INTRODUCTION

In a review paper written by Matsuoka and Kaplan (2008: 9) human needs are classified into two major groups: "nature needs" relate to the "physical features of the environmental settings", whereas "for the human-interaction needs the role of the environment is less direct". With respect to human needs in common, life satisfaction (LS) contributions are split up into four basic types of capital: human, social, built, and natural capital (Vemuri & Costanza, 2006). As human and built capital is significantly correlated with LS, but is not correlated with the natural capital, findings corroborate the exclusive positive effects of nature contact. Consequently, the total dollar value of ecosystem services emerged as a relevant factor in explaining LS.

Costanza et al. (2007: 271) stress the importance of "natural capital (renewable and nonrenewable goods and services provided by ecosystems)" for quality of life (QOL). The contribution of natural capital to regional QOL presents itself in two different ways, environmental and human-made services (Collados and Duane, 1999). Additionally the maintenance of natural ecosystems and ecosystem goods and services are considered as key concerns for the continuity of life functions. Findings show that contact with nature improves QOL and positively stimulates emotional, mental and physical health (Schipperijn et al., 2010). Furthermore, Matsuoka and Kaplan (2008: 14) confirm the importance of nearby residential natural environments for human well-being: "Urban residents express a desire for contact with nature and each other, attractive environments, places for recreation and play, privacy, a more active role in the design of their community, and a sense of community identity". Therefore, the study at hand focuses on the relationship between the residents' surrounding and its wellbeing contributions. The following chapters discuss the landscape quality from different perspectives and the empirical part finally relates objective as well as subjective measures of the same.

1.1. Landscape and well-being

Research shows that natural capital captures important QOL determinants presenting themselves in regionally different ways, but their measurement is sometimes challenging. GIS based attempts to value natural capital predominantly apply one of two approaches, the hedonic pricing method (HP) or the LS approach. The HP method determines the economic value of an ecosystem or environmental service by observing willingness-to-pay changes if characteristics of amenities are varied. The LS approach makes use of self-reported LS evaluations to derive the marginal price of amenities or public goods. In this way, self-reported well-being evaluations act as a proxy for the utility of amenities. Regression models provide coefficients for services not having a price at the market. Those coefficients are connected to the income coefficient and allow for the calculation of willingness-to-pay in monetary terms (Ambrey & Fleming, 2014).

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Ferreira et al. (2006), Brereton et al. (2008), or Moro et al. (2008) perform LS approach calculations including natural indicators and found positive effects on self-reported well-being statements. Other work supports at least a modest improvement in explanatory power when including the natural environment and climate (Ambrey & Fleming, 2011a).

Another independent factor examined using the LS approach is ecosystem diversity (Ambrey and Fleming, 2014). Simpson's diversity index including richness and abundance of ecosystems had a positive effect on LS.

Another study used urban nitrogen dioxide pollution (Welsch, 2007). Air pollution influences LS in a negative way, and pollution reductions in some countries have resulted in welfare gains. Other studies tackling the air pollution impact deduct a significant negative effect on LS by two strongly related variables: subjectively perceived levels of air pollution as well as objective air pollution measures (MacKerron & Mourato, 2009).

Scenic amenity has been evaluated in terms of the way in which public preference for scenery captures factors relating to cultural, historical, geological, environmental, aesthetic, scenic and landscape qualities, and has been incorporated into geographical information systems (GIS) (Ambrey & Fleming, 2011b). A positive relationship between improvements in scenic amenity and LS is deducted. Various relationships exist between landscape preference and indicators of naturalness, like the level of succession, the number of woodland patches, and the shape index of edges (Ode et al., 2009). Visual expression influences human beings in various ways including aesthetic appreciation, health, and well-being (Tveit, 2009).

The role of amenities and their relationship with QOL was investigated using five different aspects: climate, land, water, winter recreation, and developed recreational infrastructure (Deller et al., 2001). A multitude of sub-indicators of all five main aspects highlight the importance of natural capital with respect to rural economic growth.

Thus, QOL varies with environmental quality.

1.2. Nature and leisure

Leisure satisfaction is generally handled as an autonomous life domain influencing subjective well-being, but an alternative approach is to treat leisure satisfaction as one dimension related to other dimensions (Hribernik & Mussap, 2010). Therefore, LS might also be indirectly influenced by the natural environment, for example via leisure life. Several leisure-related pathways containing QOL enhancing aspects and being dependent from natural resources were detected (e.g. Iwasaki, 2007; Brajša-Žganec et al., 2011; Neal et al., 1999). The role of the natural environment cannot be neglected, as natural capital forms part of the leisure services delivered by the physical surroundings in form of place-centered variables (resources, environment). Their interaction with person-centered variables (participation, satisfaction, attitude) has been shown to yield the highest QOL effects (Lloyd & Auld, 2002). For example, the number of recreation areas, appearance and maintenance of the area, opportunity/place to recreate without conflict/feeling crowded or interference from other visitors, or compatibility of recreation activities in the area, contribute to satisfaction scores and the positive influence of each varies with environmental factors like green, public and commercial areas (Burns et al., 2003). Ábrahám et al. (2012) relate wellness, sedentary leisure, social leisure or self-realization to the natural surrounding as well.

1.3. Access to green space

Distance generally plays a crucial role in the development of socially sustainable communities (Soltani, Hoseini, & Talebi, 2015). Particular attention has to be given to the findings that proximity to natural environment was very important for the residents living at the urban fringe as the urban environment influences social satisfaction differently depending on commuting times (Delmelle et al., 2013). Other authors have examined this link in detail and analyzed factors influencing the use of green space (Schipperijn et al., 2010). The larger the distance to any type of green space, the lower the frequency of visits. Green space within 300m of every inhabitant is recommended, as those with the nearest green space 300-1000m from home benefit far less. Woodlands are ideally located within a 6-8 min walk from home (Coles & Bussey 2000). The amount and location of green space is identified as a crucial factor affecting the residents' satisfaction as well by Jorgensen et al. (2007). Moreover, type of habitat is a relevant factor for LS too (Ateca-Amestoy et al., 2008). Small towns with less than 20,000 inhabitants generally report lower levels of leisure satisfaction because the distance to where manifold services are provided is often too large.

Furthermore, the frequency of use varies by type of green space (beach, sea, lake, park, green space, forest, or other open natural area): forests are the least popular compared to other green space types (Schipperijn et al., 2010). Contrary to this finding, out of seven different features of the natural environment (manicured/landscaped areas, trees, gardens, mowed areas, forests, open fields, and wetlands), forested areas were found to have the strongest impact on residents' satisfaction (Kaplan & Austin, 2004). Manifold physiological benefits (e.g. lower diastolic blood pressure, lower heart rate) and psychological benefits (e.g. better subjective ratings, less negative and more vigorous moods) of forested areas are identified (Tsunetsugu et al., 2013).

Other approaches provide insight into the interconnectedness between activity patterns and environmental characteristics like green alongside routes and proximity of locations (Arentze et al., 2009). Environmental factors tested are the degree of urbanization of the residential environment, population

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density, housing density, and green space accessibility and include both distance to and size of the green space (Kemperman & Timmermans, 2008). People living in urbanized areas were found to engage more in cultural activities, visiting restaurants, cafes and discos. People living in lower urbanized areas spend more time on out-of-home recreational activities. A possible explanation is the increased number of outdoor recreation possibilities in less urbanized living regions compared to inner city areas. Reflections from different research fields stress that even small-scale urban natural parks positively influence the wellbeing of communities in terms of nature-based recreation, physical activity, health improvements, socialization, or social capital and community (Baur & Tynon, 2010). Inner city residents benefit from green space in urban centers, especially low income groups who lack time, money or access to remote nature-based recreation.

However, besides all positive effects of urban contact with nature, negative effects cannot be ignored. Varying land and rent prices reduce access to urban green space in a hard to control manner. Discrimination due to the price for a square meter of land is often driven by racial/ethnic and socioeconomic disparities whereby socioeconomically deprived neighborhoods have worse access to green public space (Dai, 2011). Similarly, leisure life is driven by societal inequalities and ethnicity (Spiers & Walker, 2009). Inequalities are undesired developments with respect to green space access (Zheng et al., 2011) and resulting health benefits, yet have become apparent in manifold ways over the centuries (Thompson, 2011).

Furthermore, urbanization goes hand in hand with a decline in forest area and increasing fragmentation (Medley et al., 1995). The lower the distance from the urban core, the smaller the mean sizes of forest patches. Especially in transient regions, suburban zones, mean-patch sizes increase greatly with distance to the center and green space has relatively more complex patch shapes. Bolund and Hunhammar (1999) discuss the benefits of services produced by urban ecosystems (air filtration, micro climate regulation, noise reduction, rainwater drainage, sewage treatment, and recreational and cultural values) and present a crucial debate on the importance of urban hinterlands: city growth either results in increased urban density, or in sprawled cities which may capture more urban ecosystems, but simultaneously occupy more land. Jepson and Edwards (2010: 421) argue by their list of 14 sustainable development principles for residential development with a high density: "More compact development will reduce the development pressure on open space." Studies tackling e.g. the problem of traditional postwar suburbs in terms of social capital were also mentioned by Adelfio (2016) and point into the direction of a dense type of housing. Although rural equivalents often outweigh the advantages of urban ecosystems, urban green space nevertheless has a substantial impact on QOL in urban areas. A well thought-out combination might be the most fruitful solution. For example, studies making use of GIS capture the accessibility and equity of public parks to derive recommendations for public authorities (Nicholls, 2001). Especially in the construction of city environments, the distance, access, attractiveness and livability of the place is important in order to minimize the perceptual gap between public service providers and users.

1.4. Landscape evaluation

As already mentioned, determining the value of ecosystems and natural capital is tricky because of the intangibility of aspects like environmental aesthetics or landscape attractiveness, as well as the difficulty in evaluating long-term benefits (Costanza, 1997). Consequentially, a lot of research has been carried out related to urban growth and planning issues. However, a deficit has been identified in terms of the failure of landscape models to spatially capture public perception, attitude and social landscape (Ryan, 2011). Daniel (2001) states that there are two main measurement streams: one focuses on subjective visual aesthetic values which are evaluated by human perception-based judgments; the other focuses on objective biophysical features which are independent from human preferences, and which typically rely on evaluations made by experts using design parameters being translated into formal features. This problem tackling the relationship between QOL and places and their characteristics have also been distinguished by Rogerson (1999): non-survey approaches in which attributes and characteristics are selected by experts and therefore exclude personal characteristics, and those which feature opinion surveys containing individual priorities and weightings. If both considerations are not combined, visual aesthetics may mesh with the ecological functioning of the environment and vice versa, e.g. the impact of man-made elements (wind turbines, business parks, agricultural buildings like barns) on the scenic beauty (de Vries et al., 2012).

Negative and unsustainable ecological effects have to be avoided through sensitive land management strategies which consider as many factors as possible during the urban planning process. Spatially integrating social and perceptual information using GIS has the power to incorporate residential and community satisfaction. The individual has to be treated as the unit of analysis. "If survey-derived data can be geo-referenced to a person's residential location (…), analysis might be able to be conducted to see how attitudes and perceptions about a particular issue or area of study, such as landscape preference or development issues, vary by block, neighborhood, or even individual." (Ryan, 2011: 363) Therefore, spatial heterogeneity plays a major role in determining the effects of similar circumstances at different locations. Rusche (2008) shows on a regional level that spatial autocorrelation is a critical issue too. The 'First Law of Geography' declares that nearby regions are more related than distant ones. In addition, the spatial aggregation level is a crucial factor and must be established under the 'Modifiable Areal Unit Problem' which tackles the difference between administrative units and functional areas. Therefore, the study at hand connects subjective individual geo-referenced perceptions aggregated at the administrative community level with objective data on the type and size of landscape within as well as beyond 10 different community borders.

2. METHODS

2.1. Primary data

Primary data was collected in the course of a publicly funded project conducted in ten different Austrian communities representing a mix of urban (with a maximum of 1,714,142 inhabitants) to rural (with a minimum of 999 inhabitants) communities. Mailing addresses were randomly selected either out of telephone books, ordered from a commercial company, or, for one out of the ten towns, selected from a full list of inhabitants received from the major. Printed questionnaires were sent to these addresses including a response envelope. In two out of the ten communities inhabitants were contacted via a questionnaire and a response envelope enfolded in the local newspaper. Inhabitants who received a printed questionnaire were asked to distribute the website address of an online survey to reach more respondents via snowball sampling. All in all, 856 inhabitants from the ten communities completed the print version of the questionnaire. 110 inhabitants answered the questionnaire online. Overall 966 responses to the following question are used: "Please indicate how landscape characteristics of your hometown influenced your well-being during the last month" (3-point Likert-scale: 1 – negatively, 2 – neither nor, 3 – positively). The distribution of respondents through the ten communities presents itself as follows: 341, 90, 89, 86, 85, 74, 60, 60, 56, and 25. The nature of this data source copes with problems listed in the literature part. More precisely, the individual is taken into account by making use of empirical data in the form of individual subjective landscape ratings of the residential neighborhood.

2.2. Secondary data

The first part of the secondary data is derived from Statistics Austria, an independent and non-profit-making federal institution under public law. Free spatial data on the type of landscape separates non-permanent habitable and built-up areas. A locality is defined as *"a coherent built-up area containing residential property as well as industrial, commercial and other economic/cultural facilities. Irrespective of municipal boundaries and other administrative divisions, localities constitute coherent built-up areas. (…)"* (Statistics Austria, 2012). Therefore, polygon edges of all localities and non-permanent habitable areas take account of the 'Modifiable Areal Unit Problem'. Borders of the ten study communities and their adjacent communities out of the 2,354 Austrian communities complete the secondary data source.

15 communities in Austria are so-called "Statutarstädte" governed under separate municipal law, which is also the case for two of the ten study communities. Each of these communities is split into districts: one

into 23 and the other into 17 districts. As three out of the ten study areas are districts within such communities they will be treated as separate administrative units to account for differences between districts of larger cities too.

The term *study communities* will be used consistently for the ten study areas throughout the text. All geo-data are projected to the WGS84 (World Geodetic System 1984, EPSG: 4326) reference coordinate system, a spheroidal reference surface (Figure 1). Localities are black colored. Non-permanent habitable areas are dark-gray shaded. Community borders are light-gray shaded.

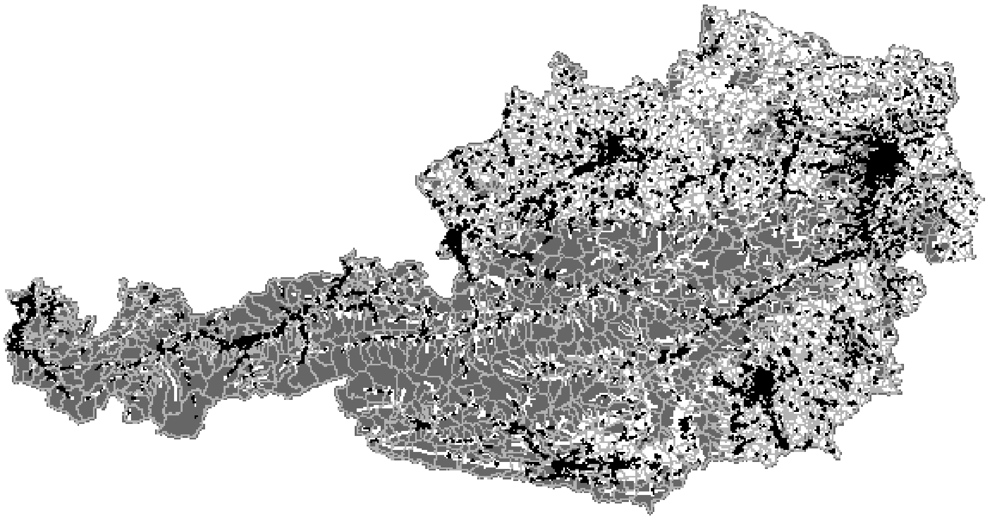

FIGURE 1 - NON-PERMANENT HABITABLE AREA (DARK-GRAY), LOCALITY AREA (BLACK) AND COMMUNITY/DISTRICT BORDERS (LIGHT-GRAY)

3. RESULTS

The 'First Law of Geography' states that locations closer to each other are more similar to each other than distant locations. Therefore distance is seen as a measure of interdependency. The secondary data source has the power to incorporate the surrounding of each community to capture spatial association. Proximity can be defined by Moran's I. This linear association correlates the values of communities with the weighted average of its neighbors. The idea behind this spatial autocorrelation measure is that similarity is determined by whether communities have adjacent borders or not. If they have a mutual border with the ten study communities they are assumed to play a decisive role in the course of the landscape evaluations. Non-contiguous communities are expected to have no crucial impact. Figure 2 outlines the neighboring network of one of the ten communities. Seven communities are located in the direct neighborhood.

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The southern border of one of the ten study communities is contiguous with the country's border. As this is only a small part of the whole community border and foreign datasets were not available, characteristics of the adjacent foreign area are ignored and the weighted average of the six remaining domestic neighbors is used.

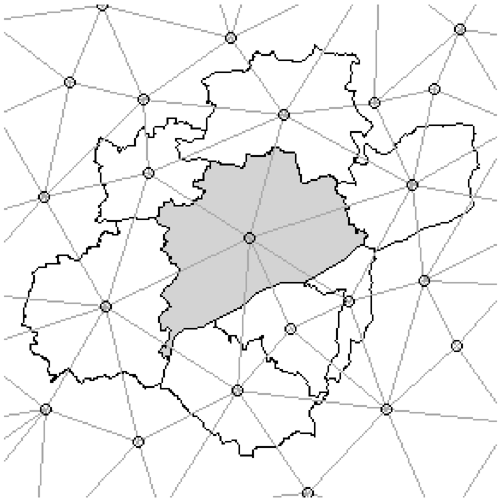

FIGURE 2 - NEIGHBORHOOD DEFINITION.

Intensity of the natural landscape is objectified as the difference between the non-permanent habitable area – light gray striped – and the built-up area – dark gray striped – and exemplified for one out of the ten communities in Figure 3. The same specification is applied for the surrounding communities.

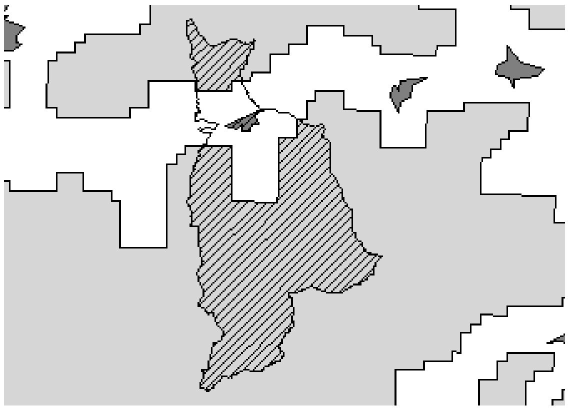

FIGURE 3 - NON-PERMANENT HABITABLE AND BUILT-UP AREAS WITHIN A COMMUNITY.

The non-permanent habitable and built-up areas not covered by the community – light and dark gray not striped – are not used for the variable describing the intensity of the natural landscape within the community but for the variable capturing the neighborhood, the spatial lag difference. Let i and j denote any two communities out of all $1, \ldots, n$ communities, $n = 2{,}354$. Let C be the binary connectivity matrix, with $c_{ij} = 1$ if i and j have mutual borders, and $c_{ij} = 0$ if this is not the case. Each row vector C_i is divided by the total number of neighbors of i, namely $\sum c_i$. Each row of the row-normalized connectivity matrix W sums up to 1 and leads to equal weights for all neighboring communities (Ward & Gleditsch, 2008).

The difference, d_i, between the non-permanent habitable and built-up areas for a community i is defined as the difference between the absolute percentage value of the non-permanent habitable area within the community, nat_i, and the absolute percentage value of the built-up area within the community, urb_i. Hence, $d_i = nat_i - urb_i$. Numeric information on the ten communities is presented in ascending order of the difference values in Table 1.

TABLE 1 - SUBJECTIVE AND OBJECTIVE LANDSCAPE INFORMATION ON THE TEN COMMUNITIES.

	Non-permanent habitable area	Built-up area	Difference	Landscape evaluation
1	0.00%	100.00%	-100.00%	1.93
2	0.00%	55.96%	-55.96%	2.79
3	0.00%	48.40%	-48.40%	2.39
4	0.00%	41.02%	-41.02%	2.79
5	0.00%	27.87%	-27.87%	2.53
6	0.00%	8.40%	-8.40%	2.82
7	44.75%	3.72%	41.03%	2.88
8	55.62%	8.49%	47.14%	2.88
9	65.78%	2.06%	63.72%	2.82
10	81.28%	0.82%	80.46%	2.83

Landscape evaluations positively match with percentage differences. But two highly urbanized communities coming with a value of 2.79 stand out. Their ratings are quite good despite the built-up share within these communities outweighing the share of the non-permanent habitable area. Structural conditions of their surroundings should clarify this phenomenon.

Let $\bar{d}$ denote the average difference between nat_i and urb_i, $\bar{d} = \frac{\sum_{i=1}^{n}(nat_i - rb_i)}{n}$. The standardized difference for any $i = 1, \dots, n$ is given by $z_i = \frac{d_i - \bar{d}}{\sqrt{\frac{\sum_{i=1}^{n}(d_i - \bar{d})^2}{n}}}$. The spatial lag difference for any $i = 1, \dots, n$ is given by $lag_i = \sum_{j=1}^{n} w_{ij}\, d_j \forall j \neq i$. Let $\overline{lag}$ denote the average spatial lag difference, $\overline{lag} = \frac{\sum_{i=1}^{n} lag_i}{n}$. The standardized spatial lag difference for any $i = 1, \dots, n$ is given by $zlag_i = \frac{lag_i - \overline{lag}}{\sqrt{\frac{\sum_{i=1}^{n}(lag_i - \overline{lag})^2}{n}}}$.

The Shin spatial scatterplot (Ward & Gleditsch, 2008) makes use of the two variables with the purpose of giving insight into the spatial correlation between communities and their neighbors (Figure 4). The abscissa gives the standardized percentage difference between the non-permanent habitable and the built-up area within the communities, z_i. The ordinate gives the standardized spatial lag of the before-mentioned difference, $zlag_i$. The quartered box gives the ±2 standard deviation boundaries of both variables. Short gray lines along the abscissa and ordinate and the two dashed curves represent the distribution of all communities. The vertical dotted line represents the equilibrium between the non-permanent habitable and built-up areas within the communities. The horizontal dotted line represents this equilibrium within all adjacent communities.

Consequently, communities located to the right/left side of the vertical dotted line are communities whose non-permanent habitable area is bigger/smaller than their built-up area. Communities located above/below the horizontal dotted line are communities whose surroundings' non-permanent habitable area is bigger/smaller than their built-up area. In more detail, communities located in the north-east/south-west quadrant are communities which are the same as their respective neighbors in that they have non-permanent habitable areas which are bigger/smaller than their built-up areas. Communities located in the south-east/north-west quadrant are communities whose non-permanent habitable areas are bigger/smaller compared with their neighbors' shares.

The sloped dotted line represents the equilibrium between the within community difference and the neighbors' difference. Communities and their neighbors located along this line have an equal overweight of non-permanent habitable areas if located above the intersection with the other two dotted lines, and an equal overweight of built-up areas if located below. Numbers above the ten highlighted dots are average subjective landscape ratings to bridge the gap between subjective person-centered evaluations and objective place-centered geo data.

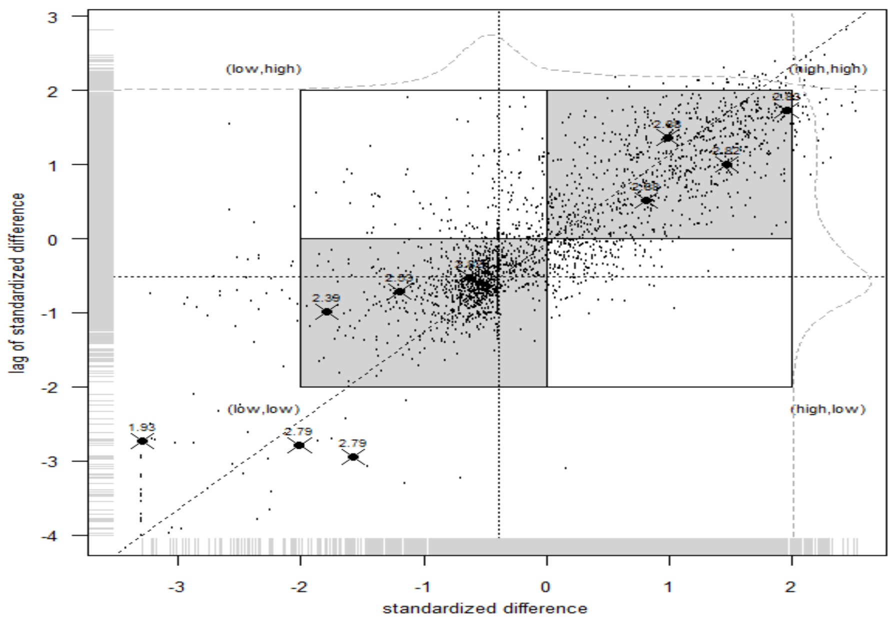

FIGURE 4 - EXTENDED SHIN SPATIAL SCATTERPLOT.

All in all there are 2,392 communities with 13,734 links and an average number of 5.74 neighbors.

If the fraction of the non-permanent habitable area is greater/less than the fraction of the built-up areas within the communities as well as within their neighbors, high/low values of communities go hand in hand with high/low values of their neighbors along the sloped dotted line. High correlation coefficients (Pearson's r: .82, Spearman's ρ: .79) between the standardized difference and the standardized lag difference support the theorized phenomenon of the First Law of Geography.

Communities within the shaded/non-shaded boxes represent communities with homogeneous/heterogeneous neighbors from the country's average ratio perspective. If the difference, d_i, within communities and their neighbors is exactly the same they will be located on the 45 degree line. Communities located at the intersection of the dotted lines have a balanced ratio of non-permanent habitable and built-up areas within the community as well as within their adjacent communities. It can be treated as the spatial grand equilibrium between nature and urbanization within and around a community. For a community to be situated exactly at this point two conditions have to be met. First, the square kilometers of the non-permanent habitable area have to match the square kilometers of the built-up area within a community which equals a ratio of 1:1. Second the ratio within the surrounding communities also has to be 1:1. The most extreme cases are 0% vs. 0% and 50% vs. 50%. The absolute square kilometer sizes are not relevant in this respect as the remaining landscape which is neither non-permanent habitable nor built-up is treated as a neutral zone. Most of the communities are settled close to the grand equilibrium indicating an overall country balance.

Additionally a tendency toward the left of the midpoint is observed for a large group of communities characterized by a slight overrepresentation of built-up areas. But these findings stand opposed to skewed distributions of both difference variables pointing from the center of the graph into the upper right corner.

The four communities captured by the shaded top right box demonstrate an over proportional share of non-permanent habitable areas within and around their borders, and receive the best landscape evaluations. The three communities captured by the shaded bottom left box have a preponderance of built-up areas within and around their borders, but this overweighting is not extreme enough to lead to bad landscape evaluations. They received mediocre evaluations compared with the seven other communities.

The area outside the quartered box segregates extreme communities. The three remaining communities at the south-west edge of the figure feature built-up areas which greatly exceed their non-permanent habitable counterparts. One of the three is located above the sloped dotted line, the other two below. The community above the sloped dotted line has a higher level of urbanization than its neighbors and ends up with a less than neutral well-being influence. In contrast, the two communities below the sloped dotted

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line, which have lower degrees of urbanization than their neighbors, are rewarded with much better landscape ratings and positive well-being contributions.

4. DISCUSSIONS

The introduced approach takes up the issue of public landscape perceptions. It focuses on well-being contributions originating from residents' hometown surroundings. Land-use models which fail to reference individuals' evaluations of the geographical area may lead to improper political actions which do not match actual inhabitants' needs. But despite this necessity, individual subjective landscape evaluations are rarely available. Therefore, determining a close connection between subjective ratings and objective geo-data on the surrounding realities would be welcome in order to bypass the financial hurdle of the primary data collection effort. Free availability stresses the use of such data sources.

Weaknesses of the study are the small number of communities with primary data and small sample sizes in some of the study communities. Due to the intentional inclusion of small rural communities, representativeness improvements are somehow limited by the nature of the study itself. A broad mix of heterogeneous communities in terms of the number of inhabitants accompanied by economic factors was prioritized compared to homogeneous urban characteristics. This goes to the detriment of the study's generalizability. The assumed equivalence of the non-permanent habitable area as a substitute for natural surroundings and built-up areas as urbanized formations can also be questioned. Only highly urbanized regions were treated as counterpart for highly natural regions or non-permanent habitable areas. Additional information on sparsely populated areas to fine-tune the results requires an equivalent natural counterpart. To cope with these limitations future research should incorporate further alternative landscape information sources.

5. CONCLUSIONS

The first law of geography is verified by the numerical closeness of the difference between non-permanent habitable and built-up areas within communities and their surrounding communities. Most of the communities feature a relatively even balance between the square kilometers of the non-permanent habitable area and the square kilometers of the built-up area. For a small group of communities a preponderance of natural areas is observed. For the broad mass of communities only a slight deviation from equilibrium is discovered, in the form of an overrepresentation of urbanization. In conjunction with subjective landscape ratings all these findings indicate a good overall balance between natural and urban space, as communities with a mild dominance of urbanization also receive good well-being contributions.

Only extreme communities with much smaller natural areas receive worse evaluations. Larger built-up areas within the community compared with its neighbors got much worse evaluations compared to communities where the urban share is larger in the surrounding communities than within the own borders. Findings indicate a higher importance of non-permanent habitable areas or natural landscapes respectively within the own community compared with the neighboring communities. Commuting distances might play a role here.

These arguments seem to recommend ensuring ample urban arrangements which avoid extremely dense levels of urbanization missing natural space. Valuable input to the ongoing debate between ample urban arrangements versus dense built landscapes is provided, suggesting in favor of the former, and should inform the work of city architects, municipal planners, landscape designers, citizen groups and environmental decision makers from the viewpoint of the residents.

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