Chapter 10

Building Emotional GIS

A spatial investigation of place attachment for urban historic environments in Edinburgh, Scotland

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Introduction

This chapter spatially investigates urban residents' place attachment to the historic environment they experience in their daily lives by developing an EGIS (emotional GIS) – a methodology proposed by the author. EGIS combines the terms 'emotion' and 'GIS' to highlight the central concern of the research, which is to examine and understand place attachment from a geographical perspective. The methodology has been developed by building on online PPGIS (public participation GIS) mapping, whereby spatially referenced place attachment data are collected via a map-based survey, interrogated by spatial analysis and made visually explicit with maps. The chapter has two main objectives. The first is to spatially access historic places to which people form emotional attachments. In this vein, the study contributes to recent academic research that has demonstrated the importance of 'considering the lived, sensorial and embodied experiences of, and emotional attachments to, historic spaces alongside traditional assessments of physical fabric' within current heritage discourse and practice (Madgin et al., 2018: 596). The second objective is to examine the spatial relationships between such historic places and the places that people visit as part of their daily lives. In so doing, this

chapter provides further evidence on the spatial attributes of place attachment that have been less explored.

This chapter presents empirical work carried out in Edinburgh, Scotland, which focused exclusively on members of local civic associations and a Facebook group, Lost Edinburgh. Civic associations in the UK broadly refer to 'those non-state, voluntary and local associations that aim at improving the quality of the built and natural environment' (Hewitt and Pendlebury, 2014: 26). The burgeoning of civic associations dates back to the late-nineteenth century. Since their inception, they have demonstrated a constant and strong focus on 'the quality of place and the value of local distinctiveness throughout their history', battling against the erosion of local heritage and identity (Hewitt and Pendlebury, 2014). Entering the new millennium, the response of people to such losses is drawing more public attention via social media. The Lost Edinburgh Facebook group, established on 4 April 2011, is a public forum 'dedicated to sharing old photos showcasing the ever-changing face of Edinburgh, its history and its community throughout the centuries' (Lost Edinburgh, 2019). Followers share, comment on and learn from the images and videos of Edinburgh's different places in the past that are posted by like-minded individuals. Such activities sparks discussions on topics including historic places lost through demolition, obliteration or alteration in the course of urban growth. These topics have made Lost Edinburgh an 'emotional community' where its members share collective attachments to the past and may 'generate the social capital needed to mobilise against the further destruction of the past' (Gregory, 2015: 45). These particular groups of people, especially members of civic associations, many of whom are often labelled as 'expert citizens', claim to represent wider public opinion by filling the gap between the state and the lay citizen in the participatory process of local governance (Hewitt and Pendlebury, 2013, 2014; see also Craggs, Geoghegan and Neate, 2015). Therefore, though some dispute their role due to the narrow demographics and background of their members, it is from this perspective that the values of EGIS as a tool

for facilitating public participation in planning and conservation can be tested. This is discussed in the final section.

The chapter is structured as follows. The opening literature review outlines the key themes involved in spatially exploring urban residents' place attachment to the historic environment. A summary of the methodology then follows, providing contextual details about the case study area and describing how the spatial data were collected and analysed. The third section presents the research findings. The fourth section interprets the development of EGIS. The final section discusses the findings, the future of place attachment mapping and the opportunities for using EGIS as part of public participation and urban development initiatives.

Place attachment, civic engagement and place attachment mapping

Place attachment has developed as an 'umbrella' concept for understanding the affective bonds (predominately positive) between people and places (see Lewicka, 2011 for an extensive review). It is a fundamental psychological condition of human existence but may only become (more) palpable when being disrupted by, for example, changes to place (Manzo, 2003). Changes to place that cause (or are believed to cause) disruptions to place attachment overwhelm people with threats to their sense of continuity, stability and place-related identity (Brown and Perkins, 1992), and result in subsequent emotional reactions such as anxiety, grief, sadness or loss (Fullilove, 1996). In cases of incongruous and unsympathetic changes to place induced by proposed development projects, such disruptions to place attachment may not only cause upset feelings, but may also further result in people's engagement in civic actions to resist the proposals regardless of their potential value (Manzo and Perkins, 2006). One such example is the place-protective actions seen in the wind farm projects in the UK (Devine-Wright, 2009). In considering the psychological force of public opposition, Devine-Wright

(2009) suggests that instigators 'seek to anchor and objectify changes in such a way as to enhance rather than threaten' their place attachment (p.437).

A recently published article by Madgin et al. (2018) highlighted the significance of understanding the London Southbank Undercroft skaters' powerful emotional attachments to their skate spot, which led to a 2015 campaign against the relocation of the venue. In Edinburgh, where the present research has been carried out, citizen-led campaigns to resist changes to the historic environment have been the focus of local news media and civic associations. The Save Leith Walk campaign, launched in 2018, is a recent example. Local residents fought against the demolition of a historic two-storey sandstone block because it is a well-loved place to shop, work and socialise (Rae, 2019). What underpinned the desire to prevent changes in the London Undercroft case and in the Edinburgh's Save Leith Walk case were the strong attachment and sense of identity and ownership 'derived from cumulative lived experience of places' (Madgin et al., 2018: 587; see also Jones and Leech, 2015). However, to begin to understand the affection that people have for a particular historic place only after a prospective development disrupts it may be too late. The geographies of 'the affective connections between bodies and spaces that transformed spaces into places', particularly the affective connections with historic spaces, ought to be uncovered and thereby 'rescued' prior to developments or redevelopments (Jones and Evans, 2012: 2322).

Turning to the place attachment literature, people's affective connections to various localities that 'could be linked with place protective action' (Brown, Raymond and Corcoran, 2015: 51) have been approached more effectively and intuitively in a few mapping studies. Central to these mapping studies is the spatial operationalisation of the place attachment concept that turns verbal emotional data into spatially referenced information. Brown and Raymond (2007) considered people's 'special place' as the '*prima facie* place attachment measure' and produced

a density map of the geographic distribution of such special place locations. The research revealed how such mapped place attachment could alert planning authorities to where introducing landscape changes may put people's attachment at risk (Brown and Raymond, 2007). In a later study, they and their colleagues operationalised place attachment as 'home range' and asked participants to identify areas that they most identified with and depended upon (Brown et al., 2015). The study further discussed the potentials of place attachment mapping for identifying where place-protective action would be strongest or where provocative development proposals would be more likely to be acceptable (Brown et al., 2015).

Therefore, the first objective of this research is to map urban residents' everyday experience of place attachment to the historic environment.

The spatial attributes of place attachment

A mapping method is more than a tool to render place attachment spatially. It also provides a methodological approach to consider the spatial attributes of place attachment.

A central concern in the literature about the spatial attributes of place attachment has been the associations between people's movements through spaces and place attachment. David Seamon's work considered how place attachment may arise out of everyday movements: 'many everyday movement patterns and places of rest are part of a habitual time-space lattice' (Seamon, 2014: 13), people unconsciously 'follow a more or less regular regimen of actions, experiences, situations and occasions all grounded in particular places and paths of movement among those places' (Seamon, 2014). The 'habitual regularity' contributes to people's identification in their everyday life and to their sense of continuity which, once disrupted, may cause feelings of emotional distress (Seamon, 2014: 14; see also Seamon 1980). Such unconsciously developed place attachment from habitual everyday movements is largely

spatially dependent as it is associated with spatial variables such as the route and spatial extent of the movements, place of residence and the distance between place of residence and the locations of various 'places of rest'.

The associations of place attachment with people's movements through spaces were also theorised in the mapping study of Brown et al. (2015). The study linked the concept of place attachment to home range, whereby a person's home range – which is initially a biological definition of the area 'traversed by the individual in its natural activity of food gathering, mating, and caring for young' – is comparable to (or at least has much in common with) the area to which he or she would develop an attachment (Brown et al., 2015: 43). Zia et al. (2014) proposed a similar idea which drew together the concepts of sense of place and 'human ambit' which is another biological term that refers to an individual's movements through spaces. In this respect, the spatial locations of historic places or areas where people form emotional attachments may not be a complete random selection, rather they are associated with their everyday movements.

Customarily, it has been a methodological challenge to identify spatially located experiences of place using psychometrics and, as a result, this has been overlooked in the established measurements of place attachment. In comparison, the mapping method enables the investigation of the spatial–emotional relationship between people and places through the analysis of spatially referenced data. This study, after identifying the spatial distribution of historic places to which people feel attached, applies a spatial analytical approach to examine the associations of people's place attachment to the historic environment with their everyday movements.

Method

Case study area

This research was carried out in Edinburgh, the capital city of Scotland. Edinburgh has a great concentration of both built heritage and residential population in and around the city centre. Seventy-five per cent of the buildings in the city have been listed and are in better condition than those in most other historic cities in the UK (Edinburgh World Heritage, 2017). Lying at the centre of the city are the medieval Old Town and the Georgian New Town which, together, have been on the list of World Heritage Sites since 1995. Fifty-five per cent of Edinburgh residents live within four kilometres of the city centre, which makes Edinburgh the fourth most densely populated city in the UK (The City of Edinburgh Council, 2013). The historic environment experienced as part of the everyday lives of Edinburgh's citizens generates the assumption that deep emotional attachments to the historic environment exist within this city.

This assumption is reinforced by the fact that Edinburgh has a vibrant 'urban associational culture' (Hewitt and Pendlebury, 2014: 26). The distinct historical character and rich historical remains of Edinburgh may never have been created without the constant pressure from the residents. Patrick Abercrombie described the challenge faced by planners in the immediate post-war years to foist development and redevelopment plans on Edinburgh: 'nothing is so likely to arouse controversy and opposition as change or destruction of any of the ancient human landmarks of this city (Edinburgh)' (Abercrombie and Plumstead, 1949, *A Civic Survey*, p.53, cited in Madgin and Rodger, 2013: 518).

Instrument

A map-based survey was designed to collect two main areas of spatially referenced data. First, in order to ground people's place attachments to the historic environment on maps, this study

drew on Brown and Raymond's (2007) work to spatially operationalise place attachment. Participants were requested to mark on a map of Edinburgh any historic places that they believed were significant or special to themselves. The mapping was done using the online PPGIS toolkit Maptionnaire, where respondents could place pins on the map to identify specific locations of historic buildings, streets, gardens or spaces, and vary the map scale to more precisely locate a place using the 'zoom' function. They were encouraged to indicate as many locations as they wanted. They were also asked to name the places they identified in follow-up questions. Following Brown and Raymond (2007) and Lin and Lockwood (2014), identifying a 'special place' demonstrates a certain degree of reliability as a proxy for the spatial operationalisation of place attachment.

Second, in line with Seamon's work, data that could spatially reflect 'place[s] of rest' in people's everyday movements were collected. Participants were instructed to identify any places or areas they visit as part of their daily lives – such as where they work, socialise, go shopping, send children to school, buy a cup of coffee in the morning, commute, walk dogs and so on. It was assumed that the spatial distribution of these places would have an effect on the special historic place selection. Question items for participants' socio-demographic profiles were also included.

Sampling

Members of nine local civic associations and Lost Edinburgh followers participated in the survey. Those associations were: the Cockburn Association (The Edinburgh Civic Trust), Edinburgh Old Town Development Trust, Broughton History Society, the Dean Village Association, Grange Association Edinburgh, Inverleith Society, Colinton Amenity Association, Portobello Amenity Society and the Cramond Association. Apart from the

Cockburn Association, which has a citywide remit, these groups focus on residents living within their immediate vicinities.

It should be recognised that some residents were members of more than one of these associations, and could also be followers of Lost Edinburgh.

Data collection

The data were collected between 1 April and 30 September 2018. The survey invitation was emailed to members of the nine civic associations and was posted on the Lost Edinburgh Facebook page.

Data preparation and analysis

In order to display and analyse the spatial data, some preparatory work was required. Each mapped historic place was assigned a unique ID and was ascribed two profiles: a place profile, consisting of its geocoordinates (longitude and latitude), name and designation; and a person profile, which comprised the socio-demographic profile of the participant who mapped it. The designation asset of each place was checked using the Designations Map Search[1] developed by Historic Environment Scotland (the leading public body 'to investigate, care for and promote Scotland's historic environment', Historic Environment Scotland, 2019a). Table 10.1 shows a segment of the first five entries of the special historic place (SHP) locations datafile

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[1] The Designations Map Search helps to identify the designated asset of a designation site by place, address, postcode or names/references of the designation site. It can be accessed at https://www.arcgis.com/apps/Viewer/index.html?appid=18d2608ac1284066ba3927312710d16d.

created for the analysis. The spatial distribution of SHPs was thereafter displayed on a series of maps.

To examine the effects of spatial distribution of the mapped daily life place locations on the SHP selection, the SHP dataset was treated as a spatial point pattern dataset and submitted to spatial point process analysis. A spatial point pattern, such as the SHP, can be thought of as the realisation of an underlying spatial point process. It can thus be described by formulating an explicit mathematical model of the underlying process. If a model can be developed that fits the data well, the estimated values of the model's parameters provide summary statistics which can be used to explain the underlying process that determines the spatial phenomenon being studied when they are related to scientific hypotheses (Diggle, 2014). Spatial point process modelling is widely covered in many statistics textbooks (e.g., Baddeley, Rubak and Turner, 2015; Diggle, 2014). It has been applied in the urban context for studies of social networks, employment, mobility, crime and health, but has been less used in environmental psychology.

In this research, using the language of point process, the SHP distribution was assumed to follow an inhomogeneous Poisson process with an intensity function depending on a spatial covariate which is the density of mapped daily life place (DLP) locations. An inhomogeneous Poisson process model with a loglinear intensity function taking the form of the following equation was fitted to the SHP data:

$$\lambda(u) = \exp. (\theta\, Z(u))$$

where $\lambda(u)$ is the estimated intensity of SHP at u, θ is a parameter vector that needs to be estimated and $Z(u)$ is the varying density of DLP available at u calculated based on kernel estimation.

Residual analysis, inhomogeneous K function and leverage analysis developed by Baddeley and colleagues were employed to diagnose the mis-specifications of the models. Detailed theory can be found in Baddeley et al. (2005), Baddeley, Moller and Waagepetersen (2000) and Baddeley, Chang and Song (2013). The analysis was carried out using the 'spatstat' package (v 2.0-1) (Baddeley, et al., 2015) in the R statistical environment (R Development Core Team, 2019).

Table 10.1 A segment of the first five entries in the SHP location datafile

Place ID	Name	Longitude	Latitude	Designation	Respondent ID	Education	Family history of living in Edinburgh
102	Sighthill Drive	-3.281693	55.920460	None	12	First degree	Third generation
103	Silverknowes Parkway	-3.267510	55.971955	None	12	First degree	Third generation
104	Pennywell Road	-3.250065	55.970250	None	12	First degree	Third generation
45	Lauriston Castle	-3.285599	55.960348	Category A listed building and Inventory of Gardens and Designed Landscapes	16	First degree	Second generation
46	Edinburgh Castle	-3.182602,	55.948623	A group of category A, B, and C listed buildings, and Scheduled Monument	16	First degree	Second generation

Results

Overall, 427 SHPs and 710 DLPs were mapped by 135 respondents. Each respondent mapped at least one SHP and one DLP. The average number of SHPs mapped per resident is 3.16, and 5.26 for DLP. This sample comprised more men (52%) than women (48%). Thirty-seven per cent were aged between 25 and 54, followed by the age group 55–64 years old (28%). The oldest age group (65 years or older) accounted for 21% while the youngest (less than 34 years old) made up 14%. A large majority of respondents reported degree-level educational attainment (72%) and claimed home ownership (85%) either outright or with a mortgage. Over half (54%) were newcomers to Edinburgh.

Of the 427 SHPs, 194 historic places including individual buildings, groups of buildings, green spaces, streets and areas were mentioned. Over 60% (119) of these historic places had been listed, scheduled[2] or selected for the Inventory of Gardens and Designed Landscapes[3]. Figure 10.1 shows the spatial distribution of the 427 SHPs in Edinburgh, revealing an aggregation of SHPs towards the city centre. Figure 10.2 displays the spatial distribution of SHPs within an area of central Edinburgh. A visual inspection suggests that places with a relatively higher density of SHPs were gardens, parks and large green open spaces. Many of these places are

[2] Historic Environment Scotland maintains a schedule of monuments of national importance. Scheduling is the process of adding monuments to this list. Scheduling is not the same as listing and uses different legislation (Historic Environment Scotland, 2019c).

[3] Scotland has an Inventory of Gardens and Designed Landscapes which is a list of its gardens and designed landscapes that are 'grounds intentionally laid out for artistic effect', and which are of national importance. Sites included in the Inventory do not have the statutory protection as listed buildings or scheduled monuments do (Historic Environment Scotland, 2019b).

also popular visitor attractions, such as the Royal Botanic Garden, Holyrood Park and Calton Hill. Table 10.2 lists the ten most frequently identified historic places.
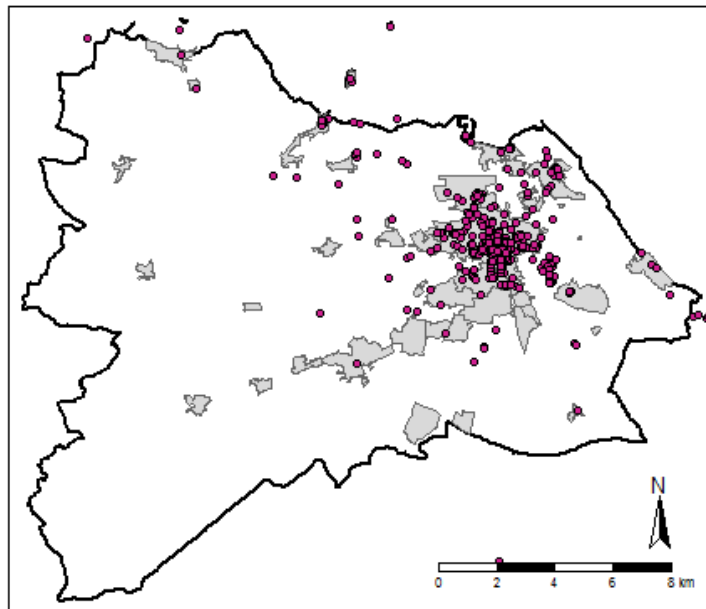

Figure 10.1. Spatial distribution of SHP locations

Notes: Areas shaded in grey are conservation areas. The boundary of Edinburgh was defined by its 597 Data Zone areas.[4] Source of polygon shapefile of Data Zone: Copyright Scottish Government, contains Ordnance Survey data © Crown copyright and database right (2019). Source of polygon shapefile of conservation areas: Copyright City of Edinburgh Council, contains Ordnance Survey data © Crown copyright and database right (2019).

This map was created using the 'tmap' package (v 3.3-1) (Tennekes, 2018) in R.

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[4] Data zones are the key geography for the dissemination of small area statistics in Scotland. The data zone geography covers the whole of Scotland and nests within local authority boundaries (Scottish Government, 2014).

Figure 10.2 Spatial distribution of SHP locations in central Edinburgh

Source of the background map: Google (n.d.). Roadmap of central Edinburgh, zoom level = 14, Retrieved 11 November 2019, using the 'get_map' function in the 'ggmap' package (v 3.0.0) (Kahle and Wickham, 2013) in R.

Table 10.1 Ten most frequently identified historic places

Rank	Place name	Frequency
1	Edinburgh Castle	38
2	Royal Botanic Gardens	21
3	Holyrood Park	18
4	National Museum of Scotland	15
5	Calton Hill	13
6	Princes Street Garden	9
7	The Meadows	8
8	Palace of Holyroodhouse	7
9	The New Town	7
10	Arthur's Seat	6

Spatial point process modelling revealed a statistically significant association of SHPs with DLPs (Z = 52.06, p < 0.001). Residual analysis, inhomogeneous *K* function and leverage function results indicated significant misspecification and poor fit of the model[5]. Figure 10.3 presents a perspective view of the leverage function. Sharp peaks indicate areas with large values of leverage, which means that the presence of SHP within these areas had a substantial effect on model fit. It can be seen that the model has extreme high values of leverage (>0.4) in central Edinburgh. The leverage of a data point in fact depends mainly on its related covariate value. The SHP with the highest leverage is where the most extreme value of DLP density was observed, for example, places like Edinburgh Castle where the lowest DLP density should be seen.
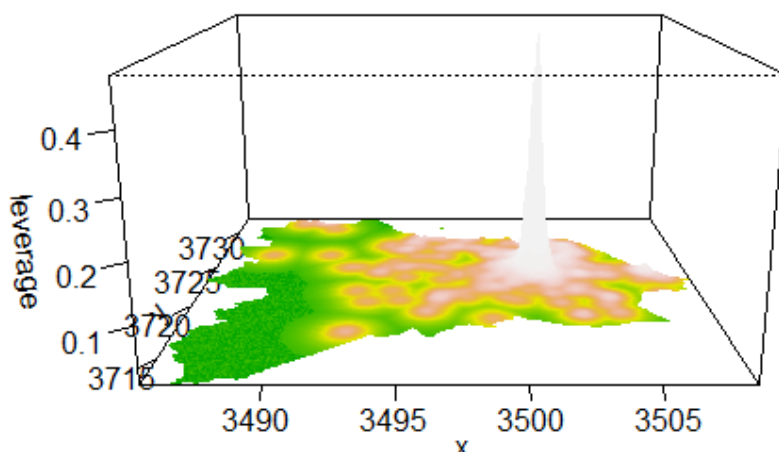

Figure 10.3 Perspective view of the leverage function for the point process model

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[5] Only leverage function result is presented as it is relatively easy to be understood for readers who do not have a statistic background, and a full discussion of all three analyses is beyond the scope of this chapter.

The creation of EGIS

The use of the online PPGIS technique for data collection, the cartographic mapping and the spatial analysis together make up the basis of an EGIS (emotional GIS) – a methodological approach for registering, displaying and exploring emotional data, which could innovate mapping studies of people–place emotion and their practical applications.

First, EGIS allows for the collection and creation of large volumes of spatially referenced emotional data using PPGIS. If made into an online open data input system, it could facilitate the collection of large volumes of volunteered geographical information (VGI) data for academic use. For example, researchers would be able to retrieve spatial emotional data matrices from an EGIS database and make links between the emotional data and other spatially referenced information such as census data to address various research questions about place attachment and the historic environment.

Second, it produces a series of maps and thus enables place attachment to be made spatially explicit, which is a necessary step for place attachment research to achieve its impact on planning or decision support (Brown et al., 2015). Planners and policymakers could use the EGIS as a crowdsourcing tool to acquire citizen knowledge and to better evaluate a specific development proposal in terms of its impact on people's lives and place attachments to the historic environment. EGIS could also be used to support public participation in spatial problem solving and decision making that would affect urban historic spaces.

Third, EGIS takes the spatial investigation of place attachment beyond simple cartographic mapping to explore meaningful spatial patterns of place attachment and its associations using spatial statistics.

Finally, EGIS offers a fascinating tool for civic engagement (discussed later).

Discussion

This research applies a spatial perspective, as well as spatial statistics, to the study of residents' everyday experience of place attachment to the historic environment. It provides interesting insights into the spatial distribution of historic places where people form emotional attachments. It also proposes an EGIS methodology to explore, understand and characterise the spatial attributes of place attachment.

The mapping findings show that participants identified a large number of *localised* historic places with which they form emotional attachments. Such places, according to Pendlebury (2009), are commonplace, mundane or everyday heritage. They do not meet the criteria for a listed building, a scheduled monument or inventory status designation, and may even not be located in conservation areas (see Figure 10.1 for their coincidence with conservation areas). They are, therefore, not afforded any legislative protection. Some, like Leith Walk, might also be in a derelict condition. However, the affection people have for them should not be disregarded by planners and conservationists. They are as important as those which have been designated for their special historic values in terms of maintaining people's attachment.

Scannell and Gifford's (2010) study found city dwellers' attachment to the natural aspects of a place was stronger than attachment to its civic aspects. The SHP clusters in green spaces corroborate this finding. There have been also many studies on how urban green spaces – such as parks and gardens – as a readily available type of nature, offer restorative benefits for individuals' health and well-being (e.g., Carrus et al., 2013; Kaplan and Kaplan, 1989; Knez et al., 2018). These places, therefore, foster emotional attachment within residents. In this sense, the history and historic meanings of these places might be aspects of secondary importance in forming place attachment.

The top ten list of the most frequently identified SHPs highlighted the emotional significance of popular visitor attractions in a historic city to its residents, which is a topic that has received little attention in the literature. Bartie and Mackaness (2016) mapped the visual exposure of popular visitor attractions in Edinburgh. Those on the SHP list, including Edinburgh Castle, Calton Hill, Princes Street Garden and Arthur's Seat, were found to have especially high visual exposure. It is thus meaningful to think about how residents perceive the prominence of these landmarks in their city, and how it might have led to their attachments.

The poor *goodness of fit* for the spatial point process model indicated that everyday movements could only partly explain the developmental process of attachment to the historic environment. Future research could consider developing a predictive point process model that can better characterise the SHP distribution by adding more spatial covariates such as the abovementioned visual exposure of different places. A useful perspective to think about when considering other covariates is to distinguish the unconscious and self-conscious development process of place attachment.

Lewicka (2013) distinguishes two types of place attachment: place inherited and place discovered. Place inherited refers to an unconscious or taken-for-granted people–place relationship that derives from a deep familiarity with a place, most commonly observed in long-time residents. Place discovered means the deliberate choice of a particular place of residence, followed by 'active involvement in its goings-on' (Lewicka, 2013: 162). The study found these two types of attachments tend to cluster with different groups of variables describing people's social and personality profiles which relate to two fundamental modalities of human existence: communion and agency (for detailed discussions, see Lewicka, 2013). This typology also applies to, and is of particular value for, the delineation of the spatial attributes of emotional relationships between people and the historic environment within the context of city life. On

the one hand, people's daily/weekly rhythms within urban historic spaces create an unconscious (or less self-conscious) *experience in place* which leads them to form the type of attachment comparable to the place inherited dimension. On the other hand, people sometimes travel (perhaps virtually) for some particular cultural, social or recreational purpose, and these contribute to a more self-conscious way of forming relationships to historic places that corresponds to the place discovered dimension. Unlike the unconscious *experience in place* which may largely be influenced by spatial movements, the self-conscious process is primarily driven by human agency, social conditions of people and the unique attributes of the historic places that draw people's attention. In this respect, the model only explained the unconsciously developed attachment conditioned by everyday movements. Future studies could consider spatial covariates that would account for the self-conscious developmental process.

Different spatial covariates in a point process model can be further viewed as representing different dimensions of attachment (e.g., self-conscious and unconscious dimensions). In this sense, a well-established spatial point process model is the spatial equivalent of a place attachment scale, which would measure place attachment in a spatial way and measure place attachment dimensions that traditional psychometric scales fail to capture.

Limitations

There are some limitations to the research. The first is the spatial operationalisation of place attachment. It should be recognised that the term 'special historic place' cannot capture the full spectrum of place attachment to historic places. In addition, unlike the early place attachment mapping studies, this study did not ask respondents to assign values of specialness to the historic places they identified (c.f., Brown and Raymond, 2007).

There were also sampling issues: the results are not sufficiently statistically significant to be generalisable to the overall residential population of Edinburgh.

Building an EGIS for civic engagement

The sampling issues involved in PPGIS research go beyond questions of generalisability, however. Brown (2012) argued that the heart of PPGIS is public sampling and participation, not the GIS, but, as far as the author is aware, none of the earlier place attachment mapping studies have defined the *public* or engaged with *participation theory*. This Edinburgh study and its use of PPGIS to create EGIS can be viewed as the first attempt to consider these issues by choosing members of local civic associations and Lost Edinburgh followers in public sampling.

Within the local-state relationship context, these groups, especially local civic associations were recognised as 'well placed to represent community views to local authorities and others' (English Heritage report *Heritage Counts*, cited in Craggs et al., 2015: 374). They usually have 'well-educated and networked membership of professionals' with sustained commitments to civic actions over a considerable time period (Hewitt and Pendlebury, 2014: 35). This professional expertise allows them to claim a level of authority over their views (Hewitt and Pendlebury, 2014). Their connections with their local community councils, the city council and other influential bodies (Hewitt and Pendlebury, 2014) also enable a sense of empowerment among community members (Manzo and Perkins, 2006). These make local civic associations a good starting place to demonstrate the usefulness of EGIS in facilitating civic engagement. Local civic associations could deploy the EGIS to engage directly and routinely with local planning authorities. They could use EGIS to obtain crowdsourced data to discover historic places that should be preserved in order to sustain local identity, attachment, lifestyles and livelihood, and to present empirical evidence when evaluating a specific development proposal

or plan that may affect such places. On the other hand, the city council and the community councils could use EGIS to engage with civic associations and the wider public in spatial problem solving and decision making that would affect urban historic spaces. As a result, EGIS functions in a way that is comparable to what Hester (1993, 2010, 2014) claimed to be 'the sacred structure': an inventory of 'sacred places' that 'exemplify, typify, reinforce, and perhaps even extol the everyday life patterns and special rituals of community life' (Hester 1993: 273).

EGIS could help to facilitate civic engagement in other ways. First, a publicly accessible EGIS could host online campaigns and provide a basis for campaigners to legitimise their wishes related to place attachment, and to negotiate with private developers or public-sector agents over unsympathetic development proposals. Second, the EGIS could be used as a pedagogical interactive digital mapping tool capable of teaching young people to appreciate historically significant spaces and to understand how socio-spatial processes extend through time – a viable strategy for developing their interests in history, enhancing their place attachment and fostering civic engagement (Stefaniak, Bilewicz and Lewicka, 2017).

The future of place attachment mapping and EGIS

This research has proposed an EGIS methodology based on place attachment mapping. In fact, the term 'emotion' encompasses both positive feelings like joy and fondness, and negative feelings such as fear, sadness and dislike. In humanistic cartographic research undertaken on the emotional relationship between people and places, the most commonly mapped emotions have been those of fear and discomfort of urban residents (Griffin and McQuoid, 2012). Researchers challenge current place attachment studies that favour the exploration of the positive affects with 'eulogized spaces' but ignore the negative and ambivalent feelings related to unloved places (Madgin, Bradley and Hastings, 2016; Manzo, 2003). Therefore, it would be worth incorporating these emotions into place attachment mapping in future studies. Exploring

a spatial division between positive and negative people–place emotions also helps us understand the politics of place attachment when a place is appreciated by some people but not valued by others.

The ways in which mapping could be integrated into a quantitative or qualitative research design for a better understanding of place attachment phenomena and related themes should also be appreciated. For example, Jorgenson and Stedman (2011) suggest that '[o]nce the boundaries of the spatial objects have been recorded for each individual, supplementary instructions can ask participants to identify the location of physical features they consider to be of particular importance', or they can be asked to rate their 'beliefs about a place, the feelings associated with it, and the behaviours that are undertaken there' (pp. 800–803). In their research, Jorgenson and Stedman coded physical variables of the mapped areas (including the 'size of the mapped area', 'the degree of fragmentation of the area', and 'whether the area of attachment included waters') and measured their associations with environmental attitudes (Jorgenson and Stedman, 2011). Brown et al. (2015) also saw a future in linking place attachment mapping to the assessment of place-inspired behaviours such as place-protective or place-enhancement behaviour. Apart from working with a structured questionnaire, follow-up interviews could also be carried out to obtain contextual details to triangulate map findings.

The most valuable aspect of mapping, however, lies in its ability to generate insights into the spatial attributes of place attachment as well as the role that spatial variables play in the development of place attachment. In this research, the first-order inhomogeneous Poisson point process modelling with a single covariate might be an oversimplification, but provides a useful first step in this emergent field of research. Future research could incorporate more spatial covariates in the model, or consider a more detailed and essentially multidimensional model to examine the spatial attributes of place attachment and its genesis. Alternatively, other spatial

analytical approaches may be considered. For instance, distance-based analysis for a point pattern approach could be used to examine whether home location would affect the spatial distributions of the historic place locations to which someone feels attached.

Finally, if place attachment is seen as constantly changing (Low and Altman, 1992) and thus fluid and adaptable (Brown and Perkins, 1992), then affective bonds between people and place are not fixed in space and time. Rather, the use of an EGIS can collect spatial-temporal emotional data over time to track changes in place attachment. This could allow researchers to consider why certain historic places that were once emotionally significant are now less valued, while other places with historically formed emotional attachments remain important today and may well continue to be in the future.

References

Baddeley, A., Chang, Y-M., and Song, Y. (2013). Leverage and influence diagnostics for spatial point processes. *Scandinavian Journal of Statistics*, 40, 86–104.

Baddeley, A., Moller, J., and Waagepetersen, R. (2000). Non- and semi-parametric estimation of interaction in inhomogeneous point patterns. *Statistica Neerlandica*, 54 (3), 329–350.

Baddeley, A., Rubak, E., and Turner, R. (2015). *Spatial Point Patterns: Methodology and Applications with R*. London: Chapman and Hall/CRC Press.

Baddeley, A., Turner, R., Moller, J., and Hazelton, M. (2005). Residual analysis for spatial point processes. *Journal of the Royal Statistical Society B*, 67, Part 5, 617–666.

Bartie, P., and Mackaness, W. (2016). Mapping the visual magnitude of popular tourist sites in Edinburgh city. *Journal of Maps*, 12:2, 203–210.

Brown, B. B., and Perkins, D. D. (1992). Disruptions in place attachment. In: I. Altman, and S. M. Low (eds) *Place Attachment*. New York: Plenum, pp. 279–304.

Brown, G. (2012). Public Participation GIS (PPGIS) for regional and environmental planning: reflections on a decade of empirical research. *URISA Journal*, 7–18.

Brown, G., and Raymond, C. (2007). The relationship between place attachment and landscape values: Toward mapping place attachment. *Applied Geography*, 27, 89–111.

Brown, G., Raymond, C., and Corcoran, J. (2015). Mapping and measuring place attachment. *Applied Geography*, 57, 42–53.

Carrus, G., Lafortezza, R., Colangelo, G., Dentamaro, I., Scopelleti, M., and Sanesi, G. (2013). Relations between naturalness and perceived restorativeness of different urban green spaces. *PsyEcology*, 4, 227–244.

Craggs, R., Geoghegan, H., and Neate, H. (2015). Managing enthusiasm: Between 'extremist' volunteers and 'rational' professional practices in architectural conservation. *Geoforum*, 74, 1–8.

Devine-Wright, P. (2009). Rethinking Nimbyism: The role of place attachment and place identity in explaining place-protective action. *Journal of Community and Applied Social Psychology*, 19, 426–441.

Diggle, P. J. (2014). *Statistical analysis of spatial and spatio-temporal point patterns* (third edition). London: Chapman and Hall/CRC Press.

Edinburgh World Heritage. (2005). *The Old and New Towns of Edinburgh World Heritage Site management plan.* Edinburgh: Edinburgh World Heritage.

Fullilove, M. T. (1996). Psychiatric implications of displacement. *American Journal of Psychiatry*, 153, 1516–1523.

Gregory, J. (2015). Connecting with the past through social media: the 'beautiful buildings and cool places Perth has lost' Facebook group. *International Journal of Heritage Studies*, 21:1, 22–45.

Griffin, A., and McQuoid, J. (2012). At the intersection of maps and emotion: The challenge of spatially representing experience. *Kartographische Nachrichten*, 62, 291–299.

Hester, R. (1993). Sacred structures and everyday life: a return to Manteo, North Carolina. In: D. Seamon (eds) *Dwelling, seeing and designing: Toward a phenomenological ecology*. New York: State University of New York Press. pp. 271–298.

Hester, R. (2010). *Design for ecological democracy*. Massachusetts: MIT Press.

Hester, R. (2014). Do not detach! Instructions from and for community design. In: L. C. Manzo, and P. Devine-Wright (eds) *Place attachment: advances in theory, methods, and applications*. London: Routledge. pp. 191–206.

Hewitt, L. E., and Pendlebury, J. (2013). *Civic Associations and urban communities: Local history, place-making and activism in twentieth-century Britain*. Project Report. AHRC Connected Communities. London: AHRC.

Hewitt, L. E., and Pendlebury, J. (2014). Local associations and participation in place: Change and continuity in the relationship between state and civic society in twentieth-century Britain. *Planning Perspective*, 29(1), 25–44.

Historic Environment Scotland. (2019a). *About us*. (Viewed 10 October 2019). Available from: https://www.historicenvironment.scot/about-us/.

Historic Environment Scotland. (2019b). *Scotland's Inventory of Gardens and Designed Landscapes*. Edinburgh: Historic Environment Scotland.

Historic Environment Scotland. (2019c). *Scotland's Scheduled Monuments*. Edinburgh: Historic Environment Scotland.

Jones, P., and Evans, J. (2012). Rescue geography: Place making, affect and regeneration. *Urban Studies*, 49, 2315–2330.

Jones, S., and Leech, S. (2015). *Valuing the historic environment: A critical review of existing approaches to social value*. London: AHRC.

Jorgenson, B. S., and Stedman, R. C. (2011). Measuring the spatial component of sense of place: A methodology for research on the spatial dynamics of psychological experiences of places. *Environment and Planning B: Planning and Design*, 38, 795–813.

Kahle, D., and Wickham, H. (2013). ggmap: Spatial visualization with ggplot2. *The R Journal*, 5:1, 144–161. URL: http://journal.r-project.org/archive/2013-1/kahle-wickham.pdf.

Kaplan, R., and Kaplan, S. (1989). *The experience of nature: A psychological perspective.* Cambridge: Cambridge University Press.

Knez, I., Ode Sang, Å., Gunnarsson, B., and Hedblom, M. (2018). Wellbeing in urban greenery: The role of naturalness and place identity. *Frontiers in Psychology*, 9:491, 1–10.

Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? *Journal of Environmental Psychology*, 31, 207–230.

Lewicka, M. (2013). Place inherited or place discovered? Agency and communion in people-place bonding. *Estudios de Psicología*, 34(3), 261–274.

Lin, C-C., and Lockwood, M. (2014). Assessing sense of place in natural settings: A mixed-method approach. *Journal of Environmental Planning and Management*, 57(10), 1441–1464.

Lost Edinburgh. (2019). *About.* [Facebook]. (Last accessed 10 October, 2019). Available from: https://www.facebook.com/pg/lostedinburgh/about/?ref=page_internal.

Low, S. M., and Altman, I. (1992). Place attachment: A conceptual inquiry. In: I. Altman, and S. M. Low (eds) *Place attachment*. New York: Plenum. pp. 1–12.

Madgin, R., and Rodger, R. (2013). Inspiring Capital? Deconstructing myths and reconstructing urban environments, Edinburgh, 1860–2010. *Urban History*, 40(3), 507–529.

Madgin, R., Bradley, L., and Hastings, A. (2016). Connecting physical and social dimensions of place attachment: What can we learn from attachment to urban recreational spaces? *Journal of Housing and the Built Environment*, 31, 677–693.

Madgin, R., Webb, D., Ruiz, P., and Snelson, T. (2018). Resisting relocation and reconceptualising authenticity: the experiential and emotional values of the Southbank Undercroft, London, UK, *International Journal of Heritage Studies*, 24(6), 585–598.

Manzo, L. C. (2003). Beyond house and haven: toward a revisioning of emotional relationships with places. *Journal of Environmental Psychology*, 23, 47–61.

Manzo, L. C. (2014). Exploring the shadow side: Place attachment in the context of stigma, displacement and social housing. In: L. C. Manzo, and P. Devine-Wright (eds) *Place attachment: advances in theory, methods, and applications*. London: Routledge. pp. 178–190.

Manzo, L. C., and Perkins, D. D. (2006). Finding the common ground: the importance of place attachment to community participation and planning. *Journal of Planning Literature*, 20(4), 335–350.

Pendlebury, J. (2009). *Conservation in the age of consensus*. London: Routledge.

R Development Core Team. (2016). *The R project for statistical computing*. (Viewed 15 October, 2019). Available from: https://www.r-project.org/.

Rae, S. (2019). Save Leith Walk campaign a demonstration of community spirit. Edinburgh Evening News. [online]. 5 July. Updated 5th July 2019, 7:00. (Viewed 5 October,

2019). Available from: https://www.edinburghnews.scotsman.com/news/opinion/save-leith-walk-campaign-demonstration-community-spirit-susan-rae-544589.

Scannell, L., and Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of Environmental Psychology*, 30, 289–297.

Seamon, D. (1980). Body-subject, time-space routines, and place-ballets. In: A. Buttimer, and D. Seamon (eds.), *The human experience of space and place*. New York: St. Martin's Press. pp.148–165.

Seamon, D. (2014). Place attachment and phenomenology: The synergistic dynamism of place. In L. C. Manzo, and P. Devine-Wright (eds.), *Place attachment: advances in theory, methods, and applications*. London: Routledge. pp. 11–22.

Scottish Government. (2014). *Scottish neighbourhood statistics data zones background information*. Edinburgh: Scottish Government.

Stefaniak, A., Bilewicz, M., and Lewicka, M. (2017). The merits of teaching local history: Increased place attachment enhances civic engagement and social trust. *Journal of Environmental Psychology*, 51, 217–225.

Tennekes, M. (2018). tmap: Thematic Maps in R. *Journal of Statistical Software*, 84(6), 1-39. doi: 10.18637/jss.v084.i06 (URL: https://doi.org/10.18637/jss.v084.i06).

The City of Edinburgh Council. (2013). *Population distribution and density in Edinburgh: Recent trends and comparisons with other cities across Scotland and the UK*. Edinburgh: The City of Edinburgh Council.

Zia, A., Norton, B. G., Metcalf, S. S., Hirsch, P. D., and Hannon, B. M. (2014). Spatial discounting, place attachment, and environmental concern: Toward an ambit-based theory of sense of place. *Journal of Environmental Psychology*, 40, 283–295.