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Social behaviour as a basis for design and development of green infrastructure

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Abstract
This paper addresses urban open spaces and their use(r)s. It is concerned with spatial relationships between usage and the physical structure of open spaces in city centres, and addresses social dimension of green infrastructures in cities and towns. Based on the method of behaviour mapping, it reveals dynamic patterns of actual occupancies of places as informative knowledge to produce responsive and inclusive design. The paper discusses the actual uses mapped in places, using repeated observation on different days, times and weather conditions as applied to parks in two European cities (Ljubljana, Slovenia; Edinburgh, UK). It shows that occupancy patterns have some spatial logic and that in development, planning and design, it is essential to pay more attention to spatiality of uses, compatibility of uses in places and to the comprehensive usage-spatial relationships when aiming for well used and people-friendly places. The paper refers to practical levels about the actual conduciveness and responsiveness of places to people's use, and examines how different kinds of spatial structure facilitate use by different public in different ways; and how much such knowledge and awareness can inform design and decision-making processes.

Keywords: behaviour mapping, usage-spatial relationship, urban ladscape, public space, health

Introduction

In 19th century urban planning was recognised as an important tool to enhance social well-being and public health. Especially green infrastructure planning and actual provision of green space in densely populated cities exemplifies actualisation of such planning approach (e.g. in United States of America with Olmsted's proposals such as central park in New York or park system of Boston). Although modernist movement claimed for user-centred approach and provision of good liveable conditions for citizens (e.g. Le Corbusier, 1951; Le Corbusier, 1971), in the 20th century the focus of city planning and design within social well-being, including public health, waned. Over the last few decades the awareness for healthier urban society is increasing, and the role which urban planning can play in making the impact of urbanisation on health beneficial for people, is recognised again, especially in provision of outdoor places and promotion of physical active behaviours. Therefore it is important to understand cities as social processes, and aiming for informing planning and design via users' dimensions, respecting and taking into account also other aspects (e.g. demographic to cultural, economic, structural, ecological and climate) influencing and shaping cities' forms and development.

The paper challenges the issues of green infrastructure planning and design exploring social behaviour applying behaviour maps, a method and tool to provide empirical knowledge for planning, design and decision-making processes. It sees mapping and map-making related to physical aspects of places and imaging, two subjects with which planners and designers are usually quite familiar. Therefore, the paper speculates that a body of knowledge represented in such way may help designers

and decision-makers effectively when addressing design, evaluation, development and re-development of places. The value of the paper is in recognition of social dimensions of places and by this:

- Helping designers be confident that layouts proposed for intended uses will, in practice serve those uses well and be likely to be used as predicted;
- Helping planning and decision-making authorities to reveal restorative environments via peoples' attachment to open spaces and their recreational habits, and to interpret people's healthier lifestyles;
- Helping planning and decision-making authorities to recognise variety of peoples' needs, habits and expectations in open spaces, via information addressing various user groups, age groups or gender referenced characteristics of place users.

Background

Ward Thompson (2013: 79) resumes that the recently reawakened policy interest in environmental design and its potential contribution to health arises partly from the current health crises in the western world pointing to the rising levels of obesity, Type 2 diabetes, cardio-vascular disease, cancer, and mental illness, and their consequences for the cost of healthcare. According to Ward Thompson (2013: 80), environments that support healthy behaviours and responses may have more permanent and population-wide effects than other forms of public health interventions targeted at individuals. Literature review shows that contemporary health researchers examining physical activity (e.g. Hardman and Stensel, 2003; Sallis et al., 2008; Sugiyama et al., 2008; Sallis et al., 2012) have used so called socio-ecological models in which built environment plays an important level of influence, commented or assessed as facilitative or inhibiting for participation in physical activity.

Theoretical backgrounds supporting contemporary research addressing activity behaviours and planning and design of outdoor spaces are mostly grounded in environmental psychology, e.g. affordances (Gibson, 1979) and behaviour settings (Barker, 1976), but are gradually getting adopted for the focussed purposes of planning or design. In relation to affordances Heft (2010: 18) says that: "affordances are perceptual properties of the environment that have functional significance for individual". Ward Thompson (2013: 81) drawing parallels with research informing planning and design argues: "By emphasising the information available from the surrounding environment as key element of landscape users' perception and action, the concept of affordances is attractive to planners and designers because it opens up ways to consider how the physical environment might be managed or manipulated to support different human experience and activities". There is a considerable body of work addressing landscape perception in relation to preferences and aesthetics (e.g. Kaplan and Kaplan, 1989; Bourasa, 1991), being a theoretical and inspiration base for researches dealing with restorative landscapes and environments to support mental well-being, linking mostly natural environments, physical activity and psychological restoration (e.g. Hartig et al., 2003; Hartig, 2007).

Behaviour setting is defined with the relationship of social and environmental characteristics of places and refers to a standing pattern of behaviour which is tied to a particular place and time (Baker, 1976). In practice means that certain types of place, including socio-cultural contexts, elicit certain types of behaviour that are most probably expected and/or predicted. Behaviour maps, records of behaviour patterns in places and a tool for usage-spatial relationships analytics and evaluations (Goličnik, 2005; Goličnik Marušić and Marušić, 2012), are strongly linked with behaviour

settings: In a very literal sense behavioural mapping is really the footprint of a behaviour setting or settings. For example, repeated behaviour patterns of skateboarders in central public squares may be observed in a platform of at least 3m wide, attached to a step of at least 15m in length, to allow skateboarders' minimum preparation journey for a jump and slide over such step (Goličnik Marušić, 2011), while such behaviour would not be found in sizable platforms with no attached steps or steps significantly shorter than 15m. Behaviour settings offer a useful unit of analysis how aspects of environmental design are related to people's activities in places, and hence, behaviour mapping represents a method and tool for visualising and monitoring usage-spatial relations and can act towards guidance for socially sustainable design.

Outdoor environment, particularly the public open space, such as parks and green spaces, is one of the milieus which can offer and provide opportunities for variety of physical activity behaviours. This paper focusses on relationships of physical activities and environmental settings in order to comment on opportunities for physical activity and provide some evidence about (active) lifestyles of urban inhabitants. The paper builds up on a stand point that it is possible to create attractive parks and other outdoor spaces that encourage and facilitate physically active behaviours; not only walking (which in last decades has been promoted and studied and hence, achieved successful results in public health issues), mostly long-stay active engagements in places such as ball games, playing frisbee or skateboarding, as one of the typical youngsters urban activity. For this reason, there is a particular interest in how the design of everyday environments might support and encourage physical activity.

Koohsari et al. (2015) find out that research examining associations between public open spaces and physical activity is increasing, but point to the conceptual and methodological gaps that are still limiting the research on public open space and physical activity. The evidence shows that in measuring physical activities in places, GPS devices, pedometers or accelerometers are often in use to collect evidence (e.g. Coombes et al., 2013; Dunton et al., 2014; Evenson et al., 2013). Such studies are usually limited to one type of activity and peoples' participation in study is conscious. Literature review shows also evidence on particular focus groups, such as children, using similar approaches by implementing the above mentioned tools (Quigg et al., 2010). Focus of such studies is predominantly on health issues, spatial dimensions, and measures which can be arrived from planning perspectives to improve public health are still vague. Similarly, Goličnik (2005) recognises the applicability gap between social science research and place design, arguing for the importance of empirical knowledge which can be gained about usage-spatial relationships by observation and behaviour mapping, emphasising also the role of GIS supported techniques of spatial annotation and visualisation.

Hence, it is crucial for the planning and design practice to develop mechanisms for measures of physical activities in relation to conduciveness of places for them, improving understanding of how individual green spaces attributes are associated with physical activity, as well as how different user-groups engage with spaces. Using research methods which can assure unobtrusive observation and actual information about situation/for simulation as much as possible, seems essential, especially to capture spontaneity of activities in places, and to examine presence of variety of users in places. Accordingly, this paper focusses on temporal-spatial characteristics of dynamic patterns in public spaces; their dimensions, intensities and frequencies, as well as buffers needed between activities themselves, as well as them and spatial structures. Thus it up grades variety of active behaviour studies addressing urban planning and design impacts on

health, and is heading towards user-informed guidance for green infrastructure planning and design.

Methodology

The data collection in the form of behaviour maps for selected open spaces of the city centre of Ljubljana involved systematic observations of all parts of each place on several different occasions in May 2003. The sample consisted from eight public open spaces: Tivoli park, Zvezda park, Argentinski park, Trg republike, Plečnikov trg, Dvorni trg, Mestni trg and Prešernov trg. The month of May was chosen as a time when the weather was likely to be warm and outdoor activity pleasant. The timings of observations were chosen to capture likely different patterns of use at different times of day and on different days of the week. There were four time periods for observation: 10am – 12 noon; 12 – 2pm; 2 – 4pm and 4 – 7pm. The observation protocol involved a systematic walk through each place, visiting all sub-areas and taking a 10-minute visual scan of each sub area. All users observed in that 10-minute scan were recorded as point data on detailed maps of the sites (1: 1000 scale) using symbols corresponding to actual activities observed in places. They were accompanied by additional data, such as duration of an activity (e.g., less than 1 minute, 1 – 2 minutes, 2 – 5 minutes, greater than 5 minutes) and estimated age classes for each person (e.g. up to 5 years, 6 – 12, 13 – 19, 20 – 34, 35 – 50, 51 – 65, and more ntah 65 years). At the same time, the areas occupied by certain activities were documented on a map. The weather condition - temperature, wind, dryness, and sunshine - for each observation period was also recorded. Altogether 106 observations were made in Ljubljana. The author has several sets of observation data at disposal for the observed parks of Ljubljana commented in this paper (e.g. Goličnik et al., 2007; Goličnik Marušić, 2009) which prove that patterns collected for the original research (Goličnk, 2005) despite some renovation works still reflect actual behaviour patterns.

That research (Goličnik, 2005) focussed particularly on usage of less clearly defined spatial settings and how spontaneous and informal uses in central parks and squares co-habit and co-shape the places. Although behaviour mapping technique requires a clear protocol of observation prepared in advance, it is at the same time very important that it stays open ended, to enable collection of the most interesting, most important or the richest data of the observed territory. Some early observations already showed differences between observed places in intensity and frequency of use, as well as variety of users present there. Therefore, in the defined time frame for observations, places with greater variety and intensity of uses were observed more often, whereas places with lower social dynamics, representing mostly usual activities such as walking, cycling, and waiting/standing were paid attention less often. Observation time-table was rearranged also according to extremely bad weather conditions or occasional cultural or sport public events which completely overwhelmed the usual character of the place's daily routine. Collected data is reliable as observations were repeated in different days, day-sections and weather conditions.

The final database was organised in GIS supported environment (ESRI, ArcView 3.3), where datasets on daily base for each place provide behaviour maps consisting of layers of information including type of activity, duration of an activity, age group of a person involved with the activity, gender of a person, and on this basis allow comments on passive or active engagement in places as well as speculation on people recreational habits and lifestyles.

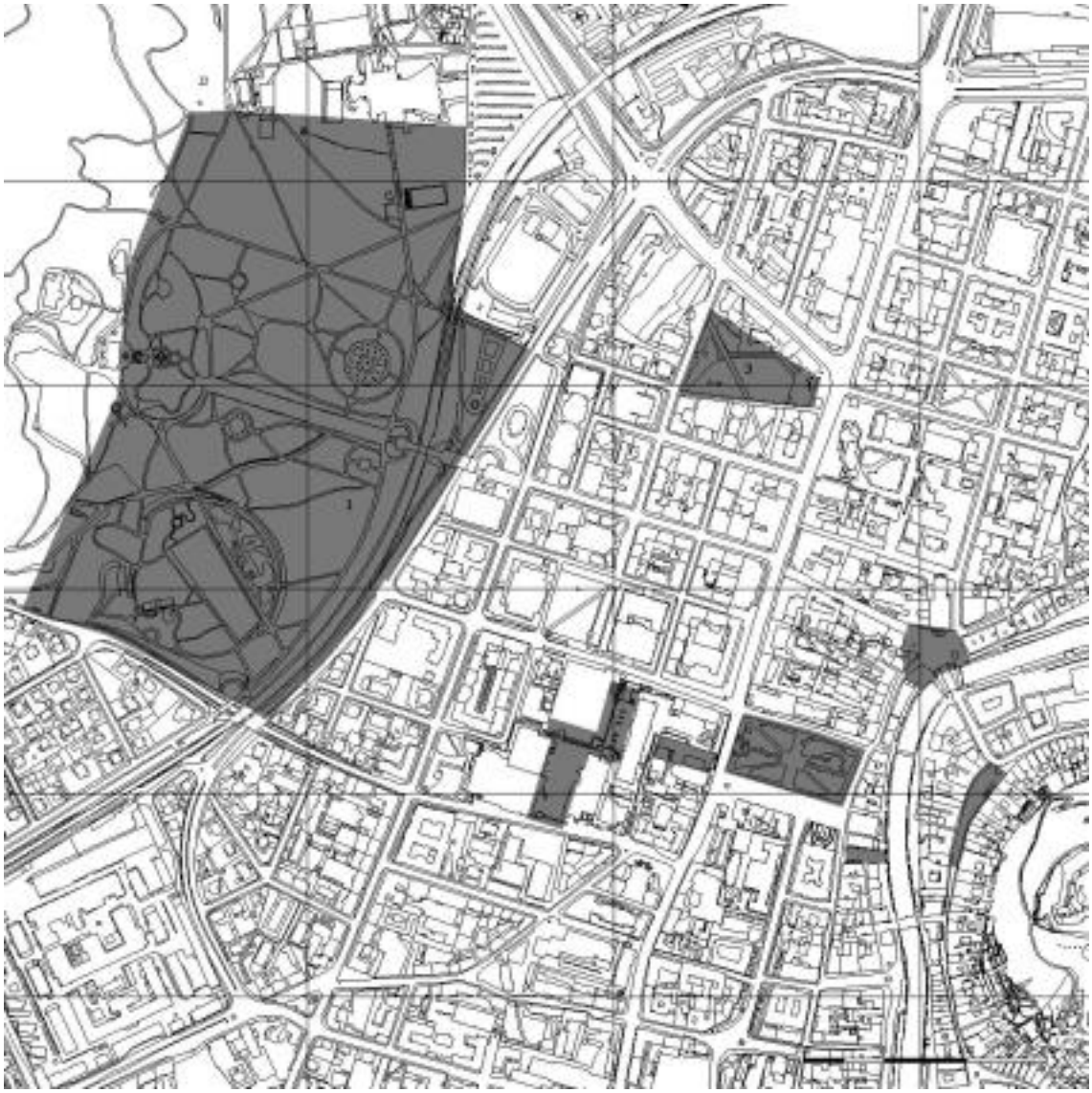

Figure 1: Selected sites included in the original research with special annotation to cases examined in this paper: 1. Tivoli park, 2. Zvezda park, 3. Argentinski park (source: Goličnik, 2006).

The case study: Central parks of Ljubljana

Although squares and parks both are public open spaces and as such are constituents of green infrastructure, their roles and meanings in public life of citizens, differ. Parks are usually characterised as places for rest, relaxation and active recreation. They are usually bigger and predominately green. In comparison to squares they are settings of less explicit limits, and usually significant for bigger variety of uses. Spatial determination and articulation of park settings is often less defined on a small scale, which is usually the case in squares, but it is often defined on a larger scale by the notion of surfaces, their size, shape and physical as well as programme articulation. In this context, a physical articulation refers to level changes in and between main surfaces (lawns) and the quality of outer and inner boundaries, for example, a solid boundary such as the edge of a parks' woodland, a transparent boundary such as a tree line, and an indication of horizontal divisions such as paths or dikes. The inner partition of so defined surfaces in parks is usually marked by different elements such as single trees or

groups of trees, and on a smaller scale, also by water motifs, walls and benches, for example, which actually address a programme articulation of a park, too.

For the purpose of this paper, central parks of the city centre of Ljubljana were selected from the entire research, to discuss social behavioural values in design and development of green infrastructures of cities or towns. All the parks included were green spaces with no large built structures and with a similar policy of maintenance. This chapter briefly shows relevant historical facts and spatial context of the parks, whereas relevant usage-spatial characteristics are commented in section Results.

Large central park: Tivoli

Tivoli is the largest public park in Ljubljana city centre, and has been shaping its physical appearance over hundreds of years. The last crucial changes reflected in nowadays uses are interventions in 60ies of 20th Century when railway and road construction significantly changed its eastern side and diminished physical as well as visual attachment to the city centre. The last visible changes date in 90ies of the 20th Century, when at the very south part of the park a new children playground was introduced and the adjoining area of the pond and greenhouse was renovated. Considering spatial context and social programme, Tivoli is characteristic for nearness of residential areas, including student accommodation, galleries, museums, outdoor cafés and a children's playground in an adjoining area. Tivoli's location and the spatial feature of its context are set by a railway corridor and the slopes of a hill, having also inner articulations and some slight slopes in some parts. Although Tivoli, as a park, is part of a larger recreational area, attached to a natural urban forest, and is equipped with some sport facilities on its northern end for in- and outdoor activities, a distinctive area of a green open space, forms a recognisable spatial entity and this has been included in the study as a park. The size is about 230000m2. Besides recreation, the sense of place of the park is as a space for a rest and to relax, equipped with amenities of traditional park features such as benches and fountains.

A square-like city centre park: Zvezda

The Zvezda park is a green part of the square Kongresni trg, initially arranged for the meeting of the Holy Alliance 1821 in Ljubljana. It is the oldest public park in the city. The boundaries of the square are defined with compact built frame consisting of buildings of various historical eras, representing mixed land use. Detailed spatial articulation of the green part is characteristic for system of crossing paths forming star shape. In the park are some symbolic-historic characteristics and other landmarks such as a fountain. In the last decade Kongresni trg has been subject of various changes. Firstly, traffic regime has changed. Couple of years later the entire square was renovated, which caused that the green part became attached to the vast paved area (pedestrian zone), previously used as car-parking space. The data about spatial usage of the green area used in this paper refers to research Goličnik (2005). However, there were observations carried out following the changes of the area (Goličnik et al., 2007; other author's archives), which showed that these lately changes in the area have not significantly influenced the usual patterns of uses there, and confirmed that data used are still relevant for the discussion.

Neighbourhood park: Argentinski park

Argentinski park is a small neighbourhood park in the city centre. Beside residential land use in its nearness there is a primary school and a kindergarten, various services, cultural institutions and administration and government offices. The park

includes children playground which is not extra fenced and has an open access. There is a restaurant at the far east end of the park and a small café at the edge of the park, too. There are two significant residential areas attached to the park, larger one, represented by Dukič apartment blocks at the southern edge of the park, built in the period between world war one and world war two, and a smaller apartment block built as a local urban regeneration site at the northern part of the park, having the ground floor facing the park occupied with design shops. There is a vast construction site open across the local one way street defining the western edge of the park, which according to planning documents will be developed to culture centre of national level. The area has been open as a construction site, however due to political and investment issues development foreseen there stopped.

Results

The examined parks differ from each other regarding their size, character and historic-symbolic values; however, they are green patches of the city, used by its inhabitants, and in structural, ecological and social aspect representing valuable elements of the green infrastructure of Ljubljana. This paper focusses on social dimensions of green infrastructure; therefore, further comments are related to people's engagement with places and behaviour patterns of place occupancies. Tivoli, the largest city park is characteristic for constant and diverse usage, represented mostly by passive engagements such as sitting in the grass or sitting on benches; and transitory active engagements such as walking and jogging. Active long-stay engagements, such as playing ball games were not observed often. Daily routine of Zvezda park is characteristic for transitory activities such as walking and cycling, also roller-skating (after introducing re-design of paved crossing paths a few years ago, hard surface was replaced with sandy cover, the pattern of roller-skating changed; since that these users are more often using the paved surfaces joining the green patch, which after the re-design became free of traffic) and as place for meeting points, mostly standing, also sitting on benches and on the grass. The intensity of use in Argentinski park is considerably lower in comparison to Tivoli or Zvezda, however types and character of activities is similar to those observed in Tivoli.

Table 1: Number of users engaged in anyone activity and frequency of appearance of activities (very often VO, often O, rarely R, very rarely VR) in observed parks in the entire observation period.

	Tivoli (N, %, fr.)	Zvezda (N, %, fr.)	Arg. Park (N, %, fr.)
walking	885, 25%, VO	1015,53%,VO	422, 63%,VO
sitting on a bench	485, 13%, VO	304, 16%, VO	32, 5%, VO
sitting on the grass	459, 13%, VO	117, 6%, VO	18, 3%, VO
cycling	330, 9%, VO	139, 7%, VO	53, 8%, VO
pushing a pram	122, 3%, VO	24, 1%, O	18, 3%, O
walking a dog	138, 4%, VO	5, <1%, R	14, 2%, VO
walking a child	197, 6%, VO	22, 1%, O	7, 1%, O
lying down	113, 3%, VO	9, <1%, R	/
standing	78, 2%, VO	194, 10%, VO	7, 1%, O
sitting around a table	457, 13%, O	75, 4%, R	/
rollerskating	131, 4%, O	20, 1%, O	5, <1%, R
jogging	66, 2%, O	3, <1%, VR	/
playing	41, 1%, O	3, <1%, R	44, 7%, O

lying down on a bench	10,	<1%, O	/		/	
sitting with a pram	12,	<1%, O	/		4,	<1%, R
playing frizbee	14,	<1%, R	/		/	
playing football	25,	<1%, R	/		42,	6%, O
climbing	7,	<1%, R	/		/	
playing with a ball	8,	<1%, VR	/		3,	<1%, VR
playing wolleyball	5,	<1%, VR	/		/	
proppeling scooter	3,	<1%, VR	/		/	
BMX acrobatics	1,	<1%, VR	/		/	
skateboarding	1,	<1%, VR	/		/	
excercising	6,	<1%, VR	/		/	
fishing	4,	<1%, VR	/		/	
playing badminton	2,	<1%, VR	/		/	
using wheelchair	4,	<1%, VR	/		/	
sitting with a dog	1,	<1%, VR	1,	<1%, VR	/	
walking a child and a pram	2,	<1%, VR	/		1,	<1%, VR
sitting on the tree	3,	<1%, VR	/		/	

Tivoli

In the research back-grounding this paper, the attention was paid to examination of potentials of variety of park settings for accommodating one or more uses, therefore spontaneous and informal uses were in focus rather than formal uses attached to particular settings purposely designed for them. For example, designed playgrounds and open air sport facilities were not included in the examination. Diversity in activities recorded in Tivoli is constituted from rare, occasional noticed uses, rather than from conventional, regular ones, such as walking or sitting. Less often recorded activities were for example playing frizbee, ball games and football, and climbing a tree; twice or one only were noticed activities such as bmx-acrobatics, playing badminton, skateboarding and exercising.

Table 2: Intensity of often recorded activities in Tivoli within the entire observation period.

activity	max number	frequency
walking	95	21 of 21
sitting on a bench	44	21 of 21
pushing a pram	20	20 of 21
sitting	59	18 of 21
cycling	54	18 of 21
walking a dog	23	18 of 21
walking a child	68	17 of 21
lying	15	17 of 21
standing	23	17 of 21
sitting around a table	54	15 of 21
rollerskating	35	14 of 21
jogging	35	12 of 21
playing	21	10 of 21
sitting with a pram	2	2 of 21

Table 2 shows activities which happened often. They were either long-stay passive engagements or transitory activities. Both types of engagements were characteristic for

engagement of variety of age- and user-groups. Transitory activities range from simply walking, cycling or roller-skating as transportation, to their different variations such as walking a child, pushing a pram, walking a dog which may occur for more recreational reasons, to pure recreation such as jogging. Parents were often seen sitting with prams, or dog walkers with dogs, while those people walking with children were often engaged in more active participation, either having a little play along the way, or in any favoured area on the lawn. Those involved in long-stay passive engagements were most often sitting on benches or in the grass, in groups, pairs or individually. The usage of Tivoli was age and gender balanced.

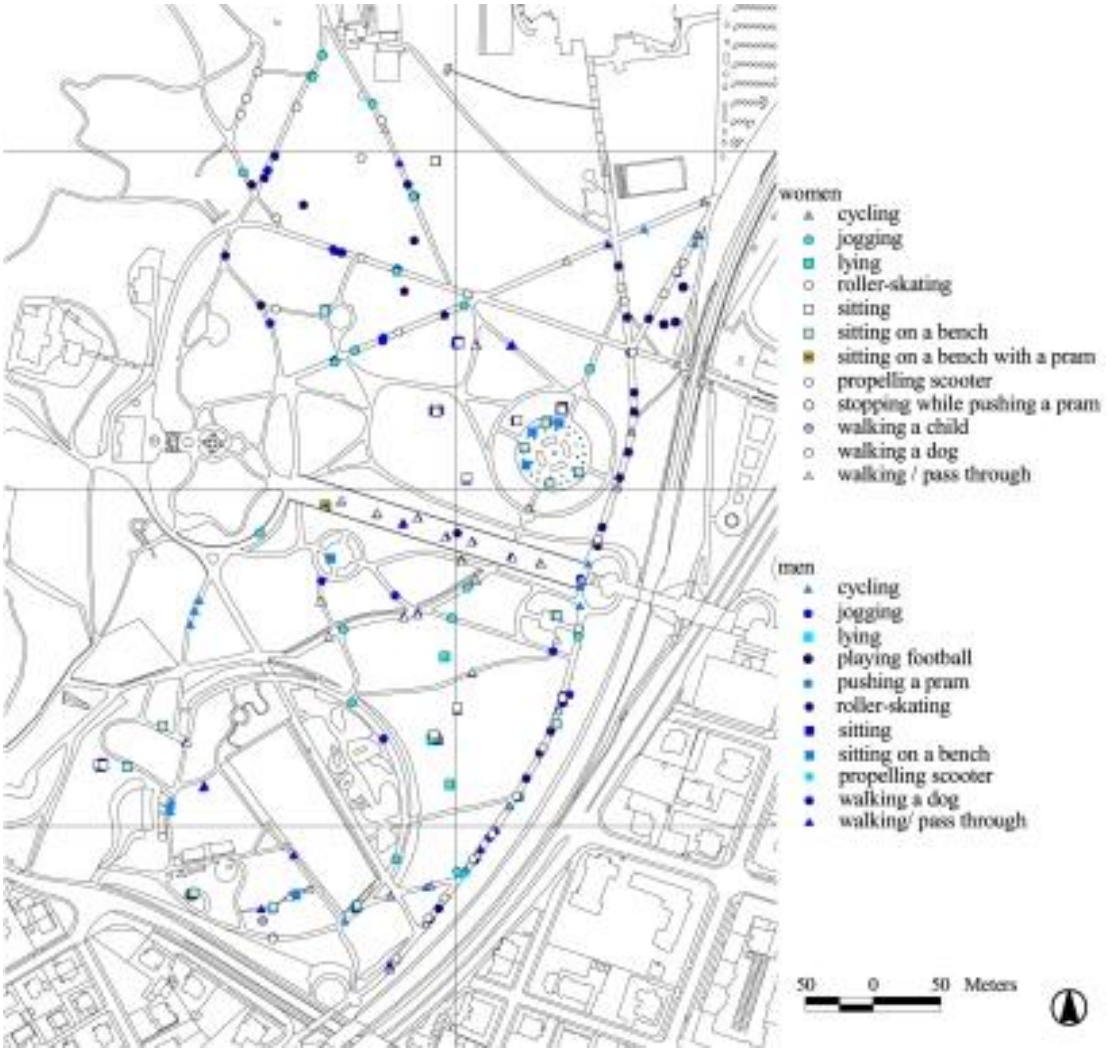

Figure 2: Typical daily pattern of usage in Tivoli, recorded in good weather conditions, late afternoon during the week (source: Goličnik, 2005).

Jakopic's promenade, the central structural feature of the park, which is linked to the main park entrance at the eastern side of the park, is a setting for walking, meeting and setting on benches for all generations, using the place either in groups of mates, families, pairs or individually. For families the promenade is also a place for short occasional play along the walk or rest on the bench. Sitting on benches is popular all over the park, the same sitting freely on the grass. This later is above all popular with young people, teenagers, young adults and families. Settings which support such engagement are green with scattered trees or group of trees. Settings without trees are

usually popular for active engagements such as playing frizbee, ball games and children play.

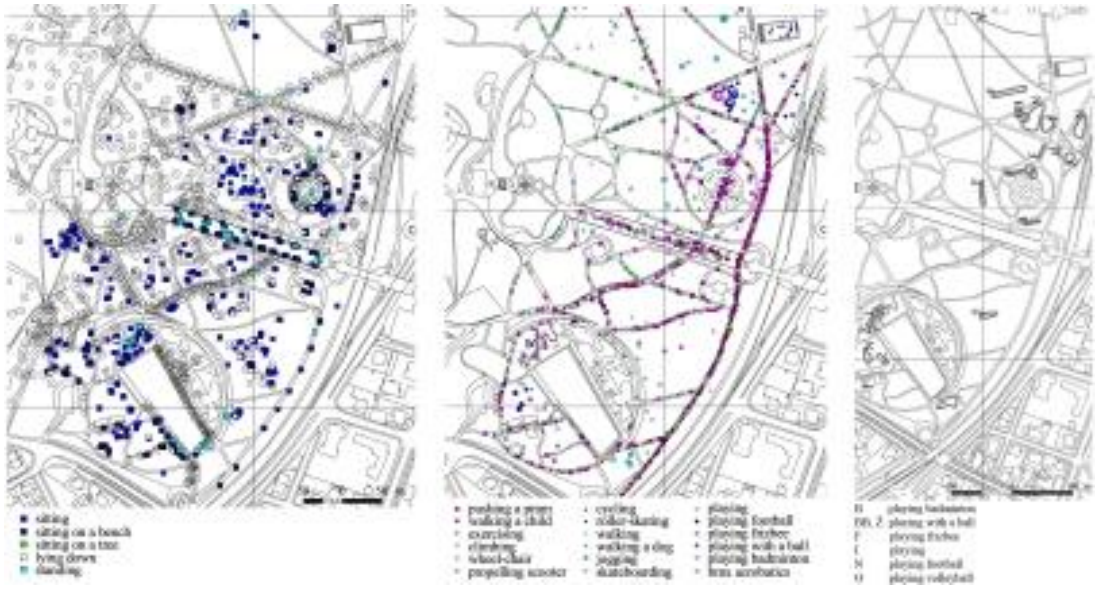

Figure 3: A composite maps showing cumulative behaviour patterns of the entire observation period, specifying a: long-stay passive engagements, b. transitory and long-stay active engagements, and c. occupancies with long-stay active engagements in Tivoli (source: Goličnik, 2005, 2006).

Zvezda

Zvezda park is located at the intersection of important connections in the city centre. Its physical structure yet additionally emphasises the sense of directions and therefore encourages transitory usages in a place. There were recorded pedestrians, cyclists and roller-skaters. Characteristic users being in transition through the place were also parents pushing prams, families walking children or an adult person walking a child. As Zvezda park is a place for transitory activities, is therefore also a place for coincidental meetings as well as organised appointments. These later are quite characteristic for bigger groups. Especially high level of transitory and a sizable number of people standing at the edges of the park (waiting for a bus) give a place a character of the square. At the same time sitting or lying down on the grass reveal a place character of a park. Due to closing down the traffic around the square, cancelling car parking areas and public transport bus stops as well as changing pavement textures at the paths crossing the park, Zvezda is gaining more and more on its park-like character.

Table 3: Intensity and frequency in engagement with activities in Zvezda within the entire observation period.

activity	max number	frequency
walking	139	15 of 15
cycling	26	14 of 15
sitting on a bench	36	13 of 15
standing	66	12 of 15
sitting	33	10 of 15
pushing a pram	5	8 of 15
walking a child	6	7 of 15
rollerskating	9	6 of 15

sitting around a table	25	4 of 15
lying	4	3 of 15
walking a dog	2	3 of 15
playing	2	3 of 15
standing with a pram	1	1 of 15
sitting with a dog	1	1 of 15

The results shows that sitting freely on the grass and sitting on benches are equally participated both, in terms of frequency of activity recorded as well as in terms of number of people engaged with the activity. Sitting freely on the grass is mostly characteristic for young people, often being recorded sitting there in bigger groups. Smaller groups up to five persons were usually gender unmixed. Sitting on benches was recorded for all age groups and all gender representatives. Play as a characteristic activity for Tivoli was practically not recorded in Zvezda; there were few exceptions when small children played for a short period informally when waiting with their parents for a bus.

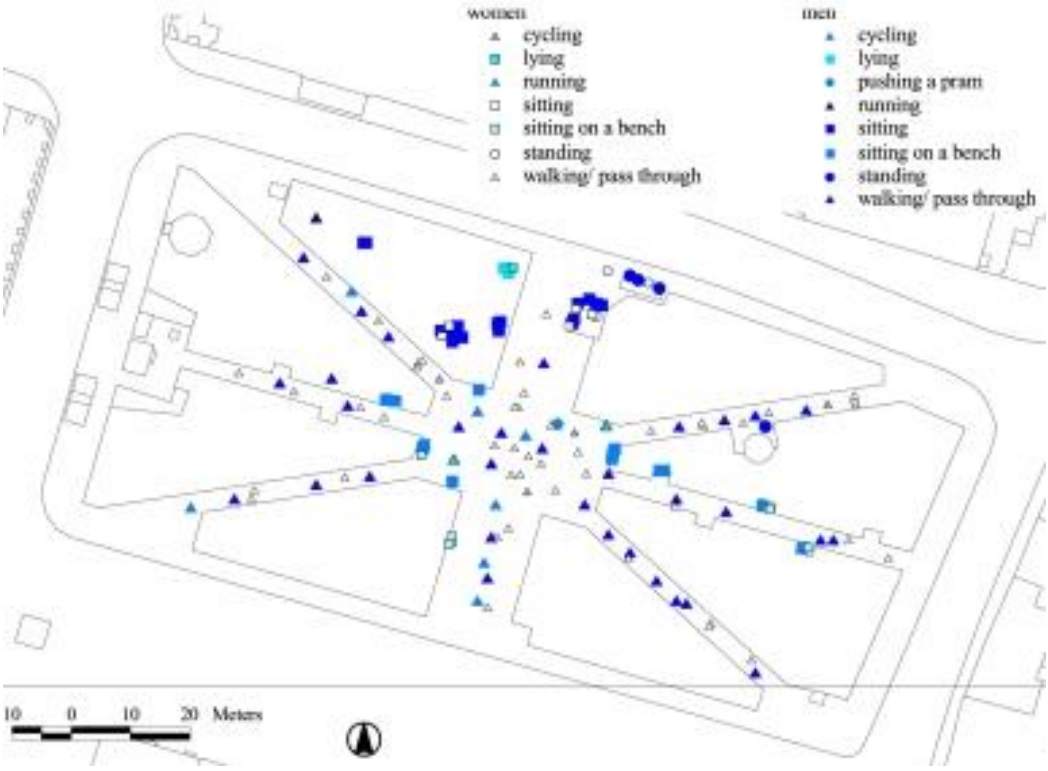

Figure 4: Typical daily pattern of usage in Zvezda, recorded in good weather conditions, afternoon during the week (source: Goličnik, 2005).

Argentinski park

Table 4: Intensity and frequency in engagement with activities in Argentinski park within the entire observation period.

activity	max number	frequency
walking	81	10 of 10
cycling	10	10 of 10
sitting on a bench	8	8 of 10
walking a dog	3	7 of 10
sitting	6	6 of 10

pushing a pram	5	5 of 10
playing	5	5 of 10
playing at the playground	10	5 of 10
sitting on a bench with a pram	1	4 of 10
playing football	18	3 of 10
walking a child	5	3 of 10
standing	4	3 of 10
rollerskating	3	2 of 10
playing with a ball	3	1 of 10
walking a child & pushing a pram	1	1 of 10

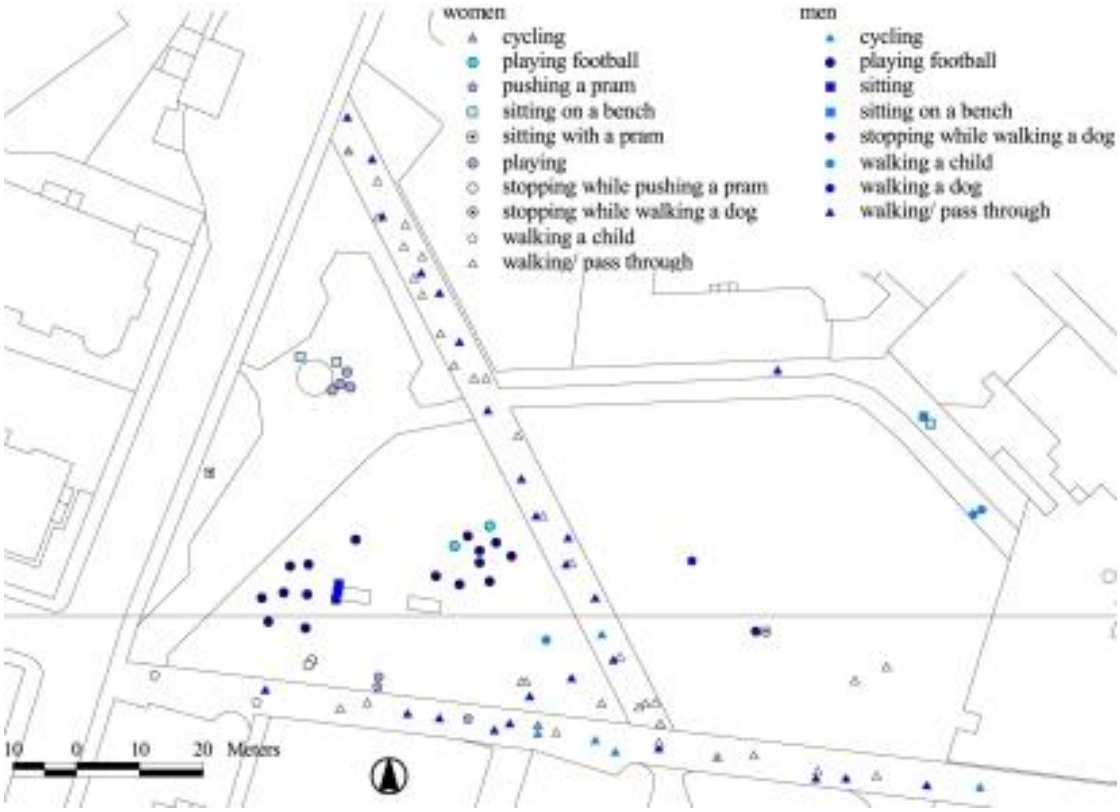

Figure 5: Typical daily pattern of usage in Argentinski park, recorded in moderate weather conditions, afternoon during the week (source: Goličnik, 2005).

Argentinski park is activity-type wise similar to Tivoli, only that their intensity and frequency of use were weaker. Any long-stay engagement, either passive such as sitting on a bench or active such as playing ball games or using open access playground equipment, reflects on nearness of the school, kindergarten as well as residential areas. There were pick-occupancies recorded straight after school/kindergarten (i.e. in the observation period 4-7pm). Occasionally groups of kindergarten children visited the park also in the morning period (i.e. 10 am-noon). Transitory activities, mostly walking, are significant as the park offers a short cut into administrative and service zones of the city centre.

Discussion

When speaking about social behaviour as informative phenomenon for spatial planning and environmental design, initially, it is important to get to know, what people do, to be able to build an empirical knowledge to support planning and design practice.

Further essential information is where, when, for how long and how much space do people require to satisfactory fulfil their needs regarding physical activities in places. This chapter is about the principles gained from the observation and behaviour mapping as source of empirical knowledge which can support and inform planning, design and decision making for socially sustainable spatial practice. Several selected principles are looked into more detail to reveal their essence and applicable value in place design, green structure planning and decision making. Discussion is based on GIS behavioural maps reproduced upon manually gathered data on the maps of the observed settings, which allow metric distance analysis between the depicted users and spatial structures as well as among users themselves. To strength the universal measures and the reliability of applicable value of empirically gained knowledge, in addition to Ljubljana case studies, comments are based also on empirical evidence collected in central parks in Edinburgh, UK, May, 2002 (Goličnik, 2005).

Spatial qualities of settings and their correlations to usage

The empirical knowledge about usage-spatial relationships in park settings gained from observation and behaviour mapping in Edinburgh, UK, May 2002, and Ljubljana, Slovenia, May 2003, shows that groups of trees, some prominent single trees, well defined edge or any other objects can play a crucial role in spatial occupancy such as sitting. Hence, articulation and a placement of uses in a place relying on a certain distance from it, really matters. For passive usage, e.g. sitting, it is reflected, in occupancies, distanced at least 5 metres away from transparent edges (e.g. tree lines along pathways of the patches, predominantly without trees); congregations right up against a solid edge, whether a steep slope or a bank; and in the areas of smaller groups of trees or solitaires. In large grass areas with transparent edges the buffer between path/avenue and people sitting may be as wide as 15 meters. For more details see Goličnik and Ward Thompson (2010).

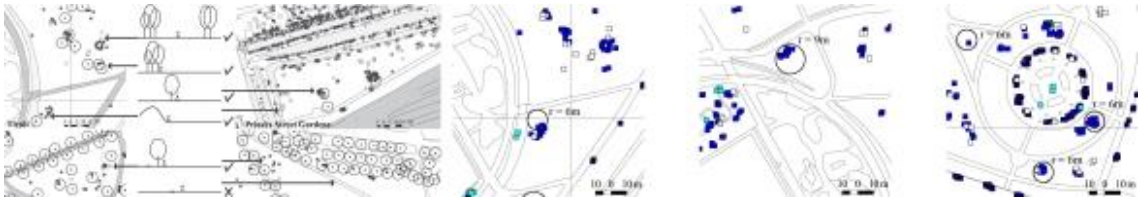

Figure 6: Empirical evidence for conducive settings for long-stay passive usage such as sitting, showing also a minimum space allowing sitting beyond appropriate edge zone (source: Goličnik, 2005).

The results also show that, even if the lawn patch is huge, if it is not articulated, unless any temporary articulation is available, uses such as sitting or lying down are less likely to occur. However, it is not only physical spatial definitions that might direct uses in a certain spatial occupancy, but also that the presence of other uses, to a certain degree, can perform this function as well. Mainly larger groups of active participants can articulate places and, in doing so, create room for themselves and for others (Figure 2).

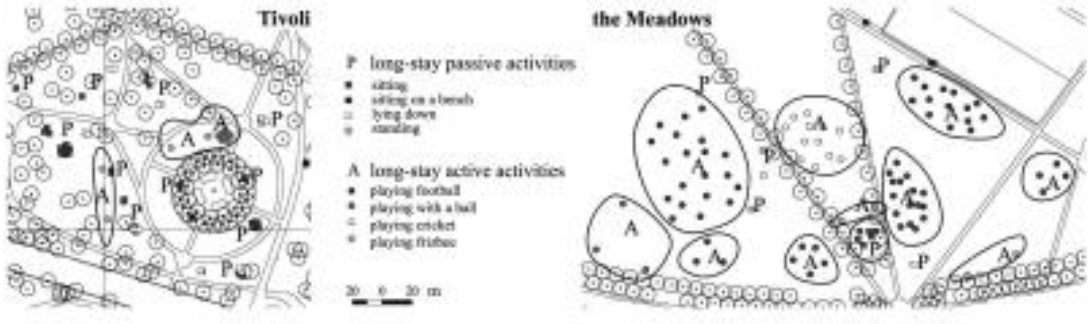

Figure 7: Boundaries in a place due to uses occupancies of territories (source: Goličnik, 2005).

Activities, especially those significant for active group games, form patterns buffered by voids: the buffer between an edge and active users (see A in Figure 8 above); and buffers between a number of adjacent active groups occupying different territories (see B and C in Figure 8 above). A speculation of their importance may provide crucial clues about necessary needed supplementary spaces for their overall comfortable co-habitation. For illustration, a point contact at shorter or narrower sides of areas of occupancies (B in Figure 8 above) and in between space along such areas (C in Figure 8 above) is relevant especially in cases of high occupancy. Point contact represents the minimum distance between two long-stay active activities at the closest points between them. In practice it is almost always about 4 meters. Activity buffer spaces between three or more active occupancies differ in shape, depending on the shape of the green patch (C in Figure 8 above). However, further analysis shows that an abstract form which can describe the minimum activity buffer space commonly needed between groups of activities is a circle of 20m radius (Figure 8 below).

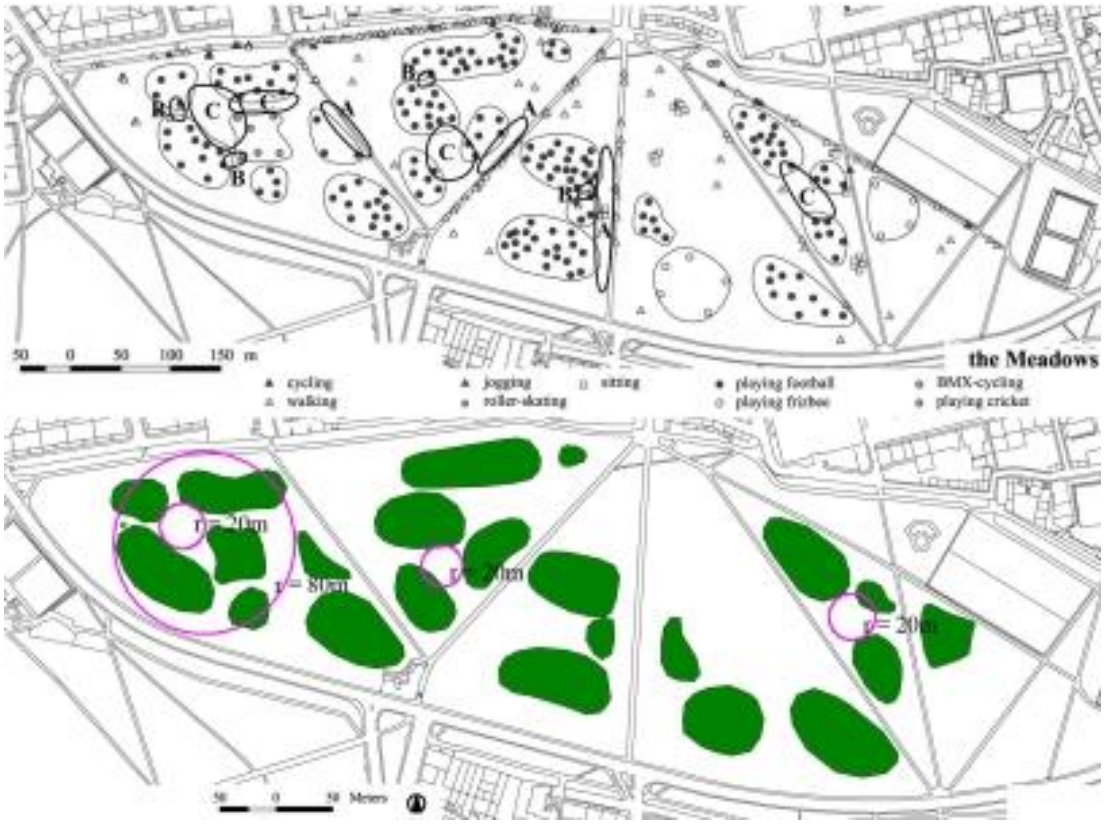

Figure 8: Types of voids (above) (sorce: Goličnik, 2005) and relationships between patch's size and shape and its occupancy (below) (source: Goličnik and Ward Thompson, 2010).

In relation to active life styles, public health, and practical planning measures that my influence or increase healthier lifestyle of cities inhabitants, further discussion referring to detailed examination of long-stay active behaviour patterns of park occupancies (Goličnik, 2005) is relevant. The results revealed that there are differences between distances activities take in relation to inner or outer edges of parks. For the Meadows, the biggest and the most non-articulated place in the entire examination the results show that distances between any part of an inner edge and an activity along it vary from 35m to 2m (average 9m); the shortest distances between an activity and an inner edge in every studied daily pattern was usually between 2 and 4m. The analysis also showed that a 4m buffer zone between an activity and an inner edge of the park was usually taken by compact bigger groups, and less than that by less compact but not necessary smaller groups, e.g. frizbee players rather than those playing football or playing with a ball. Differences between any outer edge of the park and an activity along it do not vary as greatly. They range from 8m to 20m in the case of a solid outer edge of the Meadows (along the northern border), most often about 13m; and from 15 to about 30m of any long-stay active activity from the open edge (southern border). Distances of more than 30m are the most frequent longest distances, whereas among shortest distances, those between 20 to 25m were observed the most often.

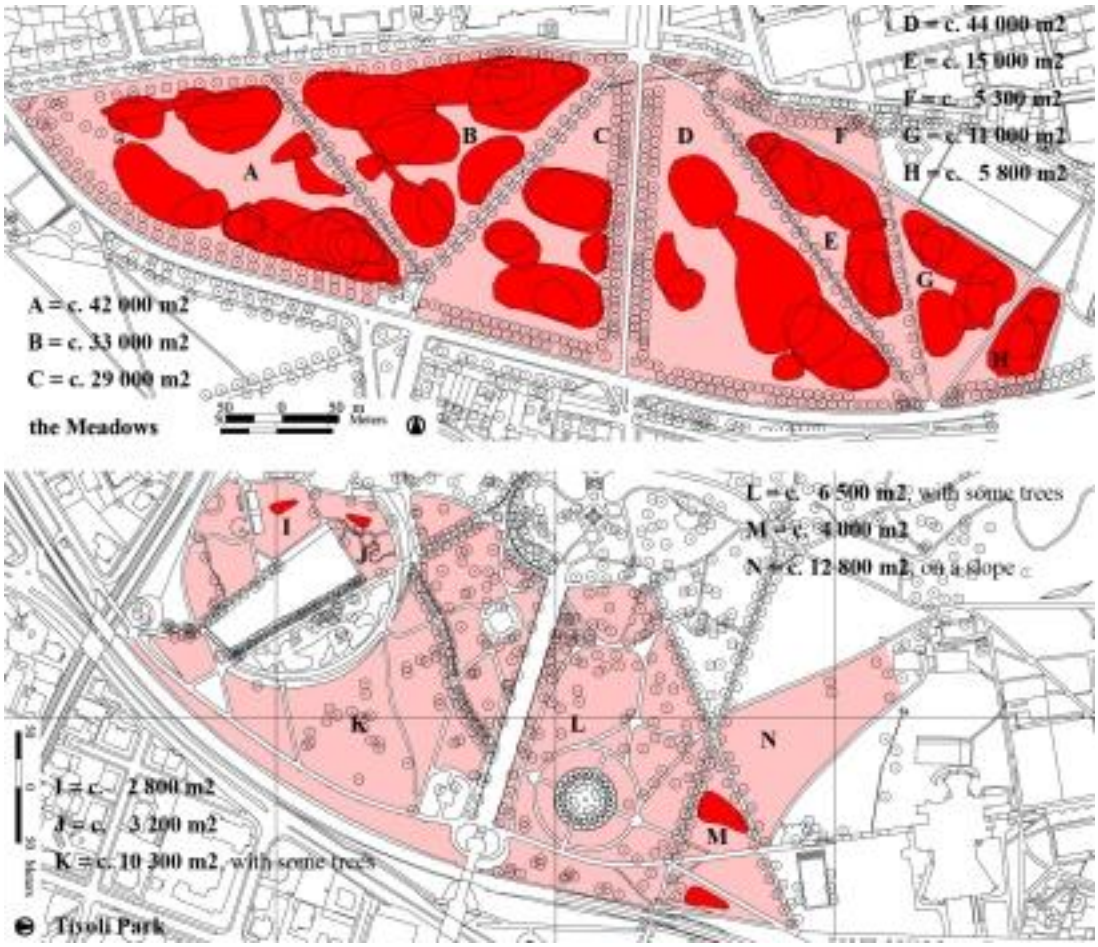

Figure 9: Suitability of park settings for long stay active occupancies (source: Goličnik, 2005).

The aspects influencing the usage-spatial relationship in positioning active long-stay uses in a park setting are size and shape of activity spaces and compactness of groups using them. Thus such initial metric distances can be additionally informed with surfaces and number of people per surface occupying the territory. Goličnik and Ward Thompson (2010) show that large groups demand clear areas of at least 3000 m2 (e.g. informal football games, groups of 15 – 20 people need 3000 – 5000 m2 and a longitudinal shaped space, informal games other than football require 1000 – 3000 m2 spaces and, in addition, both some buffer areas around it). Referring to these discussed empirical data from observation in the Meadows, one of the reasons for low participation in playing football in Tivoli, especially the low adult participation, might be that there is simply not enough room for it to occur. The size of big patches in Tivoli are from about 6500 to 10000 m2. Although they might appear suitable in size for such occupancy, the trees scattered on them reduce their potential for such particular use. The biggest patch with no trees (a triangle cca. 4000 m2), along the main walkways through the park was used once by a large group of children playing football (M in Figure 16). The biggest patch with no trees in northern Tivoli (N in Figure 16) is on a slight slope and therefore unsuitable for playing football.

Cumulative spatial capacities of places

As opposed to knowledge gained from daily patterns, overall views on occupancy patterns can indicate under or over use as well as cumulative capacities of places and thus refers to spatial capacities for users. For example, intensity of occupancies shows where activities with similar intensities of participation took place in the park (Figure 10 above). This is linked with types of activities and popularity of settings for their presence in a place. Spatial settings such as well-defined corners seem popular with all sorts of activities participated in by many people (e.g. sitting and playing football), as well as those participated in by a few, (e.g. playing with a ball, performing street-theatre and standing). Speaking territorially, all these variously intensively participated activities take place mostly in the peripheral and semi-peripheral areas.

Further, cumulative intensity of temporal-spatial occupancy, from low to high degrees and from being in transition to prolonged stay in the park generates knowledge about levels of shared areas of uses, frequency of occupancy as well as intensity of usage by one or more different activities significant for particular setting or territory within a designed place. This reflects in popularity of corners occupancy (Figure 10 middle). As opposed to a situation of different levels of occupancy (Figure 10 above and middle) Figure 10 below illustrates minimum cumulative buffer zone of the park, an area which always remained unused: about 2m from inner edges, about 16m from outer open and about 7m from outer solid edges. The main communication route across the park, lined on each side by a double row of trees, results in a buffer zone similar to that of the open outer edge on the south, i.e. 16m.

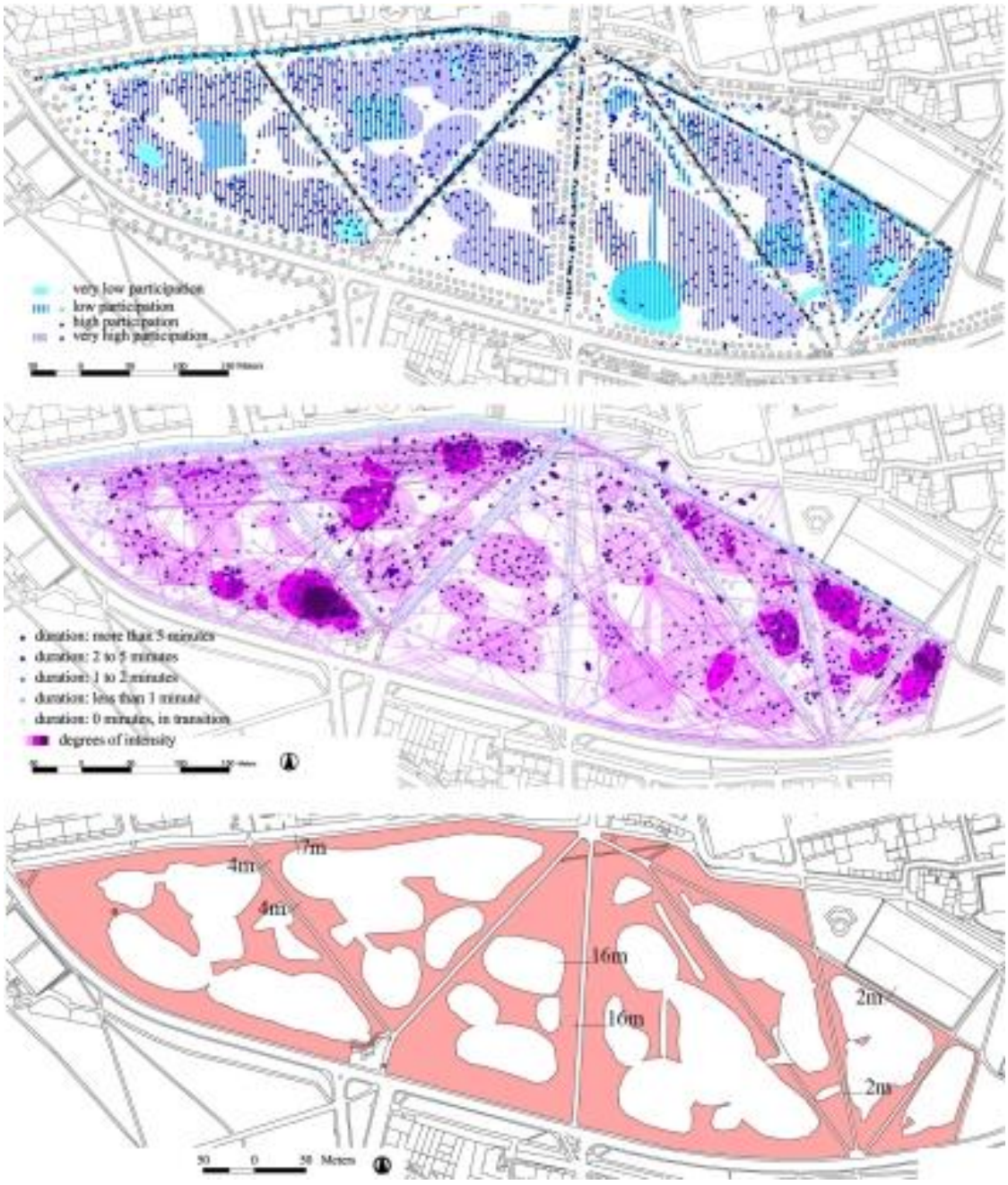

Figure 10: Spatial occupancy arranged with regard to participation of users engaged in any one activity (above), cumulative intensity of temporal-spatial occupancy of the park (middle), and cumulative minimum buffer zone for the park (below) The Meadows, Edinburgh, UK (source: Goličnik, 2005)

Informing network of places for socially responsive green structure

Key elements of green infrastructures of cities and towns, especially in city centres, are usually parks. No matter the size and shape, parks are often considered as negative or soft spaces, places of implicit limits (Trancik, 1986). This paper shows that in parks where physical limits are well defined, environments suitable for occupancy are easily recognised and realised; where voids are larger and the physical limits are further apart, uses themselves structure the resilience of the potential environment to become effective for one or more of them. Thus, a structure is given to loose-fit spaces. In parks, where large voids are usually one of the basic spatial constituents, the question how loose-fit landscapes can be (in)formed by uses is relevant here. Making a point about

park design, Ward Thompson (2002) refers to Dovey's critical comments on La Villette, Paris, that, "the emphasis on static, visual qualities of space do not in fact make for loose and free use of space, but one where use is highly controlled and limited" (Dovey 2000 in Ward Thompson, 2002: 70). Recognising the potentials and problems of/for loose-fit spaces in designed places, this paper considers one aspect of their examination through occupancies, and aims for some insights as to how this flexible concept of loose-fit landscapes of larger central parks (in a European context) can be implemented and closely considered.

Beside provision of such detailed information referring to shapes, dimensions and spatio-temporal patterns of usage-spatial relationships and usage-usage relations in particular settings, in social aspects of green infrastructure planning and implementation connections between green areas, their accessibility and proximity to various services or residential areas are usually in focus when dealing with socio-spatial issues. To meet physical dimensions and quantified references for actual planning such research is usually linked to GIS tools and analysis. From technical point of view there are variety of approaches calculating and evaluating accessibility regarding actual accesses (e.g. Schipperjin et al., 2013), using centroids (e.g. Kaczynski et al., 2009). However, this method ignores open space shape and size, which may lead into misinterpretation of proximity. Therefore improvements and advanced approaches solving such difficulties (e.g. Apparico and Seguin, 2006; Nicholls, 2001; Koohsari et al., 2013) are important to head towards consistency of such studies. At this point, references to the knowledge addressing sizes and shapes of places as functions of sizes and shapes of activities in places, seem relevant to add value to information abbot proximities and accessibilities and evaluate elements of green infrastructure also form qualitative dimensions of socio-spatial relations.

For the future socially responsive green infrastructures of cities it is important to upgrade proximity and accessibility studies with the studies informing about actual articulation of places and their supportiveness for any kind of outdoor activity as exemplified through this paper. By such integral approach issues about public health and general well-being for the city population would become more comprehensively addressed and may come closer to the fact that urban and spatial planning would be able to provide specific and directed solutions for particular, territorially associated, public health issues.

Lessons learnt for Central, Eastern and South-Eastern European perspective

The discussion in this paper focussed on a very fine scale trying to understand actual dimensions, shapes, intensities and character of uses in places to provide bottom-up platform with new insights for planning practice and design. Even if generalisations presented as an empirical knowledge are still rather speculative, they however can offer important contributions to knowledge and understandings of social dimensions of green spaces, because previous theoretical stands and guidance for the built environment have now been supported by data for large open space occupancies. At the same time, it is important to bear in mind limitations of the findings based either on accuracy of recordings or consideration of other relevant aspects that may influence space occupancies.

The socio-economic context, the functions and density of the surrounding area may vary and are certainly likely to influence the activities and level of use within a space. In this study (Goličnik, 2005), the sites chosen were roughly comparable with regard to such considerations but this potential limitation must be recognised before generalising to other parks in different (e.g. suburban) parts of other towns and cities. Well-used (and

well-maintained) city parks are likely to be perceived as safe places to visit, sit on the grass, etc., but this may not be true for emptier or poorly maintained spaces, or where there is no surrounding land use that provides informal policing of the area.

However, discussed cases were proven to be comparable. Both cities, Edinburgh (UK) and Ljubljana (Slovenia) are middle-sized European capital cities with a relatively small population in total (Edinburgh about 450,000 inhabitants, Ljubljana about 300,000). Both are important national and international cultural, educational, as well as political centres; they have a similar atmosphere in terms of their daily routine. Both cities belong to the mid-latitude temperate climate zone, Edinburgh to the oceanic, Ljubljana to the continental; which causes some differences during different times of the year, but in mid spring, a popular season for outdoor activities, they are quite similar, especially when conditions are dry, no matter if it is sunny or windy. A comparable number and typology of selected places representing popular, central public open spaces of different sizes and micro-spatial contexts were selected for study within an area of about 2 km2 in each city. Referring to central, eastern and south-eastern European dimensions, cities of such capacities are very common there, therefore messages shown here can directly contribute to green infrastructure planning and urban design as an informative bottom-up approach.

Conclusion

The aim of this paper was to provide socially informed concepts and measures for the green infrastructure and to show a potential which behaviour patterns and their characteristics can have on urban planning and design, not only to provide thresholds and evidence-based guidance, but also to connect public health research and urban planning and design in order to work towards quality of living in cities and towns. If one of the goals for public health is to increase the amount of physical activity people choose to engage in, then provision of appropriate environments for physical activities is essential, and by doing so, understanding of usage-spatial and usage-usage conditions and requirements of particular activities to happen fully, is of key importance.

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