International Journal of E-Planning Research
Volume 10 • Issue 4 • October-December 2021

Defining Parameters for Urban-Environmental Quality Assessment

Oto Novacek, Slovak University of Technology, Slovakia
Jesus Lopez Baeza, HafenCity University, Germany
https://orcid.org/0000-0002-4092-1782
Jan Barski, HafenCity University, Germany
Jorg Rainer Noenning, HafenCity University, Germany
https://orcid.org/0000-0002-1681-7635

ABSTRACT

Measuring the quality of the urban environment has been a matter of research rooted in different fields of knowledge. Several methods and indicators have been deployed through the years, as have horizontal approaches from mixed perspectives. However, currently established indexes to measure urban performance depend on the actual definition of quality and on the weighted relevance of the different features influencing it. This contribution compares the level of emphasis paired by established indexes to measure urban quality, in contrast to what people mention the most when asked about what they like or dislike about the urban environment. The underlying idea is to obtain firsthand information about the way people make decisions about their movements in urban space. As a result, the authors observe a lack of correlation between the two groups of indicators and between the key urban elements driving positive and negative emotions. In conclusion, the authors observe a tendency of people to perceive and report individual physical elements rather than intangible concepts like safety or comfort.

KEYWORDS

Emotional Mapping, Quality Assessment, Spatial Perception, Urban Environment, Urban Performance

INTRODUCTION

In the context of e-Planning and Digital City Science, digital citizen participation, smart monitoring, and urban simulations are some of the multiple resources being implemented along with the mining of information from communication technologies as part of the urban planning processes. This includes the use of data analytics to assess spatial interventions by supporting the explorations and negotiations prior to the place-making process (Konieva, Knecht and Koenig, 2019).

Social simulation solutions utilized for this purpose incorporates the simulation of people as agents making decisions. From this perspective, modeling the decision processes that occur at an individual level –choice modeling– is currently being developed for application in urban research.

DOI: 10.4018/IJEPR.20211001.oa10

Choice modeling is based on parametrization, i.e. what parameters individuals consider and the way they assess them when making decisions.

A current matter of dispute in the field of choice modeling research is the standardization of weights when parametrizing cognitive processes, e.g. the question of how to establish if someone would prefer to walk the shortest route or across the closest park. In order to address the economics of that question, the weight of speed versus the weight of the travel cost need to be assessed by exploring key urban environmental quality indicators with a specific focus on human perception and considering the socioeconomic and urban-morphological factors. We hypothesize that a specific set of features of urban space is targeted by people when assessing its quality, especially when it comes to making decisions.

The work presented in this paper aims at setting a direction for future studies on the parameters of choice of action determined by the evaluation of the quality of urban space by citizens.

Post-positivist theory approaches cities defending the human focus from a strong procedural and context-driven perspective. In contrast, the praxis of urban planning processes did not tend to be based on empirical knowledge until the first decade of the 21st, evidencing a theory-practice gap (Allmendinger 2002). Currently, the methods for place-making are being redeveloped with urbanism being a 'human and social discourse' (Chase et al. 1999). Following the modern and postmodern approach to urban systems, the spatial distribution of places and the defining formal characteristics of urban structures play the main role in driving the social performance of spaces (Hillier, 2007). In this context, the spatial relation between places would drive location choice (Svetusk, 2010) and consequently determine urban life.

In contrast to this approach, we claim that the social and behavioral dynamics of people are not only determined and conditioned by the morphological characteristics of places, but also anthropologically based on cognitive and perceptive processes, which are developed socially and influenced by practices and narratives related to the meaning of places and their intangible values. In other words, the spatial configuration of urban space –locations, distances, and available routes– are not the only factors to be considered when making choices on where to go, when to go, how to go, or what to do. Instead, a number of environmental factors not only linked to tangible elements are also taken into account, such as perceived environmental quality e.g. streets being good, safe, comfortable, entertaining, stylish, etc.

This is especially relevant to some approaches to scenario observations to inform decision-making, such as agent-based modeling (ABM) and Digital Twin solutions. They use state-of-the-art technology with the aim of monitoring and predicting 'what if' scenarios. With this in view, there is a tendency towards simulating the complexity of cities in order to gain knowledge of their holistic behavior. Thanks to defining relations, systems, and networks, one would be able to predict future tendencies and react to them with actions, policies, and decisions, on such diverse issues as congestion, pollution, gentrification, natural disasters, or traffic rerouting. To achieve such a level of definition of urban systems, it is necessary to define the behavior of individual entities in detail. In this context, social simulation comes as a discipline in the intersection of computational simulation tools, and sociological and psychological studies of human cognition, reaction, and behavioral patterns. Pragmatically speaking, in order to simulate the response of pedestrian flow to a certain event, such as the closure of a sidewalk due to construction works, one needs to define the way people react to certain stimuli when they are walking.

More in depth, the choice of action of people in the environment surrounding them would be driven by (1) physicality of space, which can be treated as stimuli evoking (2) responses to those stimuli assessed by (3) internal cognitive processes such as evaluation of needs and desires, weighting of the economy of the journey, individual's long-term strategies, search for comfort, enjoyment, etc. In other words and as a one-dimensional example, an individual deciding which route to take to walk from an origin to a destination would choose the shortest path as a result of an internal cognitive process of evaluating the walking distance following all the other routes. However, what would happen if the shortest route happened to be the most unpleasant, thus throwing off the most frequent

first criterion – the length and duration consideration? The desires for pleasure and enjoyment are based on needs constructed socially and anthropologically, which are not exclusively related to the topological characteristics of the street network but to intangible values such as the feeling of safety, comfort, or simply the enjoyment of the presence of other people. Therefore, the simple choice of which route to take becomes a complex problem in which multiple parameters come into play.

The valuation of the perceived quality of spaces is linked to a potential influence when people decide whether to go to a place, or whether to choose a street as the path to take from one place to another. To answer the question of "what are good individual spaces for individuals", Martí et al. (2017) deepen the analysis of how the quality of spaces is defined to eventually theorize about life in the city. They state that successful public spaces are those containing social life and being highly frequented by the public. More specifically, good public places are attractive (Carmona et al. 2010), animated by public transit, accessible, comfortable, safe (Lang 2006), and show a high level of social relevance and liveliness (Martí et al. 2017). These affirmations are consistent with Cerrone's (2015) work when claiming that spatial configuration is not the unique engine of urban life, but social actions and relations are determinant. Meanwhile, the notions of perception of space and the image of places have been explored in classical works such as Lynch (1960), which presented findings pertaining to how elements of the urban landscape give shape to individuals' mental representation of the city, and how they both see and also later recall given features of the urban tissue. A little more recently and working not in a built environment focus but a psychological one, Proshansky (1978) wrote about place identity, understanding it as the relationship between the characteristics of an individual and the physical environment, made up of a complex pattern of conscious and unconscious ideas, feelings, preferences, tendencies, etc. somehow relevant to a specific environment. Both of these contributions, in turn, fertilized the ground for the growth of environmental psychology, in whose eyes, following Gifford (2007), there happens a transaction (a two-direction flow) between an individual and the space: the individual shapes the space, while the space influences the behavior of the individual.

The topic of 'choice' has already been addressed from the research field of computational social simulation. From a technical perspective, simulations based on reactive behavior (stimulus with direct response) are built upon behavioral outcomes based on rational choices, such as maximizing utility or profit (Bourdieu 1984) or aiming to satisfy needs within the limits of a 'bounded rationality' (Simon 1990). Travel time, proximity to places, resistance of the network, are some of these rational parameters that would be considered by a person traveling from an origin to a destination. In contrast, social simulations including proactive behavior (stimulus, cognitive processing, response) also consider those processes based on intangible values, emotions, or social rules. In this context, Damasio (1994) describes behavioral models driven by emotion rather than rationality, and Talavera-Garcia et al. (2015) implement a similar approach from a practical perspective to develop a set of parameters based on the combination of physical and perceptual elements to evaluate the quality of pedestrian routes including values such as attractiveness, accessibility, safety, or comfort. Bourgais, Taillandier & Vercouter (2017) deepen into these factors to establish a method to define agents in social simulations, including cognitive, emotional, and social bases. Nonetheless, the selection of specific parameters is often not detailed nor justified enough and is thus often taken for granted. Therefore, there exists a need for deeper research on indexes and parameters related to the quality of the urban environment, not using morphological parameters alone (e.g. size of plots), but also including social-based parameters (e.g. popularity of places) with direct influence in choice-making.

This paper is structured as follows; Firstly, a statement of objectives and the theoretical framework was introduced in this section. Secondly, we present an introduction to the case study context followed by a description of the methodology divided in two sub-sections, "Empirical Survey" and "Established indexes on urban performance". Thirdly, results are presented and discussed in detail. Later, conclusions are stated in the final section.

CONTEXT AND METHODOLOGY

The work presented in this contribution is deployed in the city of Bratislava, the capital and the biggest city of Slovakia. The city covers an area of 367,66 km^2 and it is home to approximately 430,000 registered residents according to the Statistical Office (2017), and over 600,000 registered and unregistered residents plus 100,000 daily incoming commuters according to telecommunication tracking analytics (Konik 2019). Bratislava lies on the border with Austria and Hungary. It is the only capital city lying on the border of three sovereign states, making it a unique case involving a high volume of international daily commuters, short-stay tourists, and migrants. Bratislava is crossed by the Danube river. Its riverbanks and floodplain forests are the natural dominant of the urban natural landscape, along with the Carpathian hills and forests. Morpho-typologically, the city is developed around a medieval core that surrounds the Bratislava Castle and St. Martin cathedral. This core is surrounded by the compact city fabric of the 19th and early 20th Centuries, followed by extensive modernist residential construction of modular concrete apartment blocks built among vast green areas. The historical cores of attached villages are often connected to agricultural heritage (e.g. vineyard houses), and areas with single-family housing estates. Brownfields, the former factories dating back to the early industrialization period of this region, are also quite common.

Bratislava is a cultural hotspot, attracting active and productive populations such as students and young professionals. The closeness to international borders along with the productive capacity and job opportunities create both national and international migration flows to Bratislava, with considerable impact on the socio-cultural fabric sometimes deriving in lack of integration or social exclusion issues. Furthermore, the age distribution of the population depicts an aging tendency, in which the amount of the older population is growing considerably with respect to other age groups (Statistical Office, 2017). Therefore, attracting younger generations and integrating them well into the socio-cultural fabric of Bratislava could potentially be the focus of the city's policies in the upcoming years.

As it is described below, data from the survey Emotional Mapping (Pánek 2018) of Slovakia from 2018-2019 were used for analyzing the image of the city from the user's perspective. The use case of Bratislava was selected in view of the availability of nation-wide emotional mapping of Slovakia with a higher data density and spatial extent in the Bratislava region, due to its population, size of its metropolitan area in the wider Slovak context, and the presence of diverse urban landscapes i.e. urban fabric morphological types. In addition, the unique location of the city, close to two major metropolises –Budapest and Vienna– is the basis of Bratislava's multicultural identity. These factors constitute an asset in comparison with other Slovak regions.

To assess the specific elements of urban space that potentially drive social dynamics (i.e. people making choices) it is necessary to detect and define specific features and issues that are relevant for perception of quality – *what do people consider when they decide where to go?* – and the weight of each of them in the individual cognitive internal assessment – *is accessibility more important than comfort?* –. Several urban performance indexes have already been deployed by international agencies and actors. The spatial features and urban issues they consider are not always aligned, nor is the weight of each particular index or parameter. In order to address these shortcomings, this work (1) evaluates the results of empirical surveys, in which a set of ca. 1000 people were asked to describe positive and negative aspects of various spots in Bratislava, Slovakia, to establish a list of urban issues in which people focus their perception of the city. After that, it (2) lists established international indexes on urban performance and extracts the most frequent measurements, and observes their correspondence to the specific topics in which people were focused on the empirical surveys.

Empirical Survey

The empirical survey described in this contribution lies within the field of participatory mapping tools supported by Geographic Information Systems, i.e. Public Participatory GIS tools (PPGIS) (Sieber 2006). PPGIS can be described as a part of geo-information science disciplines with a particular

focus on the use of geospatial tools to support public participation, citizen engagement, and citizen consultation in the processes of urban governance and planning (Tulloch 2008). PPGIS methods are used in the creation of strategic planning documents, e.g. 'Manual of Public Spaces in Slovakia' (Burák, Burák, Nováček 2019).

Gathering information and data from a wide population should not be seen merely as collecting opinions on a particular issue. Instead, this information should become one of the focal points for the planning practice. The qualitative information obtained via Voluntary Geographic Information (VGI) or PPGIS includes geolocation to potentially identify relevant locations from the perspective of the inhabitants, and at the same time reveal their collective identity, relevance, or perceptive image. Panek, Ivan & Mackova (2019) utilize these tools to describe the possibilities of comparing feelings, such as fear, felt by people in public spaces, using statistics on offenses and crimes. Panek et al. (2020) also utilize PPGIS tools to evaluate the evolving sense of place of some neighborhoods due to gentrification. The use of PPGIS tools also offers the possibility of adding a qualitative approach to previously acquired quantitative movement data (e.g. Space Syntax mobility analysis) to generate more accurate analytics of urban networks (Novacek, Diezka 2019).

Our empirical surveys were performed from March 2018 to May 2019 in the context of the project 'Emotional Mapping' (Pánek 2018). These surveys are designed as a communication between decision-makers and the public, and as a tool with which citizens can evaluate several aspects of urban space with the aim of granting involvement of all persons or groups that have a legitimate right to be in the process. As a result, the information gathered using the Emotional Maps platform creates one of the supporting documents for planning investment actions, developing transport concepts, or developing green areas, thus supporting the democratization of the urban environment.

In the context of Emotional Mapping as PPGIS platforms, two approaches are being used: remote and in-place mapping. In-place mapping and face-to-face participation help initiate interaction between participants and make it possible to collect deeper layers of information, as discussions take place and consensus is reached. However, the number of inputs is limited to the number of participants attending the public events. To solve that bias, a remotely accessible online platform is used to complement data obtained in public events. Remote online platforms do not initiate interaction between participants, but they can help to collect a broader variety of inputs across wider socio-demographic groups without temporal or spatial boundaries derived from the organization of an event in a place, adding the possibility of anonymizing data collection, if needed.

From the user perspective, the central component of our PPGIS platform is an interactive map. This map provides standard functionalities such as zooming, positioning, or interactively searching. On top of that, participants can add their own inputs, i.e. 'feelings', in specific locations. In terms of data input, the key geometry type of entry is a point containing metadata in text format, i.e. comments for the given entity or location, and answers to specific questions, along with anonymized ID indexes, aiming at gathering demographic data about age and gender of the participants. These last data types were entered separately, at the end of the mapping process.

The bias in the demographic target in citizen participation is an unresolved issue. Online platforms tend to focus on younger the population familiar with the use of digital technologies – digital natives– thus indirectly excluding people with no access to internet or connected devices (e.g. the elderly). On the contrary, offline meetings, while open to the general public, require spatial and temporal availability, which indirectly excludes a different range of population. Moreover, offline public meetings tend to be less attractive for the younger population, who prefer the use of digital online technologies. As stated above, the dataset utilized in this work combines inputs from online and offline procedures as an attempt to overcome the demographic biases inherent to both processes.

During 'Emotional Mapping', 993 participants entered 18736 data inputs, among which 1806 included qualitative comments in text form. Participants were asked eight questions about the *overall quality of space* –four about positive aspects and four about negative ones– and their responses were grouped into the following topics: (1) Landscape elements such as the presence of green or

waterbodies, (2) Landmarks and architecture mentioning elements of the built space, (3) Mobility and infrastructure addressing issues such as public transport, connectivity or traffic, (4) Health, comfort and safety, mentioning mainly environmental factors such as the presence of noise, pollution, or shade (5) Specific elements of public space and street furniture, (6) Activities and sociability, reporting social interaction and people performing actions, and (7) Amenities, noticing urban functions, the possibility of action, and economic activity. Within the topic of the *overall quality of space*, 788 respondents answered the positive questions with 3819 data inputs. The average age-gender of the participant was 31.8 years old and 65.6% male, 25.2% female, 9.2% N/A. The negative questions were answered by 739 respondents with 3306 data inputs, and an average age-gender of 31.2 years old and 64.9% male, 26.9% female, 8.2% N/A. Responses to specific questions are clustered into topics according to the specific urban issues that they refer to (1 to 7), and classified as positive or negative. The classification in positive and negative is established prior to the topic classification, as it is included in the phrasing of the questions explained below.

The basis of the *overall quality of the space* was chosen because the formulation of the questions allowed for an experimental approach to the evaluation of sentiment included in the responses. It is also an efficient way of topic clustering by keywords. Respondents were asked *positive* and *negative* connotations directly, through the questions *"Which public spaces do you like to visit due to the overall quality of given spaces?"* and *"Which public spaces do you not like to visit due to unsatisfactory conditions?"*. The positive and negative classification is grounded within Schreuder's (2016) neurological studies, which claim that spaces are able to produce positive and negative emotions as a response to certain stimuli. Therefore, emotional responses consequences of stimuli at a perceptual level play a crucial role when framing urban space in our subjective memory of the city. Emotions are strongly linked to our bodily presence in physical space and framed by our sensory perception (Pallasamaa 2012). As a result, individuals tend to remember those places that produce a strong feeling of joy, beauty, security, but also fear or discomfort.

Established Indexes On Urban Performance

The process of deconstructing the complexity of cities in measurable quantitative parameters has been a matter of discussion in urban research, especially since the deployment of early computational models such as network analytics. In a broader context, multiple performance indexes aim at giving measurements to urban spaces, scoring sustainability, accessibility, morphology features, or quality of life, among others. Several of these urban indexes tend to focus on evaluating a given city's performance from cross-sector approaches, considering either various non-georeferenced sources, such as The Global Liveability Report (Economist Intelligence Unit, 2017) or the Global Power City Index (Ichikawa, Yamato & Dustan, 2017) or geo-referenced data such as Urban Audit (Feldmann, 2008), The Quality of life in the cities (Węziak-Białowolska, 2016), or The Boston Indicators (Wells, 2006), and producing general outputs applicable on a city-wide scale as general trends or patterns overall. Alonso et al.'s (2018) approach, Urban Performance Indicators, incorporates urban performance indexation extracted from granular-scale geo-data and deployed in agent-based simulations of the buildings and the life they contain on a neighborhood-scale. However, some of these urban space performance indexes tend to be evaluated under a narrowed-down selection of parameters related to mobility and transportation, leaving out key aspects of public space and activities quality assessment, specifically considering perceptual inputs.

These sets of indexes also consider non-tangible elements such as spaces being safe, active, or sociable. However, public access to the methods followed for calculation is limited in most of the cases, as well as the different weights given to each parameter, meaning that the way they value 'safety' and 'distance to green areas' to output a number that states 'the quality of this city is 6 out of 10 points' is sometimes untransparent. In this context, Wojnarowska (2016) works with several methods for obtaining data inputs, namely interviews, checklists, and spatial assessment, stating that synthetic indicators sum up the values of previously measured indexes of different natures.

The common foci that the different sets of indicators share are evaluated by counting the number of correspondences of topics across them. After that, the topics are ranked by frequency of mentions. On a later step, the topic rank is compared against the physical and perceptual clusters of features that people address in the empirical survey. As an example, the overall number of times that the topic of 'safety' is addressed by all the different sets of indicators is compared against the number of times addressing 'distance to green areas'. The proportional difference between those frequencies is compared afterward against the same difference obtained from the empirical survey Emotional Mapping i.e. the number of times that 'safety' and 'distance to green areas' are mentioned in responses given by people when explaining what they like or dislike.

RESULTS AND DISCUSSION

Empirical Survey

As explained above, the responses given by people were clustered by the specific urban issue they referred to. These topics were generated from a selection of keywords (nouns, adjectives, and verbs) extracted from the comments inputted by the participants in the system. Words such as 'tree', 'garden', or 'lake' would be clustered within the topic 'landscape'. By doing so, it was possible to distinguish which urban issues and which topics are associated with positive or negative descriptions of urban environments.

The demographic distribution of participants finds 70% of them between 20 and 40 years old, and a gender split of 65% male and 25% female. Compared to the demographic distribution of the city reported by the Statistical Office (2017), participants in Emotional Mapping are not a representative sample –erring towards older population and young migrant workers– and therefore this survey does not serve as a basis for fundamental research. However, it is a first experiment towards the use of new methods for citizen consultation using PPGIS tools, and qualitative analytics for subsequent planning assessment. Further implementation of similar approaches would need to cover the representative population bias in order to avoid potential structural inequalities inherent to contemporary planning approaches.

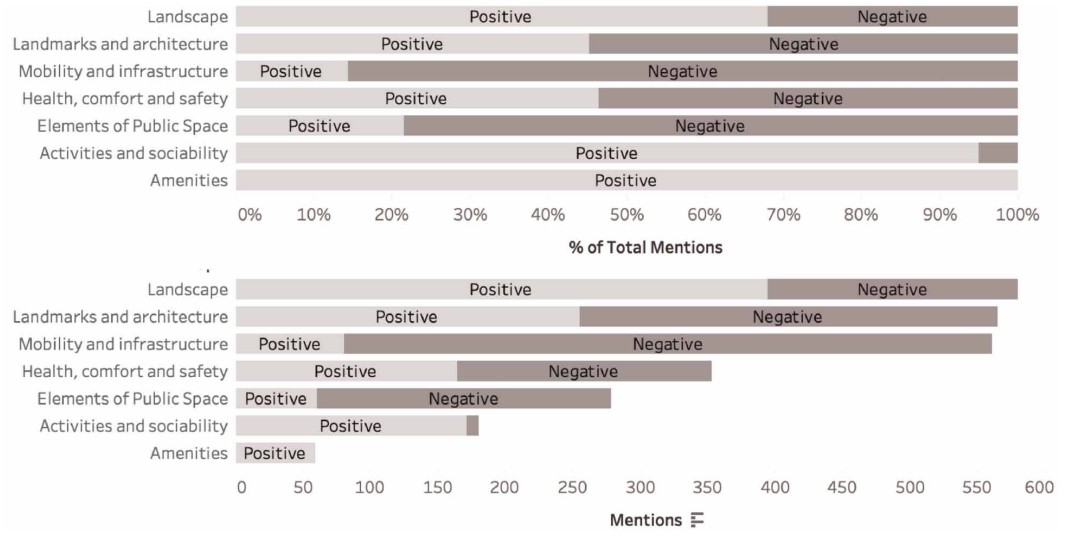
By observing the results of the text processing of all comments, it is possible to highlight the most frequent topics mentioned by the participants in Emotional Mapping. Said frequency observations highlight the topics of *Landscape, Landmarks, and architecture, and Mobility and infrastructure* as the most mentioned with over 550 mentions each, followed by *Health, comfort, and safety* with 350 mentioned. The number of mentions shows how often the topics are addressed by people. However, this research pairs special attention to the sentiment linked to the comments in which the topic is addressed, considering *Positive* and *Negative* comments within each of the topics.

From this perspective, by observing the ratio between positive and negative mentions to each of the topics, the interpretation of what people notice the most can differ from mere mention counts. Following this line of thought, Figure 1 portrays the topic of *Amenities* and *Activities and sociability* as those mentioned only when talking about positive aspects of the urban environment (over 95% of times). Opposite to that, *Mobility and Infrastructure* despite being one of the most popular topics in regards to the number of times it has been addressed, sentiment analysis shows that it is mostly mentioned within negative statements (over 85% of times) along with *Elements of Public Space* (over 80% of times).

Established indexes on Urban Performance

As described above, a similar computation of frequency is carried out in established indexes of urban performance. In contrast to the previous section, these observations do not consider any kind of sentiment associated with the valuation, meaning that neither positive nor negative connotations are associated with an index.

Figure 1. Ranking of topics by the number of positive and negative mentions in the empirical survey Emotional Mapping.



From the count of frequency in which each index was addressed, it can be observed in Figure 2 that established urban indexes pair special focus on *Health, comfort, and safety* issues, followed by *Activities and sociability*, and *Mobility and infrastructure*.

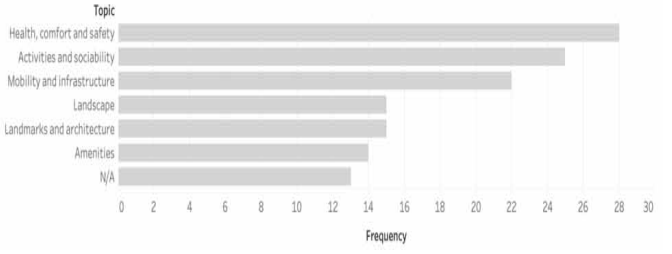
Empirical Survey vs Established Indexes On Urban Performance

A comparison of 'Established Indexes' and the results of the Bratislava survey is naturally limited due to imperfect compatibility: the categories in each set are not the same, of course. The aggregated indexes are all well-refined pieces of research that focus on *urban performance*, which gives them a clear analytical character and a kind of bird's-eye view legitimation, as they deal with broad matters like educational or economic parameters. Meanwhile, the survey in question is purely empirical (it collected people's remarks on spaces, per the name 'Emotional Mapping'), which, in turn, gives it a raw data character. This paper is the first processing of the gathered information.

Having acknowledged this limitation, we find it meaningful to juxtapose at least the top-ranked categories from the empirical survey and from a summarized category list from the 'Established Indexes'.

The first major remark is one of difference: while a category of spot-specific perception of elements of public space is absent from any of the five examined 'Established Indexes', it is included in the Slovak case study. The root of this difference is clearly methodological, namely in the decision of the authors of the respective researches to investigate or not the perception of these elements.

Figure 2. Ranking of topics by number of mentions by sets of indicators to measure urban performance



There are two easily identifiable commonalities between the 'Established Indexes' and the Bratislava survey: the first being the category of *infrastructure/mobility/transportation*: it is one of the most mentioned both among the established indexes and in the survey (third-most mentioned in both rankings). This comes not as a surprise, as this area is a fundamental component of man-made space. An interesting specification that can be offered is that in Emotional Mapping, over 80% of user comments on this category were negative. This clearly suggests that users of space tend to notice 'hard infrastructure' when it is a nuisance much more likely than when it is working properly (Figure 3, below).

Figure 3. Spaces reported with highest negative (left) and positive (right) emotions on the Empirical Survey. Credit: Peter Netri and Zora Pauliniová.

We can observe a discordance in the categories *Landscape,* and *Landmarks and architecture* being the most frequent topics mentioned in the empirical survey, while equally addressed in the bottom three categories of the established indexes on urban performance. While elements of landscape and the built environment can be perceptually associated with beauty or comfort (Figure 3, right), respondents mention those elements rather than the actual feeling of beauty or comfort, which, in contrast, is mostly addressed in the established indexes as *Health comfort and safety*. A plausible explanation following the theoretical discourse presented in the first section of this contribution is that people do not explicitly recognize these feelings but rather the origin or the cause of them; the environment and the physical context in which they develop their daily routines acts as the stimuli of cognitive process that drive the valuation of said environment as with positive or negative connotations. Whereas from a technical perspective, one could evaluate whether the feeling of thermal comfort is high or low, individuals, from a cognitive perspective one would mention whether there are trees or not.

Likely the most interesting set of findings this paper wishes to offer is the one deriving from the answers given by those who participated in the Bratislava survey. These findings revolve around the fact that people's statements tended to point to different phenomena in negative remarks than in positive ones. For instance, the *presence of other people* is associated with safety in the negative comments (e.g. lack of feeling of security caused by the homeless and loitering people), while it is associated with activities in positive comments (e.g. when commenting on children being able to play with other children in playgrounds or the pleasant business of some public spaces).

Further, there was a large number of qualifying terms on either side of the positive-negative division that did not have equivalents on the other; or, along the same lines, they were vaguer on one side and more specific on the other. Interesting examples of this phenomenon are words such as 'insecure', 'isolated', or 'insufficient' appearing in negative comments: they hardly had counterparts in the positive comments. This clearly suggests that they represent phenomena that are noticed by users of space only when they cause negative emotions. Meanwhile, positive terms such as 'good', 'pretty', 'nice' were noticeably vague compared to the negative ones, which were more specific and named problems more directly than the positive ones named virtues of spaces.

CONCLUSION

A question that naturally suggests itself is one about the most effective, sensible sets of parameters for evaluating the performance of a space in the context of choice modeling. As stated above, obtaining first-hand information about the preferences of people regarding specific aspects of the urban environment, could be a direction towards which urban simulation and modeling approaches turn in the near future. By doing so, models would not be based in general planning axioms but built from the foundation of context-based empirical knowledge at the level of internal choice and a cognitive processes as an individual level.

Regarding our particular case study, we believe there is no 'Holy Grail' of parameters on which researchers may one day arrive, since the conditions in which any such evaluation attempts take place are too nuanced, too complex for any set of measures to fit them all. What follows is that any set of parameters is going to be to some degree tailored to the case. Learning from the specific case of Bratislava rely on the emotions linked to context-based locations. Features such as riverbanks might not be present in other urban contexts. The presence of other people might be perceived as positive or negative based on a cultural context-dependent threshold. The volume of greenery might not be as valuable as the lighting conditions in some parks. The nightlife or cultural amenities supply might be perceived differently by different demographic segments. The results presented in this contribution must be considered within their sociocultural context and, therefore, the adjustment of the parameters set would need not only to be based on the desired types of information, but also to take into consideration factors such as local culture or climate/weather, etc. These add significantly to the difficulty of such investigations, as well as reduce comparability between pieces of research.

It is noticed that (1) there is no direct correlation in the intensity of the focus paired with specific topics by the established sets of indexes of urban performance, and what people notice and report. This might be caused by (2) people not focusing on the abstract impacts but intangible elements originating them. Further, and on an empirical level, (3) people tend to focus on different elements when evaluating positive and negative aspects of the built environment, which validates our hypothesis "a specific set of features of urban space are targeted by people when assessing the quality of it" and suggests further development of the urban quality assessment approach in different context-driven directions, meaning that the weight of each parameter should be adapted to the context. The positive/negative assessments are providing highly useful suggestions to planners and designers for solving problems with urban space, as well as accentuating positive values.

From a broader perspective, the process of fitting decisions based on the outcome of such survey analytics is in line with Carmona's (2014) definition of urban development as a 'place-shaping continuum', where the four distinct phases of design, development, use, and management are non-linear but rather define feedback loops. Following this understanding of urban development, involving an adaptation of spaces based on public assessment would establish a procedural approach pointing towards design, development, use, management, and back to design. This would address the theory-practice gap of the post-positivist approach to planning, through the use of e-Planning methods and tools on the intersection of urban-morphology, and socioeconomic factors.

REFERENCES

Allmendinger, P. (2002). Towards a post-positivist typology of planning theory. *Planning Theory*, *1*(1), 77–99. doi:10.1177/147309520200100105

Alonso, L., Zhang, Y. R., Grignard, A., Noyman, A., Sakai, Y., ElKatsha, M., & Larson, K. (2018, July). Cityscope: a data-driven interactive simulation tool for urban design. Use case Volpe. In *Unifying Themes in Complex Systems IX* (pp. 253–261). Springer Nature. doi:10.1007/978-3-319-96661-8_27

Bourdieu, P. (1984). *Distinction: A social critique of the judgment of taste*. Harvard University Press.

Bourgais, M., Taillandier, P., & Vercouter, L. (2017, May). Enhancing the behavior of agents in social simulations with emotions and social relations. In G. Dimuro & L. Antunes (Eds.), *Multi-Agent Based Simulation XVIII* (pp. 89–104). Springer. doi:10.1007/978-3-319-91587-6_7

Burák, M., Burák, D., & Nováček, O. (2019). *Manuál tvorby verejných priestranstiev mesta Prešov.* Košice: Architectural Studio Atrium.

Carmona, M. (2014). The place-shaping continuum: A theory of urban design process. *Journal of Urban Design*, *19*(1), 2–36. doi:10.1080/13574809.2013.854695

Carmona, M., Heath, T., Tiesdell, S., & Oc, T. (2010). *Public places, urban spaces: the dimensions of urban design*. Routledge.

Cerrone, D., Pau, H., & Lehtovuori, P. (2015). *A sense of place. Exploring the potentials and possible uses of Location Based Social Network Data for urban and transportation planning in Turku City Centre. Turku Urban Research Programme's Research Report 1/2015*. City of Turku. Retrieved from https://www.turku.fi/sites/default/files/atoms/files/turun_kaupunkitutkimusohjelma_tutkimusraportteja_1-2015.pdf

Chase, J., Crawford, M., & Kaliski, J. (1999). *Everyday Urbanism*. The Monacelli Press.

Damasio, A. R. (1994). *Descartes' error: Emotion, rationality and the human brain*. G. P. Putnam's Sons.

Economist Intelligence Unit. (2017). *The Global Liveability Report 2017*. London, UK: The Economist.

Feldmann, B. (2008). The Urban Audit—measuring the quality of life in European cities. *Eurostat, Statistics in focus 82/2008.* Retrieved from: http://telebit.gr/enfiles/self%20empl.PDF

Gifford, R. (2007a). *Environmental psychology: Principles and practice* (4th ed.). Optimal Books.

Hillier, B. (2007). *Space is the machine: a configurational theory of architecture*. Space Syntax.

Ichikawa, H., Yamato, N., & Dustan, P. (2017). Competitiveness of global cities from the perspective of the global power city index. In *Procedia Engineering, 198* (pp. 736–742). Elsevier. doi:10.1016/j.proeng.2017.07.125

Konieva, K., Knecht, K., & Koenig, R. (2019). Collaborative Large-Scale Urban Design with the Focus on the Agent-Based Traffic Simulation. In M. Haeusler, M. A. Schnabel, & T. Fukuda (Eds.), *Intelligent & Informed - Proceedings of the 24th CAADRIA Conference* (Vol. 2, pp. 221–230). Victoria University of Wellington. Retrieved from http://papers.cumincad.org/data/works/att/caadria2019_625.pdf

Konik, J. (2019). *V Bratislave žije vyše 600-tisíc ľudí, ukázali telefóny (+ mapy)*. Dennik N. Retrieved from https://dennikn.sk/1495410/v-bratislave-zije-vyse-600-tisic-ludi-a-dalsich-130-tisic-dochadza-ukazali-telefony-mapy/

Lang, J. (2006). *Urban design*. Routledge. doi:10.4324/9780080458656

Lynch, K. (1960). *The Image of the City*. The MIT Press.

Martí, P., Serrano-Estrada, L., & Nolasco-Cirugeda, A. (2017). Using locative social media and urban cartographies to identify and locate successful urban plazas. *Cities (London, England)*, *64*, 66–78. doi:10.1016/j.cities.2017.02.007

Novacek, O., & Diezka, M. (2019, September). Liquid Spaces: Understanding of Urban Spatial Networks through the Human Data. *IOP Conference Series: Materials Science and Engineering, 603*(3). Retrieved from: https://iopscience.iop.org/article/10.1088/1757-899X/603/3/032085/meta

Pallasmaa, J. (2012). *The eyes of the skin: architecture and the senses*. John Wiley & Sons.

Pánek, J. (2018). Emotional maps: Participatory crowdsourcing of citizens perceptions of their urban environment. *Cartographic Perspectives*, (91), 17–29. doi:10.14714/CP91.1419

Proshansky, H. M. (1978). The city and self-identity. *Environment and Behavior*, *10*(2), 147–169. doi:10.1177/0013916578102002

Schreuder, E., van Erp, J., Toet, A., & Kallen, V. L. (2016). Emotional responses to multisensory environmental stimuli: A conceptual framework and literature review. *SAGE Open*, *6*(1). Advance online publication. doi:10.1177/2158244016630591

Sieber, R. (2006). Public participation geographic information systems: A literature review and framework. *Annals of the Association of American Geographers*, *96*(3), 491–507. doi:10.1111/j.1467-8306.2006.00702.x

Simon, H. A. (1990). Bounded rationality. In J. Eatwell, M. Milgate, & P. Newman (Eds.), *Utility and probability* (pp. 15–18). Palgrave Macmillan. doi:10.1007/978-1-349-20568-4_5

Statistical Office of Slovak Republic. (2017). *Number of the Population by Sex - SR, Areas, Regions, Districts, Urban, Rural (yearly).* Retrieved from: http://statdat.statistics.sk/

Talavera-Garcia, R., & Soria-Lara, J. A. (2015). Q-PLOS, developing an alternative walking index. A method based on urban design quality. *Cities (London, England)*, *45*, 7–17. doi:10.1016/j.cities.2015.03.003

Tulloch, D. L. (2008). Is VGI participation? From vernal pools to video games. *GeoJournal*, *72*(3), 161–171. doi:10.1007/s10708-008-9185-1

Wells, A. K. (2006). *The Boston Indicators Project: the role of indicators in supporting environmental efforts in the Boston metropolitan region* (Doctoral dissertation). Boston, MA: Massachusetts Institute of Technology.

Węziak-Białowolska, D. (2016). Quality of life in cities–Empirical evidence in comparative European perspective. *Cities (London, England)*, *58*, 87–96. doi:10.1016/j.cities.2016.05.016

Wojnarowska, A. (2016). Assessment Model of the Quality of Public Space of Town Center. *European Spatial Research and Policy, 23*(1), 81-109. Retrieved from: https://www.ceeol.com/search/article-detail?id=426964

Oto Novacek holds MSC in Urban planning and design from the Slovak University of Technology in Bratislava. He is PhD candidate at the Department of Urban Planning and Urban Design of the Slovak University of Technology in Bratislava. Moreover he has experiences from both private practice of urban planning and architecture in Slovakia and Germany, as well as with work with public organizations (e.g. Bratislava municipality, the Permanent Mission of Slovakia to the United Nations in New York). His work focuses on the correlation of people and space and on the development of more flexible tools of urban planning and design based on data analysis, visualisation and experimental simulation.

Jesús López Baeza is an MSC in Architecture. He works as Research Associate in CityScienceLab - HafenCity Universität Hamburg, and Project Architect in SPIN Unit ÖU, where he has led and participated in several international projects in Europe and Asia. He is Ph.D. candidate at the Department of Building Science and Urban Planning of the University of Alicante. His work focuses on socio-spatial phenomena applying data analysis and visualization techniques to observe urban dynamics in the field of advanced spatial analysis.

Jan Barski holds a Master of Science degree in spatial planning from the Wroclaw University of Technology and a Bachelor of Arts degree in English studies (translation) from the University of Wroclaw. His PhD thesis was dedicated to the topic of industrial suburbanization, while his experience as assistant teacher revolved around regional development, European policies, city-building, and spatial analysis. His further academic interests include European programmes and the overlaps of planning and language sciences. In his career, he has been both a member and the leader of international and cross-disciplinary teams which have worked on scientific research and project applications. His responsibilities at the CityScience Lab consist of an overall engagement in the Lab's project involvement, with special focus put on European programmes, as well as of research activities.

Jörg Rainer Noennig is Professor for Digital City Science at the CityScienceLab at Hafencity University Hamburg and director of the Wissensarchitektur Laboratory of Knowledge Architecture at TU Dresden. Between 1998 and 2001 he practiced as a freelance and employed architect in Tokyo, among others at Ishiyama Experimental Underground Architecture Factory and Arata Isozaki & Associates. From 2001 he was Research Associate at TU Dresden, where he was appointed Junior Professor for Knowledge Architecture (2009-2015). He has taught at different universities in Japan, USA, China, Italy, Switzerland, and Angola. He was Visiting Professor at Universit degli Studi dell l´Aquila and at ISEN Toulon. He has published several books and more than 100 scientific papers and essays. He has won several prizes, scholarships and awards, incl. the Grand Prize of the European Association for Architecture Education (EAAE).