Optional and necessary activities: Operationalising Jan Gehl's analysis of urban space with Foursquare data

Abstract: The article presents a method to operationalise Jan Gehl's categorisation of dweller's activity patterns in public space using Foursquare data. The "Urban Activity Wheel" method is instrumental in showing how location based social media data is beneficial to understand the distribution and variety of contemporary activity patterns. Re-organising both location-based social media data and statistical sources, unearths emerging activity patterns across scales from local to regional city making. Urban Activity Wheel shifts focus from the traditional functional analysis of urban space towards understanding activities and, thus, the human perspective of use, practices and new agencies. A specific analysis, the Shannon-Wiener Index of the complexity implemented on urban activities, gives further hints about the experiential qualities and development opportunities of urban spaces and neighbourhoods.

Keywords: Activities, Public Space, Social Media, Urban Analytics, GIS, Jan Gehl

1 Introduction

Fifty years after their original formulation, many of Jan Gehl's ideas are still popular and keep influencing the practice designers, academics and policy makers. Liveable cities and regional centres, densification, pedestrianisation, high-quality public space, active street-frontage and programmed events have become standard practices, with Gehl's own architectural company as a visible player today. But many things have also changed since the 1970s. The influence of information and communication technologies (ICT) on cities and the urban system has been debated since the 1980s (Brenner and Schmid, 2017; Castells, 2001; Graham and Marvin, 2002) but today appears to present its effects on the public sphere. For public urban space, the recent popularisation of mobile Internet connection and the linked introduction of near-ubiquitous smart devices is a crucial issue, still to be conceptualised and probed. Our agency as users of space and as activators of social phenomena is changing. The role of physical space and age-old locational logics are mutating.

During the past decades, the overall form of western cities has changed very slowly, while social norms, cultural practices and classic economic models have been dramatically remodelled around information and communication technologies – and they still keep changing today at a fast phase. Spatial structures may seem to no longer mirror social structures and mimic mobility patterns. To test this claim it is necessary to look at the relation between spatial configuration and activity patterns.

This paper presents a method to map and analyse activity patterns through the operationalisation of Jan Gehl's classification of human activities (Gehl, 2013) utilising mainly data from the social network Foursquare. More specifically, we canter on mapping and measuring the variety and popularity of urban amenities to gain information about what activities one city can offer and how the spatial connections between social and economic amenities are characteristic to the local, urban or regional contexts.

Challenge to study the contemporary, mediated urban spaces

Urban form is a classic object of enquiry in architecture and planning. Currently, digital connectivity challenges the power of physical space in explaining how we use and experience urban places. Whole new patterns of local, city-wide, regional and international uses are emerging. In architecture and urban planning, a rich tradition of analysis and practice foregrounds physical space and spatial configuration as the set of constraints that shape flows of people and direct the evolution of urban activity patterns.

The spatial distribution of places is directly related to the characterisation of urban morphology and temporal patterns of settlements (Hillier, 2007). Spatial relations that conduct the choice of location of these places have been studied by several scholars (Sevtsuk, 2010). However, social dynamics are not exclusively determined by the morphology of a place but they have an anthropological basis. Social needs – need for security, for openness, of play, for expression, isolation and encounter, etc. – are human requirements generated and developed in accordance to cultural practices developed in physical place. It is crucial to map and comprehend these relations within their social and cultural frames of reference to gain the dweller's perspective of the intangible features of the urban fabric.

Structure, function and form are not sufficient for the generation of social relations; they can only favour it. In the context where social platform became ubiquitous, the socio-cultural expression and economic transactions are no longer space-bound. Instead they dramatically influence the determination of social needs, which can be influenced by global trends as well as by local phenomena.

In this context, the collection and study of activities that people engage with becomes fundamental to learn more about contemporary life in the city. In urban planning, there is a long-lasting tradition of functional zoning and, more generally, a consideration towards classifying urban structures and infrastructures according to functional typologies – which separate for example housing, leisure and work, as well as organisational typologies that distinguish public and private spaces and providers. If on the one hand the functional classification of amenities has its values in regards to planning and regional law, it does not consider the actual use that dwellers make of urban structures.

2 Operationalising Gehl's ideas

In Life Between Buildings, originally published in Danish in 1971, Jan Gehl introduced an approach for practitioners to study public life from the dwellers' perspective by surveying and mapping what type of activities people perform in public and semi-public space. His approach is not only analytical but provides guidelines for architectural and urban design in favour of increasing the variety of activities and typology of users. Through his practice, he proved the efficacy of his method. The research presented in this paper intends to provide a framework to overcome some Gehl's approach's spatial and temporal limitations. The novelty of Gehl's method was the inclusion of the human dimension in the classification of small urban spaces. Instead of mapping buildings, streets and park according to their designated function, he observed and mapped what activities that are taking place on those topologies.

Jan Gehl distinguishes three main types of activity people engage in public urban space: necessary, optional and social (Gehl, 1987, pp. 9–14). Necessary activities are all the ones that are vital for dwellers in their sociocultural context (e.g. going to work, going to school, buy groceries), optional activities all the ones that are usually undertaken during free time, for pleasure, self-initiative or whim, while social activities are the ones that individuals perform in groups. Gehl's aim was to re-evaluate the social significance of urban spaces and improve their design in the context of modern post-war planning. In his view planning ideology had led to a situation where "*streets and squares disappeared from the new building projects and the new cities*" (Gehl, 1987, p. 45). Gehl notes that the social consequences of modern planning were not discussed, because "*it was not recognised that buildings also had great influence on outdoor activities and consequently on a number of social possibilities*." (Gehl, 1987, p. 46). Thus, the evaluation of the modern projects came relatively late. In the 1970s and 80s, a widespread criticism led to alternative design approaches that took inspiration from history, everyday practices, structuralism, critical theory or a combination of these (e.g. Rossi, Siza, Plater-Zyberk, Habraken, Tschumi).

Interesting for the present research on categorising activities in contemporary cities is the way in which Gehl and his contemporaries understood the linkages between space and its use, on the one hand, and between the different uses, on the other hand. Gehl's basic assumption is that the necessary activities are rather insensitive to the quality of physical environment, while the optional activities are greatly influenced. This makes sense: one goes to grocery store despite bad conditions but sunbathes only in good weather and in a nice location. The third category, social activities, is for Gehl "resultant", because "*in nearly all instances they evolve from activities linked to the other two activity categories*" (Gehl, 1987, p. 12). Gehl puts high value on spontaneous "low intensity" social activities – chance encounters on streets and watching the crowd – in line with other commentators such as Jacobs (1961), Whyte (1980) and Sennett (2000). Passive and change contacts are valuable in themselves as a form of enjoyable city life, but they also form a possible starting point for contact at other levels (i.e. acquaintance, friendship, partnership), give easy possibility to maintain already established contacts, are a source of information (especially for children and newcomers) and may provide inspiration and stimulation (Gehl, 1987, p. 15). – In a nutshell, for Gehl, actively used public urban space is a key social good and physical urban design has a big role in facilitating that social good.

Combining Gehl's with later categorisations (Axhausen et al., 2000; Ben-akiva and Bowman, 1998; Jiang et al., 2012; Zhong et al., 2015) and empirical observations from data retrieved from social media, the research presented in this paper developed a categorisation that aims to include all activities capable of being performed in the city with the purpose of recognising specific spatial patterns.

- Taking care: to maintain or improve the condition of health (i.e. hospital, doctor, dentist, health centre)
- Income: to receive a payment for a good or service (i.e. office spaces, or any other working activity)
- Nutrition: to consume food with no other purpose (i.e. food that is ready to be eaten)
- Mobility: horizontal physical displacement by a mean of transport (i.e. transportation nodes or stations, commuting, travelling)
- Education: to learn by being taught (i.e. schools, kindergarten, university, people studying)
- Civic: to pertain to citizenship (i.e. rallies, parades, public events and commemorations, volunteering, going to church, all activities that are part of the civic life of one community)
- Leisure: to recreate by making use of the freedom from demands of work or duty (i.e. picnic, playing, reading, exhibition, sunbathing, walking the dog)
- Social: to be in companionship with others (i.e. bar, nightclub, café, home party, dinner)

- Consumption: to make use of a good or service (i.e. stores, boutiques, retail, supermarket)
- Personal care: to maintain or improve the condition of comfort, wellbeing, fitness (i.e. sports, spa, nail care, make up)

Dataset

Users' performativity in crowd-sourced locative platforms and especially location-based social networks centred on urban spaces is contingent on the places where the actions take place. In Foursquare, registered places are sorted into 'categories' attending to a main function or an action that it hosts. This cataloguing suffers variations across platforms – the same space can be classified as 'food' in Google Places, or as 'restaurant' in Foursquare. In this context, operating with data from different social networks raises the need to equate a categorization that is common and standardized.

Mapping activities begins with retrieving the Foursquare dataset of all urban amenities and categorising them to the nature of the activity that can be performed in them. Traditionally, Jan Gehl deployed a reliable classification system to study public space and the links between design and public life. Even though Gehl's focus is in small public spaces such as streets, squares and parks, his approach can be used to survey urban space in general thanks to its elemental yet powerful categorization. The applicability of a classification to all kinds of activity within the city should be regardless of space characteristics – including also those performed in indoor or private spaces. Operationalising and scaling up this approach would potentially allow estimating and study activity patterns for one or many cities while keeping the resolution of the analysis at a human scale. The core benefit of this approach including crowd-sourced data is the possibility to chart tangible environment with the elements that are intangible but valuable for the social and economic success of one neighbourhood and its streets and squares.

This research prioritises the use of Foursquare, which remains significant across countries and social strata. Harvesting data from these sources could potentially establish alternative methodologies to traditional practices, and progressively rely on new technologies that are widespread and capable of reaching a higher amount of users than surveys, field research, or users' group analysis could. In this context, it would be possible to perform partially automated digital surveys to provide new insights into socio-spatial patterns, as well as into the way the city is lived and perceived. Therefore, it would be possible to understand not only the relationship between different groups and the city, but also hidden potentials inherent to certain locations and spaces, highlight problems, and find guidelines for urban development.

Foursquare is based on a series of spaces listed by the users and categorised according to the nature of the activity that can be performed in them. Its user interface – in combination with Swarm – has the particularity of being utilised to register real time visits to places and award them with points. In consequence, further from the description of places, several studies talk about user's location choice in the city driven by Foursquare and the relation to its game-like interface capable of affecting individual's decision making within the urban context (Frith, 2014; Jin et al., 2016; López Baeza et al., 2017; Schwartz and Halegoua, 2014), and being a feature of the individual spatial self described as an intentional representation of lifestyle in order to perform social relationships (Barkhuus et al., 2008; Schwartz and Halegoua, 2014).

As a complementary methodology, images posted on Instagram are also utilised in this paper within several indicators (Table 1). This social network is based on an interactive platform in which users can upload photos and videos and use them as nodes for interaction with other users through comments, likes and messages. Content, motives, intention and styles of Instagram pictures have been studied in several disciplines, since they constitute the birth of a new contemporary graphic style consequence of new contemporary social behaviours and practices (Manovich, 2008). Acknowledging the relevance of Instagram from sociological and anthropological perspectives, this study centres mainly on spaces of representation and activity depicted in images in order to extract socio-spatial information.

The potential implementation of the method is specially justified in places where it is hard to find local databases, or as an alternative to national and international statistical agencies, marketing and other institutions with their own systems to make sense of the multiplicity of human behaviours and their spatial underpinnings.

3 Turku, Finland

The test ground for our method is the city of Turku, located in the south-western coast of Finland. Turku has about 190,000 inhabitants – 300,000 in the entire region – and harbours some of the oldest historical assets of the country. Because of fresh investments in culture and industry, Turku is developing relatively rapidly and requires changes on its urban structure and infrastructure. For this reason, in 2017, the City of Turku decided to finance a pilot study through its Urban Studies Programme, to assess and support decision- and plan-making through a system that would combine and visualise different datasets. This tool would help recognise urban development potentials and discuss them both amongst planning professionals and with citizens and stakeholders.

With this purpose, a pilot platform titled Turku Open Platform (TOP) was deployed eventually evolving to an interactive web interface. TOP website is currently in test-phase and it is used by urban planners, developers and other stakeholders to learn about the city space with fresh eyes, assess potentials and support negotiations. The use of interactive software platforms to assess decision-making is novel and places itself in the intersection of active public

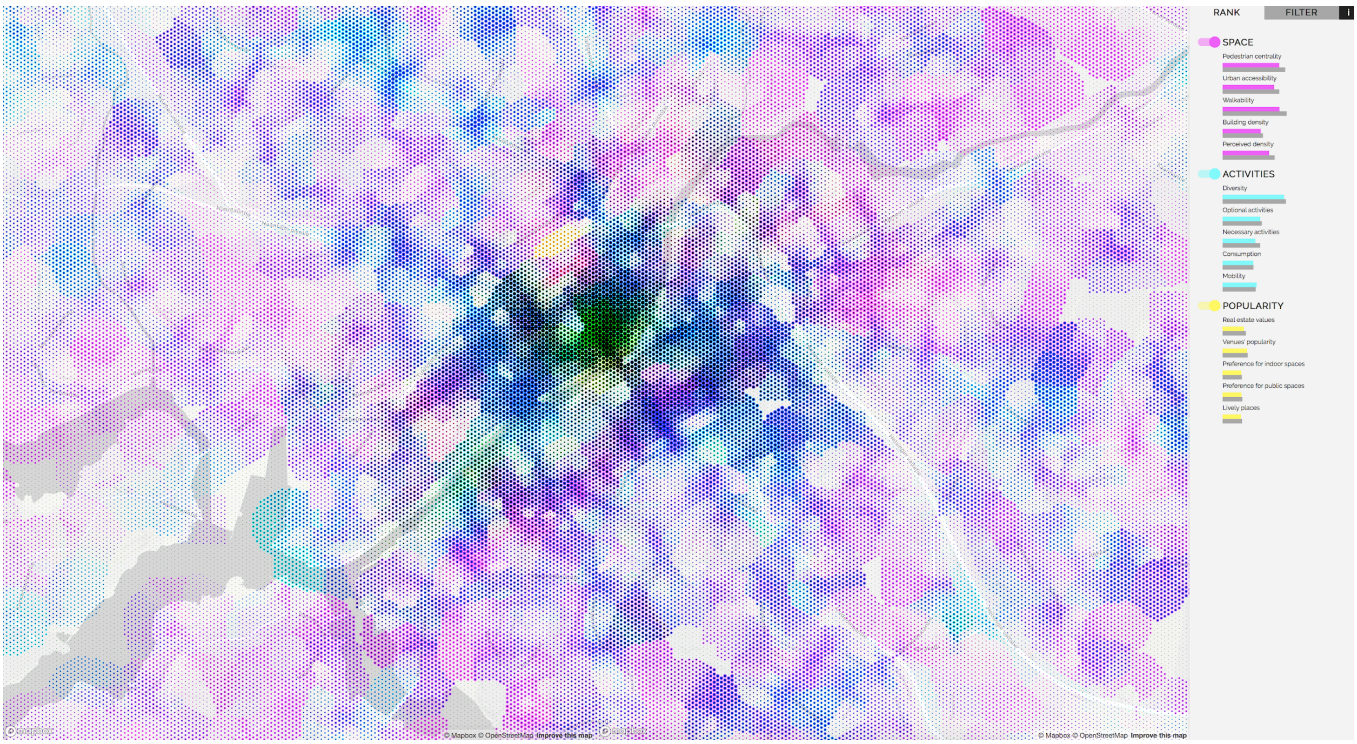

Figure 1. Image of the interactive interface – desktop version. Interaction is performed in the filtering panel (right) to operate with the map visualisation (left).

participation with top-down planning; now interventions can emerge from consensus between parties based on in-depth analysis. Other approaches include tailor-made hardware development (Noyman et al. 2017) or dynamic simulation software engines such as agent-based modelling. Besides the simplistic "making people gather in a table and discuss about the city", the main assets of TOP rely on (1) the implementation of socially-oriented data sources in combination with objective data and complex computations, and (2) the open accessibility of the platform based on a website thus able to be used from any computer, smartphone or tablet in any location.

Complementing this last feature, a key element of TOP is real-time visualization of users' defined spatial extent and context-tailored indicators. The tool is designed according to two different ways of space evaluation: filtering and ranking. Filtering mode is intended to work on a single spatial area to deepen its characteristics by combining different indexes interactively, offering in-depth analysis of a single place across different layers. Ranking mode, on the contrary, aims to maintain static indexes to compare two spaces in separate user windows. In other words, while filtering mode offers a detailed description of the spatial, social and economic characteristics of a single location – understand how a place is and what a place needs – ranking mode is intended to compare two different areas to help location choice linked to decision-making – how one area is more likely of hosting a spatial intervention than the other.

Both filtering and ranking modes have the capability of allowing users to tailor the extent, scale, and visualisation

	Source	**Data**	**Calculation**
		ACTIVITY	
Diversity	Foursquare	All activities and categories	Shannon-Wiener entropy
Optional Activities	Foursquare	Activities classified as optional	Gravity index
Necessary Activities	Foursquare	Activities classified as necessary	Gravity index
Consumption	Foursquare	Activities classified as consumption	Gravity index
Mobility	Foursquare	Activities classified as mobility	Gravity index
		POPULARITY AND PREFERENCES	
Venues' Popularity	Foursquare	All activities weighed by number of visits	Gravity index
Preference for indoor spaces	Instagram[1]	Pictures taken indoors	Gravity index
Preference for public spaces	Instagram[1]	Pictures taken outdoors	Gravity index
Lively Places	Instagram[1]	Activities classified as optional	Gravity index

Table 1. Indexes obtained from Foursquare and Instagram related to activities.

parameters. The rendering engine of areas and indexes is designed to match flexible visualisation demands thus enhancing discussion and negotiation based on locative information such as where to place specific infrastructures, evaluate the need of areas to be upgraded, or providing specific intervention guidelines.

In the left panel of the user interface (Figure 1), indicators are grouped by the nature of their applicability, being: 'Space' those related to the mathematical calculations on the street network – including Space Syntax analytics – to answer questions such as how connected, how central, and how accessible streets are. 'Activities' gathers those indexes related to amenities and venues and their categories. The last one, 'Popularity' includes indexes related to values inherent to locations that potentially influence people's preferences, such as social activeness and popularity of places. From all indexes computed, those obtained from Instagram and Foursquare are shown in Table 1. Data from different sources have been wrangled and combined to eventually compute mathematical indexes of higher complexity further from merely visualizing datasets. Based on Foursquare and Instagram data, (1) Urban Network Analysis (UNA) is used to calculate the spatial relevance of places – UNA Gravity calculation (Sevtsuk et al., 2013) – and (2) the level of Entropy in activities is calculated to extract information related to liveability and complexity of places – Shannon-Wiener entropy index (López Baeza et al., 2017).

Figure 2. Fragment of the regular grid of points used for the calculation. Weight values are visualised as the diameter of every point.

UNA Gravity calculation

A measurement of distance along the network, computing the number of destinations reached from each origin within a given radius, outputting a ratio of attractiveness divided by the travel cost; the resistance of the formal street network itself as perceived sensitivity to distance. In other words, not only is it possible to see the distribution of places but also their affection to the spaces surrounding them. The output of this process is a grid of points, which covers the entire city, where every point of the grid is weighted by the resulting value; the gravity of every place (Figure 2).

$$Gravity[i]^r = \sum_{j \in G-\{i\}, d[i,j]}$$

where Gravity[i]r is the resulting value in every point i of the grid within a r radius set as 400 meters acknowledged as a walkable distance to every point j with a weight W (Sevtsuk et al., 2013). When measuring 'preference for public spaces', the gravity index would be implemented to all public spaces registered in Foursquare weighed by the number of check-ins registered, measuring the distance from every point in the city grid to every public space found in a 400 meter radius and considering the street network resistance.

Shannon-Wiener entropy index

An index based on entropy is employed to assess the measure urban complexity, meaning that the Shannon-Wiener index would be higher in places with an elevated number of venues and amenities, and also in places with a high level of distinct types (categories) of places. This index measures the amount of places and the diversity of types of places, simultaneously (López Baeza et al., 2017). In practice, amenities are classified in a number of n common categories being H(n) defined as follows:

$$H(n) = -\sum_{i=1}^{n}$$

where pi is the probability that a venue belongs to a certain category, given by the normalised number of venues (number of venues within the category divided by the total number of venues in the city). Upper and lower bounds on H(n) are defined by, respectively, a uniform distribution of venues across all n categories and a distribution in which venues are concentrated within just one category.

4 Results and discussion

One of the aims of our research was to design an interactive tool to allow having aware conversations to learn about the hidden potentials of the city. To do so we needed a metric to assess the potential benefits of urban features for Space, Activities and Popularity. Yet, the geometries we used to calculate the metrics of Space, Activities and Popularity combined lines, points or polygons and bound to their geographic location in the city. To learn which were the places that could have pro and cons from their proximity to Space, Activities and Popularity, we found it significant to lay a close grid over the city's extent and used (1) a gravity index to measure the distance-cost from a measurement of perceived sensitivity to distance to specific categories of activity and (2) an entropy index to acknowledge the richness of spaces in terms of activities and activity types.

The datasets used did provide for new insights and new lines of thinking amongst the planning and urban studies community of Turku. Even in a rather small city, there are both 'known unknowns' and completely hidden issues that the TOP tool has to an extent brought to surface. The new knowledge and a new way to package and present knowledge has a clear potential to influence decision-

making and public discussions on the development priorities and content of urban projects.

However, it seems that the very open approach regarding possibilities of 'playing' with varying many possible combinations of data caused confusion amongst test users. There seems to be a need to provide for a limited number of theory-based and expert-proofed data and analysis options, with some threshold values in each dataset. This work is not yet done. After testing, City of Turku expressed its will to open TOP to fully public use.

Methodological and theoretical implications

Since activities are the drivers of what makes a place urban, the methodology proposed in this paper studies urbanity understood not only as structure, form and function of the physical space but also as presence, diversity, and complexity of activities. This grid-based approximation aims to reveal qualitative and quantitative characteristics of the socio-spatial dialectic even when the physical morphology does not portray them.

Following the discourse of Bingham, Nabatchi and O'Leary (2005) regarding management and the making of places, the current shift towards participation and active bottom-up procedures portrays the exhaustion of the top-down-only tradition described by Healey (1995), since local dynamics must be considered when acknowledging the city as a procedural space. These small-scale dynamics are not always formal, built and tangible; digital tools can help unveil them and make them measurable.

Potentials for urban planning

The method presented in this paper is aimed to be placed in between the sphere of public participation – in the sense that takes society into account by mining their behavioural patterns – and elective democracy in the sense that a limited number of actors and stakeholders take an active role in decision making and management processes.

This kind of hybrid approaches have been tested in the field of interface design for integrative negotiation and put into practice with great success (Noyman et al., 2017). Since data driven technology and user-centric, co-creation approaches can eminently support urban development and place-making activities, a new field of research is emerging and the applicability and operationalisation of means and methods is crucial at this stage. To do so, not only should we look into scenarios for ways in which data collection and analysis can be deployed, but also we should have a wider awareness of how hybrid methodologies as the one presented in this paper can be used to tackle contemporary urban issues by combining novel techniques with existing and traditional approaches.

While the call for participation in planning is not new, digital tools and mobile Internet are creating a new situation worth a careful study and inspirational action. As one element of the current situation, we assume that crowd-sourced big-geodata representing users' location choice and temporary rhythms of city life can help to retool urban planning and management for the common good, deepening into the so-called socio-spatial realm; the dual relation between people and space.

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6 Figures and Tables

Table 1. Indexes obtained from Foursquare and Instagram related to activities.

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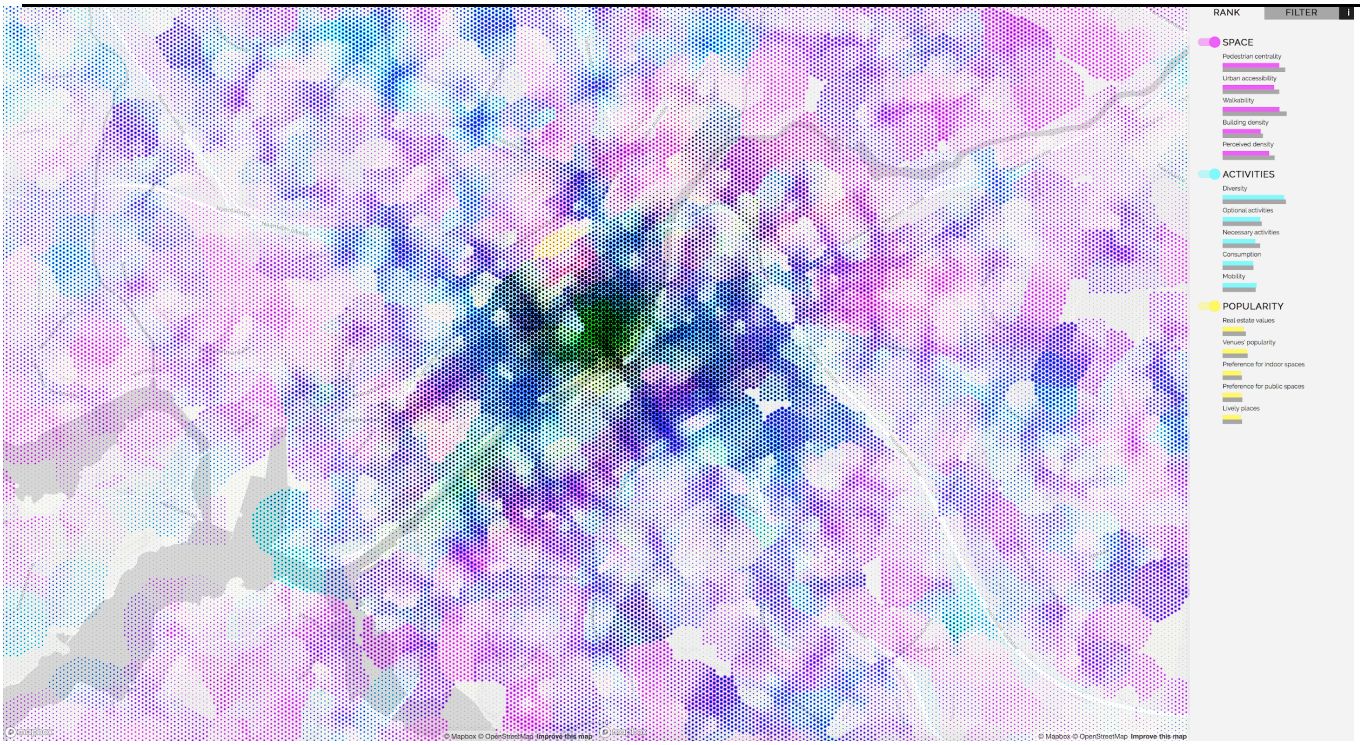

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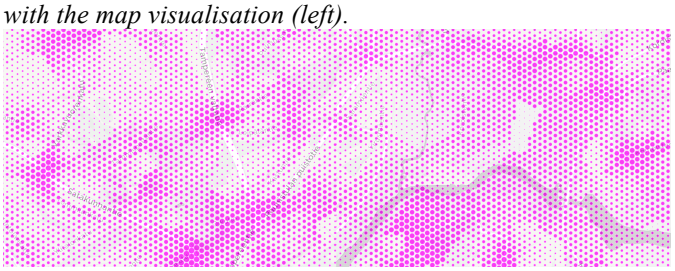

Figure 2. Fragment of the regular grid of points used for the calculation. Weight values are visualised as the diameter of every point.

Subject: Revision and resubmission of manuscript

Thank you very much for reviewing our manuscript. We also greatly appreciate the reviewers for their complimentary comments and suggestions. We have carried out the experiments that the reviewers suggested and revised the manuscript accordingly. Please find attached a point-by-point response to reviewer's concerns. We hope that you find our responses satisfactory and that the manuscript is now acceptable for publication.

1. Typing errors and phrases corrected by proof read by native English speaker.
2. The introduction of section 3 has been modified to include a wider explanation of the tool and its capabilities able to be understood by non-experts, following recommendations given by reviewer A.
3. Other examples of similar implementations have been mentioned at the beginning of section 3, following recommendations given by reviewer A.
4. Explanation and practical examples about potentials to help plan-making has been included in this section, following recommendations given by reviewer B.
5. Regarding the reference to the explanation of the TOP highlighted by reviewer A, we consider the technical explanation necessary for the validity of the method, as well as to ensure possibility of replication. Therefore we decided to maintain the formulas (UNA gravity and Shannon-Wiener entropy indexes), but also added a longer explanation at a non-technical level for non-experts.
6. Unclear sentences have been rephrased, as the one highlighted by reviewer B.
7. The section about limitations of data –with unclear link to the paper– has been eliminated following the recommendations given by Reviewer B.

Best regards,
The authors