Chapter 6: Observing behaviour for site planning and design

Peeter Vassiljev, Cristina Vert and Simon Bell

Introduction

One of the challenges facing planners and designers of outdoor public spaces is to know exactly for whom the space is being provided and how successful a space is once it has been developed. If a completely new space is being created, for example, at a former dockside to which no one had access, except for the dock workers, then designers must try to predict how and when a place might be used. Once implemented, however, it is possible, through the application of different tools, to measure the success of the project and the design. If, on the other hand, an existing public space is to be the focus of an improvement or regeneration project, it is extremely useful to be able to find out how people already use the site and then use this information alongside the assessment of the site itself, using, for example, the BlueHealth Environmental Assessment Tool (BEAT), which was presented in Chapter 5, to design the layout and programming of the site. Then, as in the previous example, an assessment of the success of the project can be gained.

Of course, when a larger-sized site is the subject of a project, it may be subdivided into different zones (e.g. functional, ecological or aesthetic) where there are different affordances for physical or social activity – places within the site which may also be known as “behaviour settings” (Barker, 1968). In addition, where a location has very pronounced seasonal differences, a site may be used very differently in, for example, summer or winter. Just walking around a site to observe casually what is going on will provide a general picture of its use, but something rather more systematic and reliable can provide valuable evidence for use in planning, design and management. When we add a desire to capture the health and well-being benefits provided by a public space, we must use another tool for this purpose. It needs to be a tool that helps to identify the range and amount of physical or social activities of different types being undertaken by different groups of users and may be able to convert some of this into calories expended by them. This could provide really valuable information. The generic name for this kind of data collection and analysis is “behaviour observation”, and it has developed significantly over recent years to become a tool which not only relates well to theory but which has been developed methodologically and technically for both research and practical application in planning, design and management of public open spaces.

This chapter introduces and describes two methods and tools for capturing and mapping of behaviour by users of sites. The first method, the System for Observing Play and Recreation in Communities (SOPARC), is a tool already developed and in use by researchers who want to know how much and what kind of activity is being undertaken in parks (McKenzie et al., 2006). This tool was not developed for the BlueHealth project, but it was applied in one specific study, and the method and this application will be summarised here.

The second tool has different but related aims: to be able to link what people do, who does it, where they do it and when they do it both before and after the introduction of the social or spatial intervention. This approach goes beyond merely recording numbers of users engaged in different levels of physical activity to uncovering spatial,

temporal and weather-related associations between all kinds of passive and active behaviour, social groups and the physical locations or behaviour settings.

Environment-behaviour research using behaviour mapping for understanding the interaction between people and place was initially developed by Ittelson et al. (1970) to record behaviour in a design setting. Bechtel et al. (1987) noted the value of observational methods and behavioural mapping to identify kinds and frequencies of behaviour and to demonstrate their association with particular sites. Cooper Marcus and Francis (1998, p. 346) stated:

with a very limited investment of time the investigator can achieve considerable insight into the actual use of designed places – a vast improvement over the conjecture and guesswork generated by studying a site plan from the remove of the studio or office.

(1998: 346)

They emphasise its systematic approach, being based on function rather than aesthetics. Work on mapping use of public spaces was advanced by Goličnik and Ward Thompson (2010) in a study of squares and parks in Ljubljana and Edinburgh and also by Unt and Bell (2014) in their use of mapping of a single space in Tallinn at two time periods, before and after a so-called “urban acupuncture” spatial intervention – which was also the inspiration for the Blue-Health intervention case studies. There has also been extensive work by Cosco et al. (2010) on mapping the use of children’s play areas, related to specific “behaviour settings” (Barker, 1968). One of the drawbacks of these methods is the fact that they are paper based, points have to be recorded using colours and symbols and analysis has been somewhat limited, especially statistical analysis. One of the strengths is the ability to show spatial patterns.

Some earlier behaviour mapping methods, for example, Project for Public Space (2005), involve dividing the mapped site into zones and using a matrix to record use by people across each zone. This results in large amounts of data, but, because the precise location of individuals is not recorded on the map, it is not good at determining how behaviour relates to the layout of the space. The value of the Cooper Marcus et al., Goličnik and Ward Thompson, Unt and Bell or Cosco et al. techniques is that they take a more detailed approach to behaviour mapping, using techniques that allow detailed recording of each individual’s location on a site map. They all stress the importance of time, weather, activity, social interaction and so on in relation to the mapping of individuals’ use of a site.

The development, application and utility of SOPARC

General approach

SOPARC is a tool based on systematic observations designed to assess park use in community environments. Although it was primarily designed to assess parks, SOPARC can also be used to assess other types of settings – both indoor and outdoor – such as school campuses or patios, walking/jogging tracks or streets, among others (McKenzie and Cohen, 2006; McKenzie et al., 2006).

SOPARC is used to quantify the number of people using a predefined area, to assess the observable sociodemographic conditions (mainly gender, age and ethnicity) of these people and to estimate the amount of physical activity that they conduct in the area. Besides this, SOPARC might also be used to evaluate individual aspects of park activity (e.g. accessibility, usability, supervision, equipment of the area, whether there are organised activities, darkness, etc.) to provide contextual information of the site that is being used and assessed (McKenzie and Cohen 2006; McKenzie et al., 2006). Despite the fact that SOPARC can be adapted for the purpose of each study by including or excluding

Figure 6.1

Renovated (blue tint) and non-renovated (pink tint) areas of the Besós riverside park in the vicinity of Barcelona. Pink lines denote existing walkways, and the dashed black line indicates the lower part of the area. The intervention (i.e. paved walkway, ramps and stairs) is marked in blue. Red dots indicate the position at which observers made their recordings (further detailed in the following subsections of the chapter) for the pre-post intervention evaluation with the SOPARC tool

(Source: Cristina Vert and Orthophoto: Institut Cartogràfic i Geològic de Catalunya, 2020)

characteristics to be recorded and/or by incorporating methodological modifications (Evenson et al., 2017), users are encouraged to follow the existing procedure manual (Mckenzie and Cohen, 2006) as much as possible in order to ensure validity, reliability and feasibility of the tool (Mckenzie and Cohen, 2006; McKenzie et al., 2006). The procedure to be followed when using the SOPARC tool is described in the following section.

The SOPARC tool has been employed in different studies to evaluate the impact of nature-based interventions in urban areas (Cohen et al., 2014, 2015; Evenson et al., 2017; King et al., 2015). It is suitable for this purpose because it is a non-invasive and cost-effective method and observations before and after the intervention can be compared to assess potential changes on the usage of an area. It is useful to evaluate the success of interventions in terms of usability and to identify and assess the target population using the area. As part of the BlueHealth project, SOPARC was used in a pre-post intervention case study of a section of the Besós River in Barcelona (Catalonia, Spain) to evaluate the impact of an urban riverside regeneration project (see Figures 6.1 and 6.2). The aim of the project was to provide access to the riverbanks, facilitating a walkway – for walking, cycling or running – and a resting area. The SOPARC tool was employed before and after the intervention to assess changes on the use of the area and the characteristics of the people using it (Vert et al., 2019).

Figure 6.2
A view of the Besós urban riverside park in the vicinity of Barcelona. The intervention, assessed with the SOPARC tool, included the construction of a paved walkway next to the river (on the left side of the picture)
(Source: Cristina Vert).

Figure 6.3
Schematic workflow for SOPARC application

Application

SOPARC is an easy tool to use, although suitable preparation before starting the field-work for data collection is required. These are the main steps that must be followed when using the SOPARC tool (Figure 6.3):

1. Identification of target areas
2. Preparation of observation materials and definition of codes
3. Observation procedure
4. Data management and scoring

1 Identification of target areas

Target areas are those sections of the setting to be assessed. It is very important to become familiar with the study setting before starting the assessment so as to identify the sections that best represent the study area. This must account for all the locations and spaces likely to be used by people. In each target area, an observation location should also be selected. This needs to be a spot with good visibility, allowing for clear observation of the whole target area. The scale of the target area must be adapted according to the number of people expected to use it. Target areas might also be divided into sub-target areas in order to obtain more accurate measures (Mckenzie and Cohen, 2006).

2 Preparation of observation materials and definition of codes

Observers intending to conduct the observations using the SOPARC tool must be trained in advance using the support materials, including video tutorials and manuals supplied by Active Living Research (2006). Observations may be recorded manually on a paper form or

by using the SOPARC app, which allows data collection using a web browser, or an app for Android or iOS (Active Living Research, 2006; Ciafel, 2013). In either case, the coding form needs to be prepared before data collection commences. The original coding form can be found and downloaded from the SOPARC manual (Active Living Research, 2006; McKenzie and Cohen, 2006), and it can be adapted according to the purpose and characteristics of each study. Either way, the coding form must include at least the following data categories:

- a. *Gender*. It is generally categorised into female and male.
- b. *Age group*. This is determined according to the following criteria: (i) child = 0 to 12 years old, (ii) teen = 13 to 20 years old, (iii) adult = 21 to 59 years old and (iv) senior ≥ 60 years old. Since age is assessed by observation, these ranges are designed to be fairly easy to recognise.
- c. *Ethnicity*. This is usually categorised into the following (US) categories: (i) Latino, (ii) Black, (iii) white or (iv) other. It might be appropriate to introduce different groups depending on the range of ethnicities expected to be encountered (such as South Asian in the United Kingdom). This data can be important in studies that aim to consider a specific population group characterised as, for example, a minority ethnic group. In some studies, however, this information is not collected due to ethical or practical reasons.
- d. *Physical activity*. This is usually classified into three different categories: (i) sedentary, when users are lying down, sitting, crouching or standing in place; (ii) moderate – such as walking at a casual pace; or (iii) vigorous, when users are engaged in a vigorous activity such as running or cycling. When physical activity is categorised as vigorous, the type of physical activity is also specified (e.g. football, skating, jumping, etc.). This is to be used in the scoring step of the SOPARC procedure.

For the case study conducted within the BlueHealth project, in which SOPARC was used to evaluate the Besós River urban riverside regeneration project (Vert et al., 2019), we also included “location” (to indicate whether users were walking, running or doing any other activity in the lower [“L”] or upper [“U”] part of the riverside area – see Figure 6.1) in the coding form (see Figure 6.4), as this was relevant for the study. It is also useful to include a section for taking notes during the fieldwork. This can be helpful for the further steps, in case some of the recordings were not clear. Likewise, it is helpful to include a detailed description of the codes used at the bottom of the form so the observers can easily check them if needed. Observations can be conducted by a single observer, although it is highly recommended to have more than one observer at the same time and location. In this way, the risk of recording incorrect observations is reduced because observers can check and correct each other. The degree of agreement between observers can be assessed, for example, using the intraclass correlation coefficient (ICC) (Hallgren, 2012). A sample of the form used in the urban riverside evaluation study as part of the BlueHealth project is shown in the following.

3 Observation procedure

The duration of each observation, as well as the time sections (i.e. time divisions within each observation), have to be defined in advance. For a walking/jogging track, the duration of a time section is defined as the time a person needs to walk from one side to the other of the track/path (McKenzie and Cohen, 2006). Thus, for example, if a time section has an observation length of seven minutes, within a one-hour observation, there will be six time sections (7 min $\times$ 6 time sections = 42 min), with breaks of approximately three minutes between time sections.

DATE: 23/05/2017 OBSERVER (Name): Peter Time section: 1 2 3 4 5 6
 START TIME: 11:00 END TIME: 12:00 Temperature and weather: 20°, SUNNY
 TARGET AREA: A (La Ribera Neighborhood) B (purifying plant)

# P	Location	Gender	Activity level	Activity (specify)	Age group	Ethnicity	Notes
1	U <u>L</u>	F <u>M</u>	S <u>W</u> V	WALK	Child Teen <u>Adult</u> Senior	<u>C</u> <u>LA</u> <u>B</u> <u>A</u> <u>O</u>	
2	U <u>L</u>	F <u>M</u>	S <u>W</u> V	WALK	Child Teen <u>Adult</u> Senior	<u>C</u> <u>LA</u> <u>B</u> <u>A</u> <u>O</u>	
3	<u>U</u> L	F <u>M</u>	S W <u>V</u>	RUNNING	Child <u>Teen</u> Adult Senior	<u>C</u> <u>LA</u> <u>B</u> <u>A</u> <u>O</u>	
4	U <u>L</u>	F <u>M</u>	S <u>W</u> V	STANDING	Child Teen Adult <u>Senior</u>	<u>C</u> <u>LA</u> <u>B</u> <u>A</u> <u>O</u>	
5	<u>U</u> L	F <u>M</u>	S <u>W</u> V	WALK	<u>Child</u> Teen Adult Senior	<u>C</u> <u>LA</u> <u>B</u> <u>A</u> <u>O</u>	
6	<u>U</u> L	F <u>M</u>	S <u>W</u> V	WALK	Child Teen <u>Adult</u> Senior	<u>C</u> <u>LA</u> <u>B</u> <u>A</u> <u>O</u>	
7	U <u>L</u>	F <u>M</u>	S W <u>V</u>	RUNNING	Child Teen <u>Adult</u> Senior	<u>C</u> <u>LA</u> <u>B</u> <u>A</u> <u>O</u>	
8	U <u>L</u>	F <u>M</u>	S W <u>V</u>	CYCLE	Child Teen <u>Adult</u> Senior	<u>C</u> <u>LA</u> <u>B</u> <u>A</u> <u>O</u>	
Etc...	U L	F M	S W V		Child Teen Adult Senior	<u>C</u> <u>LA</u> <u>B</u> <u>A</u> <u>O</u>	

NOTES:

Time section: each time section will last 7 minutes (in total we will have 6 sections of 7 minutes, so 42 minutes observation time, with breaks of 3 minutes between sections, in total 60 minutes).
Start time: time at which the observation process starts.
End time: time at which the observation process ends.
#P: number of subject observed.
Location: U=upper part of the section (sidewalk), L=lower part of the section (near the river)
Gender: F=female, M=male
Activity level: S=sedentary (lying down, sitting, standing in a place), W=walking, V=vigorous (increasing heart rate, sweating: jogging, biking...)
Activity specify: indicate the specific activity the person is doing.
Age group: Child (<12 years), Teen (13 to 20 years), Adults (21 to 59 years), Seniors (>60 years)
Ethnicity: C=Caucasian, LA=Latin-American, B=Black, A=Asian, O=others
Note: Please indicate any events or observations of interest, including close calls, unlawful behavior, or any other information that may affect your count, or observed behaviors such as significant events or background information, i.e. free zoo day, formal event at park, etc.

Figure 6.4

A sample of a completed SOPARC form used in the urban riverside evaluation study

Figure 6.5

Observer filling in the SOPARC coding form of observations. She does it from a predefined location from which she can observe and assess the target area defined for the study

(Source: Glòria Carrasco)

The observation procedure consists of systematically scanning target areas during a specific period of time to quantify the number of people using the area and their characteristics and levels of physical activity (see Figure 6.5). Scans are visual sweeps from left to right across the target area during the established time for each time section. Before each observation, observers need to fill in the heading of the form indicating the date, time, temperature and weather conditions and other information relevant for the study (Figure 6.4). The time length of each time section is measured with a chronometer and, during this time, observers annotate all the observations in the SOPARC form.

Observations must be conducted at different times of the day (e.g. morning, afternoon, evening) and several days per week (including weekdays and weekends) in order to capture the real pattern of use of the area.

This is the recording procedure for walking or jogging tracks, which is the one employed in the BlueHealth project. However, SOPARC can also be used to assess other settings with different characteristics. In this case, the recording procedure has some differences, which are described in the SOPARC manual (Mckenzie and Cohen, 2006).

4 Data management and scoring

All the data recorded in the SOPARC coding forms must be transferred to an Excel spreadsheet and then imported into statistical software to conduct the analysis. First, data must be aggregated according to the variable of interest. This information will be used to conduct descriptive analysis and statistical comparisons between categories (Mckenzie and Cohen, 2006). Second, for the assessment of physical activity levels, physical activity observations must be converted into energy expenditure units, which refers to the amount of energy a person uses. The total number of

sedentary, moderate and vigorous users must be summed and then multiplied by the respective metabolic equivalent of task (MET) for each physical activity category according to the compendium of physical activities developed by Ainsworth et al. (2011).

Sample outputs of a BlueHealth case study using SOPARC

The results of the pre-post intervention case study of a stretch of the Besòs River in Barcelona are illustrated in part in the next section of the chapter in order to show how the findings can be presented. The example is drawn from a paper by Vert et al. (2019) and focuses on three main aspects, illustrated by graphs. The first focuses on gender, the second on age and the third on ethnicity.

Generally, for the whole observed sample, the results suggested that interventions developed to facilitate access to blue spaces in socioeconomically deprived urban and peri-urban areas were successful in promoting the use of these natural settings. The number of users significantly increased in the renovated area (30.2% in 2016 vs. 36.1% in 2017, $p < 0.001$), while it significantly decreased in the non-renovated area (69.8% in 2016 vs. 63.9% in 2017, $p < 0.001$). More specifically, in the lower part (riverbank) of the renovated area, we observed a noticeable increase of

Figure 6.6
Levels of physical activity by target area (i.e. renovated and non-renovated area of the Besòs River) and period of evaluation (i.e. pre/post-evaluation), stratified by gender

(Source: Cristina Vert and Anna Wilczyńska)

users (1.7% in 2016 vs. 15.9% in 2017, $p < 0.001$), whereas in the upper part, the number of users decreased, indicating that users employed the stairs and ramps dedicated to facilitate access to the riverbank.

Patterns of physical activity were observed to vary slightly between the different population groups evaluated in this study. First, in the post-intervention evaluation period, sedentary use of the renovated area increased for both females and males (Figure 6.6). Nevertheless, the increase of vigorously active users in the non-renovated area was higher for males (65.5% in 2016 vs. 69.8% in 2017) than for females (20.2% in 2016 vs. 21.9% in 2017) (Figure 6.6). Results showed that females had a significantly higher chance of being sedentary and moderately active both in the renovated and non-renovated area compared with males.

Second, the increase of moderately active users over time in the renovated area was mainly driven by children (38.9% in 2016 vs. 57.7% in 2017) and adults (53.3% in 2016 vs. 60.9% in 2017), although the proportion of moderately active seniors also increased (Figure 6.7). In the non-renovated area, teenagers experienced the highest increase of

Figure 6.7

Levels of physical activity by target area (i.e. renovated and non-renovated area of the Besòs River) and period of evaluation (i.e. pre/post-evaluation), stratified by age group

(Source: Cristina Vert and Anna Wilczyńska)

vigorous physical activity levels (from 15.0% in 2016 to 71.4% in 2017). We also observed an increase of vigorous levels of physical activity for adults and seniors but not for children (Figure 6.7).

Third, non-Caucasians had a significantly higher likelihood of being sedentary and moderately active users than Caucasians. As shown in Figure 6.8, in the post-evaluation, the proportion of sedentary non-Caucasian users increased in both the renovated (from 0% in 2016 to 18.6% in 2017) and non-renovated area (from 2.6% in 2016 to 16.3% in 2017). Likewise, the proportion of Caucasian vigorously active users increased in the non-renovated area (from 56.8% in 2016 to 63.4% in 2017), while the proportion of non-Caucasian vigorously active users decreased (from 35.9% in 2016 to 11.6% in 2017) (Figure 6.8).

Moreover, we observed that the increased use of the riverside area was particularly significant to user groups which are usually underrepresented in such environments (e.g., women, children or migrants). As an example, although more males were observed in the riverside area than females, after the intervention, we observed a 43% increase in females at the renovated area of the river. Furthermore, more than 90% of the users were coded as Caucasians. However, a significant increase of non-Caucasian users was observed in the renovated area after the

Figure 6.8
Levels of physical activity by target area (i.e. renovated and non-renovated area of the Besòs River) and period of evaluation (i.e. pre/post-evaluation), stratified by ethnicity
 (Source: Cristina Vert and Anna Wilczyńska)

Table 6.1 **Energy expenditure (in mean METs/observation) by target area for the pre- and post-evaluation SOPARC assessment**

	<i>Renovated area</i>			<i>Non-renovated area</i>			<i>Both areas</i>		
	<i>Pre (2016)</i>	<i>Post (2017)</i>	<i>Comparison between years (% of change)</i>	<i>Pre (2016)</i>	<i>Post (2017)</i>	<i>Comparison between years (% of change)</i>	<i>Pre (2016)</i>	<i>Post (2017)</i>	<i>Comparison between years (% of change)</i>
<i>Mean METs/observation</i>									
Upper	4.34	4.12	–5	5.44	5.80	7	5.08	5.21	3
Lower	4.59	3.41	–26	6.79	6.74	–1	6.69	5.29	–21
Total	4.34	4.01	–8	5.64	5.91	5	5.25	5.22	0

intervention (2.6% of non-Caucasian users in 2016 vs. 7.8% in 2017, $p < 0.001$). All this might have a positive impact on the reduction of health inequalities.

Besides using the SOPARC tool to quantify the number of users in the urban riverside park and their sociodemographic characteristics, the tool was also suitable to estimate the physical activity levels of the users of the setting. On average, it was observed that, for the pre- and post-evaluation period and for both areas of the river, 90% of the users of the Besòs Riverside Park were engaged in moderate or vigorous levels of physical activity. However, we found a significant increase of users engaging in sedentary and moderate levels of physical activity in the renovated area (7.7% of sedentary users in 2016 vs. 12.0% in 2017, $p < 0.001$ and 66.9% of moderately active users in 2016 vs. 68.7% in 2017, $p < 0.001$) and a significant increase of users engaging in vigorous levels of physical activity in the non-renovated area (56% in 2016 vs. 62.4% in 2017, $p < 0.001$). Findings from the renovated area of the river were similar to those already reported in other studies (Kramer et al., 2017; Schultz et al., 2017) that suggest that urban regeneration projects might stimulate leisure-time walking (i.e. moderate physical activity) among adults in deprived areas. Nevertheless, residential proximity and access to parks may facilitate physical activity among residents of the area, even if it is only by providing destinations to which people can walk or cycle, although park-based physical activity may account only for a small proportion of the total physical activity people conduct (Cohen et al., 2015; Stewart et al., 2018).

Overall, we did not observe changes in energy expenditure (expressed in METs/observation) after the intervention. However, we observed an 8% decrease of METs/observation in the renovated area and 5% increase in the non-renovated area. This was mainly driven by the decrease of energy expended in the lower part of the river and the increase of energy expended in the upper part of the river in the renovated and non-renovated area, respectively. An example of presenting the METS using a table is presented next (Table 6.1).

The development, application and utility of the BlueHealth Behaviour Assessment Tool

General approach

The BlueHealth Behaviour Assessment Tool takes the basic theory and approach, as described earlier in the introduction, and moves on from paper-based mapping to the application of a geographic information system (GIS)-based recording application on a tablet computer used on site (see Figure 6.9) where all the data are automatically linked to a database. This system is not only more accurate, but it is quicker, enables more points to be collected without the map becoming crowded and allows for primary and secondary activities to be noted simultaneously. The specific GIS program used in the system described in this chapter is Quantum GIS (QGIS) (The QGIS Community at www.qgis.org), which is free,

Figure 6.9

A photo showing how the GIS digital interface is operated on a tablet computer on site. Here the drop-down menu for recording the attributes of someone using the site is open over the map base

(Source: Peeter Vassiljev)

Figure 6.10

Schematic workflow for BBAT application

open-source software. When supplied with some additional scripting (freely available to readers via the BlueHealth Tools website at <https://bluehealth.tools>), it can easily be set up for use and tailored for activities which might be specific to the site in question. A similar application that served as an inspiration and a basis for us was developed and applied by Frederico Meireles as part of his PhD on assessing the success of a programme of new or restored parks in Portugal (Meireles Rodrigues, 2015).

Application

The demonstration of the application uses a site of Pelgurand Beach at Kopli in Põhja-Tallinn, Estonia, where an experimental intervention was constructed (see Chapter 3), although we focus only on the pre-intervention state for illustration purposes. The application of the methodology includes several steps (see also Figure 6.10). These are as follows:

1. Background data collection
2. Preparation of site maps divided into specific areas or behaviour settings
3. Planning the observation points or routes
4. Identifying the range of likely activities to be recorded and designing the specific coding system for each
5. Selecting the time periods for sampling
6. On-site data collection
7. Preparation of a spatially explicit database
8. Analysis of results both statistically and visually
9. Repetition of Steps 6–8 for the post-intervention surveys (two phases)

1 Background data collection

Notes and photographs covering the characteristics of the study site should be collected for the initial site survey. This will reveal the character of the area and, if carried out when people are using the site, the likely activities and some of the likely locations within the site where activities are concentrated can be captured, to make planning easier. It will also reveal the condition of the site and help in the preparation of a base plan to be used for the recording. In addition, it will suggest suitable places from where all or significant parts of the site may be observed. If the water element of the site is variable, such as being tidal, or the seasons are significant, such as freezing in winter, these should also be noted, as it may be necessary to include sampling across these variations. Therefore, the site should be visited several times in order to build up a good overview prior to the data collection phases.

2 Preparation of site maps

Site maps should be prepared by simplifying extracts from digital map bases or aerial/satellite photographs in order to accentuate relevant elements and erase unnecessary features that would complicate observation recording. The site map should contain the main features such as boundaries, entrances, paths, water edges, main vegetation zones, specific buildings and landmarks that help with orientation. The digital site map will be used in a GIS data acquisition solution on a tablet computer, but a paper version of the site map will also be required as a fallback solution in case of technical problems (environmental extremes, battery, security). Space on the paper map form should be provided for noting the date, time of day, weather conditions and water conditions. The map should be able to be printed in

Figure 6.11

An example of a paper form used for BBAT data collection with part of the survey area (sector A) shown on a map (topographic data and orthophoto: Estonian Land Board, 2018) and the coding key to the parameters that should be recorded. For example, the person in the central portion of the map marked with the code “M2aliW4” indicates a male; aged 13. . . 20; alone; paddling, splashing or wading in the water. The western-most point captures a group of three with the last user coded as “M3grA31011” indicating a male, aged 21. . . 59, in a group, standing while also drinking and eating something

(Source: Peeter Vassiljev)

black-and-white in A4 format, scaled to fit the paper so that it can be fitted to a clipboard and unobtrusively carried around (see Figure 6.12). Typically, multiple copies are needed for each observation episode to distribute abundant information thematically (usually by gender or age) on the limited form space.

3 Planning the observation points or routes

As the whole idea of the method is to observe the activities of site users, it is necessary to try to be as unobtrusive as possible in the selection of places from which to observe and record without drawing undue attention to the surveyor. If there are single spots such as a high point with an unrestricted view of the entire site, then this is ideal. However, when a site is broken up due to its size, or by tall vegetation or buildings screening parts from the view, it is necessary to find several observation spots and to plan a route between them to enable a systematic repetition of the observation process each time. If the site is very large, it should be subdivided among more than one surveyor to avoid the danger that observations might not fit in the allocated maximal four-hour time slot. In some circumstances, the safety and security of the surveyor may need to be considered in the choice of how the observations are carried out. If the site or part of it is used for children's play, then it may be necessary to take precautions and to carry identification in case of being stopped or suspected of inappropriate behaviour when standing near such places making observations.

4 Identifying the range of likely activities to be recorded and designing the specific coding system for each

The digital BBAT interface consists of a set of drop-down boxes with a number of aspects to be recorded: gender, age group, a selection from a list of main activities, who the person was doing the activity with and what they are doing as a secondary activity (e.g. listening to music, reading, chatting, etc.). Behaviour types to be recorded as the main activity should be predefined, based on past examples when possible, to allow comparison of the results and also new thinking, to capture the specifics of the particular site. The range of main activities used in the BlueHealth experiment sites as well as the range of secondary activities can be seen in the paper form example (see Figure 6.12). The wording

Figure 6.12

Diagram explaining the rotation of observation days and times in the schedule. Notice the cycling of four time slots within the day (marked with A, B, C, D) against the three observation episodes within the week, ensuring all possible time combinations and sufficient time between observations to increase the likelihood of changes in weather (Source: Peeter Vassiljev and Anna Wilczyńska)

of activity types should be concise so that it can be easily and efficiently identified while operating the tablet interface in the field. If the observations are recorded on paper forms, alphanumeric coding can be used (see Figure 6.12).

5 Selecting the time periods for sampling

In general, for many sites in the northern hemisphere, May to September/October is suitable for data collection since blue spaces are more likely to be busy in this period (although, of course, it varies according to climate). However, in cases of strong seasonality and winter use, such as in Estonia, some extra sampling should be carried out in order to capture the differences, and specific winter activity types should also be added to the QGIS menus for this. If the observation is part of a pre- and post-intervention setup, then the repeat observations should follow the same pattern so as to ensure good possibilities for statistically accurate comparison.

During the “on-season” observation period, the behaviour mapping data should be collected at specific time intervals in order to ensure that a good representative sample of all possible times is obtained. For practicality, it has been calculated that to make observations every other week, on two random weekdays (Monday to Friday) and one weekend day (consult Figure 6.11 for a sample schedule) is sufficient. For example, if the first data are collected on three days in the first week of May, then the next observation campaign will be over three days during the third week of May. Following this spread of observations will ensure data will capture the variable weather conditions that represent the whole season, but it is of course possible to compress the observation schedule into a shorter time if less representative results are acceptable. Observing a two weekday/one weekend day schedule will slightly over-sample the weekends, which in principle can be compensated for by omitting some weekend observations or using weighted data in the statistical analysis.

The days of the observation period should be divided into four blocks of morning 7.00–11.00, lunchtime 11.00–15.00, afternoon 15.00–19.00 and evening 19.00–23.00. Four-hour time slots allow for some variation according to the latitude and local patterns of use determined in Step 1. Times for observation are selected rotationally so that consecutive observations cycle through the sequence of morning, lunchtime, afternoon and evening (see last column with letters A to D in Figure 6.11). Adhering to this rotation will ensure that samples are equally spread among times of the day and progression of seasons.

During “off-season” or winter sampling, two or more additional observation weeks can be used. With limited winter daylight, these observation weeks should only use lunchtime and afternoon time periods and double the observations (either one time slot over four weekdays and two weekend days or two time slots over two weekdays and one weekend day). These observation weeks do not have to be separated by one week and instead should try to capture the most characteristic winter conditions according to the weather at the time. If the water body is expected to freeze over sufficiently to be walkable, then such conditions should be targeted, but if, due to climate variability, the freeze is unreliable or there is a sudden thaw, a week with snow cover on the ground should be selected. In milder conditions where only occasional snow cover is expected, that condition should be targeted when it occurs.

6 On-site data collection

Field work is generally safe to undertake, but some sites may be, or feel, a little less safe than others, especially if they are derelict or abandoned or may contain dense vegetation. We usually give the following advice to research assistants:

Do not put yourself in unnecessary danger. Always let someone know where you are, what you’re doing and when you expect to be back. In some circumstances your safety and security may need to be considered in the choice of how the observations are carried out. For example, you may work in pairs, resort to recording data on paper to avoid unwanted attention or leave the site altogether when feeling threatened or in danger.

The observation method should be unobtrusive so that the researcher does not affect how people use the site. Wandering too close to people while making notes might not be very welcome to some, so we also advise research

assistants to respect the privacy of people present on-site. Taking photos or recording videos of the subjects present during the behaviour mapping observation with any device is generally an unacceptable invasion of privacy and also runs the risk of affecting the visitors' behaviour. However, in some circumstances when the site is expected to be exceptionally busy and all ethical considerations and regulations have been resolved with the appropriate authorities, then taking sample photos at intervals from a specific viewpoint can be considered (see Sun et al., 2019). All records must be anonymised – there should be no extra information recorded beyond the given data entry forms that would allow identification of a particular individual.

Regardless of whether the data are collected digitally or on paper, observers should always bring:

- a. a badge stating who they are and what they're doing and a photo ID (potentially also carrying a letter showing that they are bona fide research assistants and have permission to undertake the work),
- b. clipboard (with transparent plastic covering for rain protection),
- c. at least two copies of the paper forms (in case the technology fails),
- d. set of fine-tipped waterproof markers for manual recording, and
- e. larger plastic bag to seal the tablet computer and/or paper forms in case of heavy rain penetrating the backpack or handbag.

Before starting the observations, a set of basic data are noted in the form, which include date, time of day, weather conditions (temperature from the closest available weather station; clear or few clouds/considerably cloudy/almost or completely overcast; dry/light rain/heavy rain/light snow/heavy snow; calm/light breeze/strong winds) and the water conditions (frozen over/calm water/mild waves/strong waves; unknown water level or irrelevant/low tide/average water level/high tide).

The observation protocol involves either sitting/standing in the point or points selected for the complete site overview or else, in case of limited visibility or due to a narrow linear shape to the area, a systematic walk through each site, visiting all sub-areas and taking a visual scan of each sub-area. All visual scans, unless stated otherwise in the specific site instructions, are performed from predetermined observation spots in the direction from left to right. In the case of data collection during a systematic walk-through (done only if stated in site instructions), all users are recorded on the map when closest to the observer (who is only moving on the predetermined track). All users observed in that scan are recorded as point data on the site map using the coding selected or, if the coding does not cover that activity, a note of this is recorded separately (pilot testing of the protocol should hopefully reduce the need to record unique activities). The recording of the points (see Figures 6.12 and 6.9) is accompanied by additional data, including gender (female or male; if gender cannot be identified, record as male), estimated age class (using the same as for the SOPARC – Child 0 . . 12, Teen 13 . . 20, Adult 21 . . 59, Senior 60+; if age cannot be identified, record as adult), social context of the activity (alone, in pairs, in a group; if unknown, then mark as alone), only one main activity and optional multiple secondary activities (doing something, e.g. chatting, using a phone, drinking, eating, etc. while engaged in the main activity), as already noted (see Step 4 and Figure 6.12).

In a case where there are large numbers of users and especially when paper map forms are used for data collection, it is possible to subdivide the visual scan and data entry by gender (recording female users first and male users later) and/or subdivide the observable (sub-)area into yet smaller sub-units. Each person is then recorded in the order of the visual scan from left to right. If a person leaves the sub-area after being counted, the record is still kept; if a person leaves the sub-area before being recorded, the record is not made. The same person may reappear in the next sub-area, and if that happens during the visual scan, that person should be recorded again (because it is the number of activities which are being observed, not the number of people being counted). There is an equal chance of another person moving in the opposite direction and thus never being present in the visual scan and never being recorded. The BlueHealth tools website contains instructions on how to use the QGIS tablet-based data input method.

7 Formatting data after acquisition

The data from every observation episode collected using the BBAT digital interface should be saved in a separate folder (naming convention example: Tallinn_2020_05_17_morning) because programmed forms of the BBAT interface use the same filenames that must be saved in separate folders to avoid overwriting. The data file for every observation session must be checked for consistency and integrity, as each entered point should be accompanied by gender, age, social context, primary and secondary activity information, observation date and time, weather and water condition data. If any of the observation episodes were split between multiple observers (due to the size of the area), these separate files will have to be checked for possible overlaps in observed territory (however unlikely these may be) and reconciled before merging into a single observation file. If the observations were originally mapped on paper, they should be re-coded in the office with the BBAT interface in QGIS. After data for each observation episode have been verified, they need to be merged into a single GIS point shapefile, creating a rich, spatially explicit database of observations ready for visual cartographic, statistical and geostatistical exploration in a number of different ways.

8 Analysis of results using maps and statistics

Once the database is complete, the layer can be examined and interpreted, for example, according to type of activities, estimated age of people observed, weather and water conditions, and so on in GIS, but the database file containing all the attribute data associated with the point shapefile can also be separately imported and analysed in a spreadsheet or a statistics program. Descriptive statistical analysis, such as the production of time series graphs, histograms and bar charts to illustrate activities and behaviour for different segments of the population at different times of day or days of the week can be used to reveal temporal, weather and activity variations. Comparison of the mapped data allows analysis of the different spatial attributes of site use according to different layers of data. Once Steps 6–8 have been repeated, a comparison of pre- and post-intervention surveys can be undertaken. In this section, we will use pre-intervention data from observations made at the experimental intervention site at Pelgurand in Tallinn, Estonia, in order to demonstrate different ways of looking at the data in order to answer certain research questions. We used the high-definition aerial photograph available from the Web Map portal of the Estonian Land Board as the base, as it clearly shows the different landscape features and allows us to make visual associations of uses with specific locations or elements.

ISOLATING PARTS OF THE DATA BY DIFFERENT ATTRIBUTES

First, it is quite useful just to open the GIS and load all the data points in order to see what stands out spatially, if anything, and to obtain the first overall impression – so-called “eyeballing the data”. This may produce a very crowded picture depending on the degree of zoom into or out of the site, so it may be best to separate the data between, for example, male and female users. This can be achieved by filtering data by attribute value and/or setting categorised display styles in layer properties. Figure 6.13a and b shows this thematic separation between male and female users for the entire observation period in 2017. The size of the points in combination with the zoom level in the GIS means a lot of data points will overlap, but in general, it can be seen that there are some indicative patterns present, such as a very dense area along the beach to the south, clusters along paths and so on.

This filtering of point data can be explored further by subdividing data according to age, time, social interaction and so on or combining multiple filtering parameters – much more potentially useful analyses and very easy to differentiate. Of course, we also want to see what activities are being undertaken on the site – land- and water-based – where and by whom. We can then visually split the data further and identify the most and least popular locations. Figure 6.14a and b shows active and passive behaviours for a section of the study area. The points are colour coded according to activities, but the gender or age differentiations are not shown. It can be seen that passive use is much more popular and spread over larger territory, with sitting/crouching, lying and standing on the beach and immediate area behind it most preferred, although the grassy places next to and between the trees are also well used. The active uses congregate on the paths (walking, cycling, jogging) and also along the waterline on the beach.

Figure 6.13a and b

a) All the points for the observation period of 2017 for male users and b) for female users

(Source: Peeter Vassiljev and Orthophoto: Estonian Land Board, 2020)

Another important variable to explore is time of day. Figure 6.15 shows three maps of all activities involving sunbathing according to the time of day – 1) in the early to mid-morning, 2) in the middle of the day and 3) in the late afternoon/early evening. The pattern is fairly obvious for this type of use – according to the heat and angle of the sun. Yet another observation in the location pattern can be made – contrary to a cliché that sunbathing occurs mainly on the beach, a lot of sunbathing took place away from the beach on the grass in the park. That is especially prominent in the middle of the day, but as the sun sinks to the west, these areas are cast into shadow, so most people use the beach and grassy dunes immediately behind it.

Another variable is that of the weather, especially air temperature. The next set of maps show the level of use (all records) during cooler and warmer periods (Figure 6.16a and b). In the cooler times (14°C and below), the paths are busiest, while in the warmth (20°C and above), it is the beach and grassy areas that are used.

We can also explore the social aspects of site use by differentiating between the users as individuals, in pairs/couples and in groups (and of course by gender and age or activity type if needed). Filtering out data by different variables or combinations of variables and viewing the distribution patterns of the filtered data offers many possibilities, but it also requires considerable time spent in trials, as every site is different and combinations are multiple. It is also worth remembering that besides looking for differences in the data, it is just as valuable to look at similarities between different groups.

COMBINING OBSERVATION DATA WITH SPECIFIC PARTS OF THE LANDSCAPE

It is possible to generate similar maps for many combinations of the variables collected. However, these need to be interpreted in a rather subjective way – for instance, when relating the users/uses to specific parts of the landscape.

Figure 6.14a and b

a) Pattern of active use in one section of the study area and b) the pattern of passive use (see legend)

(Source: Peeter Vassiljev and Orthophoto: Estonian Land Board, 2020)

Figure 6.15a-c

Pattern of sunbathing (all records), a) early/mid-morning; b) midday/early afternoon; c) later afternoon/early evening

(Source: Peeter Vassiljev and Orthophoto: Estonian Land Board, 2020)

Figure 6.16a and b

a) Usage of the area during the colder periods of the 2017 summer and b) during the warmer periods

(Source: Peeter Vassiljev and Orthophoto: Estonian Land Board, 2020)

The next section shows the possibilities when the site has been divided into behaviour settings (Barker, 1968). For this, it is necessary to define the different types of setting based on the physical elements and potential affordances offered by them and then to create a new GIS layer of polygons. Following this, the observation points falling within each behaviour setting can be isolated and analysed to detect the patterns of use and users. This is of value when understanding the actualised affordances offered by each setting and for improving the potential of a site. Figure 6.17 includes a close-up of one section of the behaviour setting map which shows how sunbathing or non-sunbathing can be clearly seen as directly associated with the settings of the beach (more non-sunbathers than sunbathers) and the vegetated sand dunes immediately behind the beach (majority of sunbathers). This difference is also brought out by the percentages of these two sets of activity for each behaviour setting (for the entire site), as shown in the chart in Figure 6.17.

A further interesting example is of bench users. Benches were identified as a specific behaviour setting. The differences in the distribution are not so apparent on a map, while the differences presented as percentages of observations for all benches on the entire area (Figure 6.18) with more occupation by female users, especially older, become apparent.

Figure 6.17a and b

The differentiation between two behaviour settings (beach and vegetated dunes) where a clear relationship between sunbathing (orange) and non-sunbathing (blue) stands out visually on the map, (a) (Orthophoto: Estonian Land Board, 2020); b) Percentage shares of sunbathers/non-sunbathers for two behaviour settings at the entire study site confirm the trend

(Source: Peeter Vassiljev and Anna Wilczyńska and Orthophoto: Estonian Land Board, 2020)

Figure 6.18

Percentages of observations of bench users by age and gender

(Source: Peeter Vassiljev and Anna Wilczyńska)

Figure 6.19a–c

a) Standard deviation ellipses for men and women aged 60+ on two comparison areas: b) the rocky beach park; c) the sandy beach park. Centroids for ellipses are also shown along with the radius values of the ellipses in metres

(Source: Orthophoto: Estonian Land Board, 2020, photos Peeter Vassiljev)

GEOSTATISTICAL ANALYSIS

The maps so far show points presented over the map base, aerial photo or behaviour settings. It is also possible to examine the data points using geo-statistical approaches such as central tendency measures, some other form of cluster analysis or spatial regression.

A very straightforward way of characterising the distribution within a point cloud is to generate a standard deviation ellipse out from the mean centre of the cloud encompassing locations of roughly two thirds of the points. This can be done for different, such as social groups in the data, to compare distributions in relation to each other and to the boundaries of the site. Figure 6.19 shows an example of ellipses calculated for older visitors to the rocky beach park, the mean centres of which, for both genders, are located in roughly the same place – to the east of the centre of the area itself – indicating that both groups make more use of the eastern part of the beach that is next to the sandy beach park, which has better amenities. We can also see that men are more dispersed over the area compared with women, as indicated by the considerably larger radius values of the ellipse. In the case of the sandy beach park, the radii of the ellipses are very similar for both genders, but the mean centres vary significantly. For women, the standard deviation ellipse fits within the boundaries of the park and is close to its centre, while the location of the ellipse for men is considerably shifted towards the south. The reason for such a shift might be something particular in the landscape that affects this user group and will be investigated further in the following section.

Figure 6.20a and b

a) Hot spot analysis of older women and b) older men overlaid on the aerial image of the southernmost tip of the area

(Source: Peeter Vassiljev and Orthophoto: Estonian Land Board, 2020)

A slightly more sophisticated statistical technique to consider is hot spot analysis (not to be confused with heat maps) based on the Getis-Ord G_i^* statistic, which uses counts of points within a square or a hexagonal grid of a pre-determined mesh size to determine local regions of higher or lower values. In this way, it is possible to reveal neighbourhoods where the congregation of users (or a subgroup of users) is beyond a random chance with 99%, 95% or 90% statistical confidence. Figure 6.20a and b shows two examples – for older women using the southern part of the site contrasted with older men. These are overlaid on the aerial photograph and can be seen to relate to combined areas of beach and grass in the case of the older women and to two specific spots in the case of the older men. These two specific hot spots are around a cafe and a set of chess tables (Figure 6.21) and are also responsible for the differences in the standard deviation ellipses described earlier (see Figure 6.19a).

NON-SPATIAL ANALYSIS

The maps, as demonstrated so far, are very revealing of how people use the different parts of the site, but so far, we have presented limited quantitative information on the numbers or proportions of users in relation to different attributes. The next set of analyses demonstrate how the data can be analysed non-spatially, taking different sets of attributes associated with the data points to identify trends and patterns associated with the mapped results. Descriptive statistics can be used to explore aspects such as the proportion of gender and age groups compared to the local general population (see Figure 6.22), the relative popularity of different primary activities in general (see Figure 6.23) and by gender or age.

Figure 6.21

A set of chess tables and regular picnic tables that attract a large portion of older male users of the park into a specific, well-defined hot spot – a vivid example of small investment making a large impact

(Source: Peeter Vassiljev)

Figure 6.22

Proportions of gender and age groups within observed visitors to the two parts of the study area and comparison with the proportion of these groups in the general population living in the area of Põhja-Tallinn (Statistics Estonia, 2020)

(Source: Peeter Vassiljev and Anna Wilczyńska)

Figure 6.23
Number of users engaged in different primary activities during all observations in 2017
 (Source: Peeter Vassiljev and Anna Wilczyńska)

Figure 6.24
The number of observed women and men overlaid with air temperature during the afternoon observations
 (Source: Peeter Vassiljev and Anna Wilczyńska)

Clearly, there are important findings here which are not apparent from the maps alone. There are also many different attributes which can be explored in this way, depending on what information is needed from the analysis. Another possibility of analysis of the attribute data is to explore changes over time. Figure 6.24 shows a time

series graph revealing that visitor numbers tend to follow air temperature fluctuations to some degree. In the second half of the warm season, the number of female visitors appears to become more sensitive to temperature fluctuations, increasing dramatically with warmer periods and returning to the same level as male visitors during cooler spells.

It is also possible to run some inferential or predictive statistics using correlations or regressions. Table 6.2 shows an example of a regression looking at the influence of a range of independent variables such as time of visit or weather conditions “predicting” use of the site by people of different ages. Overall, it can be noted that the regression model performs very well, except for age group 60+, where the *R*-squared value (an indicator of how much variation in visitor numbers the model can explain) is very low. Looking at the particular components in this model, it is possible to observe that air temperature is positively affecting the observed visitor numbers (also confirming the observation presented on the time series graph at Figure 6.24), and the effect is strongest with activities that imply spending a longer time on site – something that seems intuitively logical. However, contrary to what might be expected, the rain does not affect the number of observed visitors. Instead, the level of cloud cover affects the visitor numbers negatively, suggesting a far more sensitive response to even a hint of unfavourable weather. From the temporal perspective, weekends by themselves do not seem to affect the number of observed users, but weekends during summer vacations do seem to cause a reduction in the number of visits. Last, among various age groups, the number of teenagers is affected by the fewest number of factors – air temperature and time of day.

With the ability to model the level of use by different groups in various weather, environmental and temporal conditions, it is possible to identify factors that influence different user groups. This sort of information provides valuable insights into behaviour predictors but also gives hints of possible ways to cater to the needs of specific groups during unfavourable conditions or solutions that could mitigate conflicts between different user groups. Here we demonstrated a regression on the total observed users, but similar modelling applied to a number of users engaged in specific main or secondary activities or social situations could reveal further insights.

Converting BBAT data to the SOPARC format

Sometimes it might be potentially useful to convert BBAT data into the SOPARC format for comparison purposes. Since the data collection rules have the same principles, it is an easy task. First, SOPARC requires counts of visitors by age group, gender and activity level for each sub-area or behaviour setting (McKenzie et al., 2006). Subdividing the BBAT point data to sub-areas that can be determined at a later stage of analysis is a straightforward task of intersecting the point cloud with behaviour-setting polygons in GIS. It is possible to start BBAT observations with less preparation and use the experience gained through the observations to refine the borders of the behaviour settings or sub-areas. Then the BBAT data points can be subdivided between these sub-areas, counted and analysed separately.

Second, BBAT captures a rather specific activity type for each user, while SOPARC observations differentiate between three activity levels (McKenzie et al., 2006): sedentary (lying down, sitting or standing), walking (at a casual pace and other moderate activities) and vigorous (any activity that requires more energy than casual walking). The activities captured in BBAT can obviously be reclassified to calm, moderate and energetic levels – a task that involves creating an extra column in the GIS database and using conditional logic to fill out the values based on other fields in the database. Table 6.3 provides a suggested conversion schema for performing the conversion.

Table 6.2 **Multiple linear regressions of observed visitor counts in various groups with a number of environmental and temporal factors. Green indicates statistically significant results, and the value of beta indicates the direction and magnitude of the influence on visitor numbers**

Dependent variables ->	All users		Age group 0...12		Age group 13...20		Age group 21...59		Age group 60+		All stationary activities	
Adjusted R square ->	0.476		0.383		0.378		0.565		0.181		0.430	
F ->	9.388		6.722		6.614		12.968		3.039		7.955	
p ->	0.000		0.000		0.000		0.000		0.004		0.000	
Independent variables	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p
Influence of vacation on visitor numbers	0.031	0.786	0.092	0.452	0.134	0.278	-0.012	0.906	0.003	0.981	0.058	0.623
Influence of years on visitor numbers	0.089	0.274	0.208	0.021	0.173	0.054	-0.012	0.872	0.225	0.030	0.099	0.247
Influence of weekend on visitor numbers	0.154	0.158	0.151	0.202	-0.047	0.691	0.182	0.069	0.165	0.225	0.132	0.246
Influence of weekends during vacation period on visitor numbers	-0.248	0.043	-0.287	0.031	-0.196	0.139	-0.237	0.035	-0.156	0.304	-0.232	0.069
Influence of time of day on visitor numbers	0.205	0.022	0.074	0.438	0.365	0.000	0.267	0.001	-0.173	0.119	0.127	0.170
Influence of air temperature on visitor numbers	0.469	0.000	0.476	0.000	0.256	0.036	0.496	0.000	0.303	0.031	0.518	0.000
Influence of cloudiness on visitor numbers	-0.273	0.003	-0.208	0.036	-0.143	0.146	-0.290	0.001	-0.269	0.019	-0.219	0.022
Influence of rainy weather on visitor numbers	-0.103	0.257	-0.073	0.464	-0.147	0.140	-0.097	0.246	-0.070	0.541	-0.068	0.478
Influence of windiness on visitor numbers	-0.084	0.307	-0.029	0.741	-0.110	0.219	-0.112	0.135	0.040	0.698	-0.065	0.444

Observations in years 2017, 2018, 2019

statistically significant result
 statistically non-significant result

Figure 6.25 shows an example of proportions of activity levels on the study site, grouped by gender and sub-areas, where specific main activities from BBAT observation data have been converted into SOPARC activity intensity levels according to the conversion schema presented in Table 6.3. Comparison of the observation data between Kopli Rand beach in Põhja-Tallinn and Besòs River in Barcelona (see Figure 6.6) becomes possible.

It is possible to assign metabolic energy expenditure rates to every activity and to use average METs per person per observation episode as the analysis unit. Where the BBAT activities are used, the exhaustive list of MET values for various activities in the compendium of physical activities by Ainsworth et al. (2011) can be consulted, while if the activities have been reclassified to the three levels as in Table 6.3, then reference values for these can be used (see Vert et al., 2019). The distribution of the observed points categorised by SOPARC activity levels may be displayed or explored further by intersecting the values with behaviour settings. An example of mean MET values per user per behaviour setting of the Pelgurand demonstration site is shown in Figure 6.26.

A limitation with applying METs in the context of BBAT or SOPARC data is the lack of a duration measurement – it is possible to estimate the potential to expend a certain amount of energy per minute, but it does not take into account the actual duration of visits. Many sedentary activities tend to last longer, so the total calorie budget may be higher than for some vigorous activities. Another limitation of using energy expenditure is that it discounts the quality of the sedentary experience as a source of psychological restoration as opposed to active physical exercise. We must look at these two aspects separately in terms of their respective health benefits.

Table 6.3 Conversion schema of BBAT main activities into SOPARC activity intensity levels (S – sedentary activities, M – walking and other moderate activities, V – vigorous activities)

SOPARC intensity	BBAT Activity type: terrestrial	SOPARC intensity	BBAT Activity type: aquatic
Activity on foot		Activities in the water	
<S>	A1 – lying down	<S>	iW1 – fishing
<S>	A2 – sitting or crouching	<S>	iW2 – feeding birds or fish
<S>	A3 – standing	<M>	iW3 – pond dipping / throwing rocks
<M>	A4 – walking quickly for transport	<M>	iW4 – paddling / splashing / wading
<M>	A5 – strolling	<V>	iW5 – bathing / dipping
<M>	A6 – walking with a dog	<V>	iW6 – (active) swimming
<V>	A7 – Nordic walking with poles	<V>	iW7 – diving / jumping into water
<V>	A8 – running / jogging	<V>	iW8 – snorkeling / scuba diving
Sports and games		Activities on the water	
<V>	G1 – ball games (alone and teams)	<V>	oW1 – windsurfing
<V>	G2 – physical exercise / outdoor gym	<V>	oW2 – surfing on waves
<V>	G3 – frisbee, kite flying, disc golf	<V>	oW3 – paddleboarding
<V>	G4 – (child) playing on equipment	<V>	oW4 – wakeboarding (cable pulled)
<V>	G5 – (child) playing freely	<V>	oW5 – boating, rowing, pedalo
<M>	G6 – sand play	<M>	oW6 – boating (motor)
<M>	G7 – other games and informal sports	<V>	oW7 – kayaking/canoeing
<M>	G8 – playing with dog	<M>	oW8 – sailing
<V>	G9 – horse riding		
Wheeled movement			
<V>	B1 – cycling		
<V>	B2 – kick-scooter		
<V>	B3 – rollerblading		
<V>	B4 – skateboarding		
<M>	B5 – using a wheelchair

Figure 6.25

Comparison of physical activity levels according to SOPARC activity levels by analysis sub-area (rocky beach and sandy beach of Pelgurand) and by gender

(Source: Peeter Vassiljev and Anna Wilczyńska)

Conclusions

This chapter introduced two methods that can be used to conduct observations to capture the use of a blue or green space. Both methods are essentially momentary time sampling techniques which do not give a complete visitor count of an area but rather a series of snapshots of the usage levels taken within a longer period. It is up to the researcher to decide how often this snapshot is taken, but the guiding principle should be to ensure representativeness. Clearly, having observations that cover different time slots only once, for example, one observation per weekday afternoon, will not be enough to draw conclusions as to what people generally like to do on weekday afternoons, but three or four observations will give much greater confidence.

The key difference between the two methods is the spatial resolution and granularity of the activity types recorded (see Figure 6.27). SOPARC looks at user numbers within predetermined sub-areas of the site, while BBAT captures more or less the exact location of every user. Having more specific data allows for significantly more detailed analysis, especially about the question: "Where?" As previously stated, BBAT data can be converted to the SOPARC format, making it possible 1) to compare the new results with observations for the same area that were carried out with SOPARC and 2) to apply the same data analysis techniques so as to be able to compare data from different research teams or from different sites. Converting the data the other way around, however, is impossible.

While the main advantage of BBAT over SOPARC is the finer detail of the data, its main drawbacks are higher requirements for equipment, skills and training. A lightweight tablet computer with a very bright screen running

Figure 6.26

A map showing the mean METs per minute per person calculated for each behaviour setting. Sedentary activities have been assigned 1.3 METs (green), moderate activities 3.5 METs (yellow) and vigorous activities 7.5 METs (red)
(Source: Peeter Vassiljev and Orthophoto: Estonian Land Board, 2020)

Windows is required for BBAT, while a simple paper form works fine for SOPARC. Only rudimentary GIS skills, which are well described in the guidance materials, are required to conduct the observations themselves, but preparation of GIS base maps and analysis of the data requires slightly greater skill. Instructions for these tasks have also been provided in the guidance materials (a video on the BlueHealth tools website), but it is yet another set of skills that someone already needs or has to learn. Finally, both methods require observers to be trained so that they can apply the method in a consistent and valid manner and are capable of dealing with data overload scenarios (too many people to be recorded at once). However, BBAT requires slightly greater familiarity with the exhaustive list of activity types and also the ability to pinpoint someone's location on a map in an area that might lack clear landmarks.

Figure 6.27

Similarities and differences between SOPARC and BBAT

(Source: Peeter Vassiljev and Anna Wilczyńska)

Generally, the SOPARC and BBAT methods do not pose major ethical or privacy issues – observations are conducted in public spaces, there is no intentional interaction with the users of the area and the identification of a particular individual from the information being gathered is impossible. Nevertheless, ethical issues must still be considered from the regulatory perspective as well as from the point of perception. For example, standing periodically next to a children’s playground might be legal but could be perceived as a potential problem by parents. Another example of a very controversial subject is recording racial, ethnic or religious groups. It is very important to consider if such data are actually needed and even how reliable such a classification can be during observations.

Both methods are labour intensive, so naturally there could be a desire for automation. Using video equipment to reduce the amount of fieldwork is a first option, but the observations could be automated even further with the use of artificial intelligence. From the technical perspective, the biggest challenge is to train the algorithms to understand the context, for example, learning to differentiate between strolling, walking quickly for transport (especially in older visitors) or wading in shallow water (especially in tidal conditions). The biggest challenge, however, would be to ensure the respect for privacy, because the risk of accidental or malicious misuse of the video material and image recognition software is high.

Observation techniques give an objective picture of how visitors use a blue or green space. This can be a powerful tool for building the evidence base to help with planning, design, management and monitoring tasks. What this evidence lacks to some degree is the understanding of values associated with the landscape experience. Short and infrequent activities can supply significant restorative, emotional and spiritual benefits, but these tend to be much less prominent in the count frequency of the observations. A good example of this discrepancy is a person visiting a sandy beach for half a day. If that person were to be asked: “What were you doing?” the most likely reply would be: “I went for a swim.” The actual time spent in the water and, subsequently, the probability that the swimming activity would be recorded in the data would be low compared to the time and probability of that person being recorded as lying down or sitting on the sandy beach. The obvious conclusion here is the desirability of using a mixed-methods approach – to combine observations with some form of questionnaire or interview methods so as to be able to attach landscape experience values to the blue and green spaces and to compare these with the observations. This can be achieved using public participation GIS, which will be discussed in the next chapter, Chapter 7.

References

- Active Living Research. 2006. *Tools and Measures SOPARC: System for Observing Play and Recreation in Communities*. Available: <https://activelivingresearch.org/soparc-system-observing-play-and-recreation-communities> [accessed 29 January 2020].
- Ainsworth, B.E., Haskell, W.L., Herrmann, S.D., Meckes, N., Bassett, D.R., Tudor-Locke, C., et al. 2011. 2011 compendium of physical activities: A second update of codes and MET values. *Medical & Science in Sports Exercise* 43:1575–1581. doi:10.1249/MSS.0b013e31821ece12.
- Barker, R.G. 1968. *Ecological Psychology: Concepts and Methods for Studying the Environment of Human Behaviour*. Palo Alto: Stanford University Press.
- Bechtel, R.B., Marans, R., Michelson, W. 1987. *Methods in Environmental and Behavioural Research*. New York: Van Nostrand Reinhold.
- Ciafel. 2013. iSOPARC for iPad. CIAFEL iOS Dev. Available: <http://ciafel.fade.up.pt/isoparc/> [accessed 18 December 2019].
- Cohen, D., Han, B., Isacoff, J., Shulaker, B., Williamson, S., Marsh, T., et al. 2015. Impact of park renovations on park use and park-based physical activity. *Journal of Physical Activity and Health* 12:289–295. doi:10.1016/j.jsr.2014.05.003.A.
- Cohen, D., Marsh, T., Williamson, S., Han, B., Derosé, K., Golinelli, D., et al. 2014. The potential for pocket parks to increase physical activity. *American Journal of Health Promotion* 28:S19–S26. doi:10.4278/ajhp.130430-QUAN-213.The.
- Cooper Marcus, C., Miller Watsky, C., Insley, E., Francis, C. 1998. Neighbourhood parks. In: Cooper Marcus, C., Francis, C. (Eds.), *People Places: Design Guidelines for Urban Open Space, Part 4*. New York: John Wiley & Sons, Inc., pp. 85–148.
- Cosco, N.G., Moore, R.C., Islam, M.Z. 2010. Behaviour mapping: A method for linking preschool physical activity and outdoor design. *Medicine and Science in Sports and Exercise* 42(3):513–519.
- Estonian Land Board. 2018. Topographic data based on 27.01.2016 ETAK extract and Orthophoto. Low-altitude flight 11.04.2016. Published under Licence of open data by Estonian Land Board, 1.07.2018.
- Estonian Land Board. 2020. *Orthophoto*. Summertime forestry flight 28.05.2018. Published under Licence of open data by Estonian Land Board, 1 July 2018.
- Evenson, K.R., Jones, S.A., Holliday, K.M., Cohen, D.A., McKenzie, T.L. 2017. Park characteristics, use, and physical activity: A review of studies using SOPARC (System for Observing Play and Recreation in Communities). *Preventive Medicine (Baltimore)* 86:153–166. doi:10.1016/j.ypmed.2016.02.029.Park.
- Goličnik, B., Ward Thompson, C. 2010. Emerging relationships between design and use of urban park spaces. *Landscape and Urban Planning* 94:38–53.
- Hallgren, K.A. 2012. Computing inter-rater reliability for observational data: An overview and tutorial. *Tutor Quantitative Methods for Psychology* 8:23–34. doi:10.1080/11035896009449194.
- Institut Cartogràfic i Geològic de Catalunya. 2020. May 2019 25cm pixel Orthophoto of Catalonia by the Institut Cartogràfic i Geològic de Catalunya (ICGC). Published under a CC BY 4.0 license.
- Ittelson, W.H., Rivlin, L.G., Prohansky, H.M. 1970. The use of behavioural maps in environmental psychology. In: Prohansky, H.M., Ittelson, W.H., Rivlin, L.G. (Eds.), *Environmental Psychology: Man and his Physical Setting*. New York: Holt, Rinehart & Winston, pp. 658–668.
- King, D.K., Litt, J., Hale, J., Burniece, K.M., Ross, C. 2015. “The park a tree built”: Evaluating how a park development project impacted where people play. *Urban For. Urban Green* 14:293–299. doi:10.1016/j.ufug.2015.02.011.
- Kramer, D., Lakerveld, J., Stronks, K., Kunst, A.E. 2017. Uncovering how urban regeneration programs may stimulate leisure-time walking among adults in deprived areas: A realist review. *International Journal of Health Services* 47:703–724. doi:10.1177/0020731417722087

- McKenzie, T.L., Cohen, D.A. 2006. *System for Observing Play and Recreation in Communities*. York: Description and Procedures Manual. Sci.
- McKenzie, T.L., Cohen, D.A., Sehgal, A., Williamson, S., Golinelli, D. 2006. System for observing play and recreation in communities (SOPARC): Reliability and feasibility measures. *Journal of Physical Activity and Health* 1:S203–217.
- Meireles Rodrigues, F. 2015. *Da especificidade do parque português contemporâneo – Specifics of the contemporary Portuguese park* (Doctoral thesis in Landscape Architecture, University of Porto), pp. 340. Retrieved from the Scientific Repository (TID N°: 101376057). Available: <https://hdl.handle.net/10216/94540>.
- Schultz, C.L., Wilhelm Stanis, S.A., Sayers, S.P., Thombs, L.A., Thomas, I.M. 2017. A longitudinal examination of improved access on park use and physical activity in a low-income and majority African American neighborhood park. *Preventive Medicine (Baltimore)* 95:S95–S100. doi:10.1016/j.ypmed.2016.08.036.
- Statistics Estonia. 2020. *RV0241: Population by sex, age and administrative unit or type of settlement*. 1 January 2017. Available: https://andmed.stat.ee/en/stat/rahvastik__rahvastikunaitajad-ja-koosseis__rahvaarv-ja-rahvastiku-koosseis/RV0241 [accessed 29 November 2020].
- Stewart, O.T., Moudon, A.V., Littman, A.J., Seto, E., Saelens, B.E. 2018. Why neighborhood park proximity is not associated with total physical activity. *Health Place* 52:163–169. doi:10.1016/J.HEALTHPLACE.2018.05.011
- Sun, Z., Bell, S., Scott, I., Qian, J. 2019. Everyday use of urban street spaces: The spatio-temporal relations between pedestrians and street vendors: A case study in Yuncheng, China, *Landscape Research*.
- Unt, A-L., Bell, S. 2014. The impact of small-scale design interventions on the behaviour patterns of the users of an urban wasteland. *Urban Forestry & Urban Greening* 13:121–135.
- Vert, C., Carrasco-Turigas, G., Zijlema, W., Espinosa, A., Cano-Riu, L., Elliott, L.R., et al. 2019. Impact of a riverside accessibility intervention on use, physical activity, and wellbeing: A mixed methods pre-post evaluation. *Landscape and Urban Planning* 190:103611. doi:10.1016/j.landurbplan.2019.103611.