



THE UNIVERSITY *of* EDINBURGH

## Edinburgh Research Explorer

# Are greenspace attributes associated with perceived restorativeness? A comparative study of urban cemeteries and parks in Edinburgh, Scotland

### Citation for published version:

Lai, KY, Sarkar, C, Sun, Z & Scott, I 2020, 'Are greenspace attributes associated with perceived restorativeness? A comparative study of urban cemeteries and parks in Edinburgh, Scotland', *Urban Forestry and Urban Greening*. <https://doi.org/10.1016/j.ufug.2020.126720>

### Digital Object Identifier (DOI):

[10.1016/j.ufug.2020.126720](https://doi.org/10.1016/j.ufug.2020.126720)

### Link:

[Link to publication record in Edinburgh Research Explorer](#)

### Document Version:

Peer reviewed version

### Published In:

Urban Forestry and Urban Greening

### General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

### Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact [openaccess@ed.ac.uk](mailto:openaccess@ed.ac.uk) providing details, and we will remove access to the work immediately and investigate your claim.



# Journal Pre-proof

Are greenspace attributes associated with perceived restorativeness? A comparative study of urban cemeteries and parks in Edinburgh, Scotland

Ka Yan Lai, Chinmoy Sarkar, Ziwen Sun, Iain Scott



PII: S1618-8667(19)30798-8

DOI: <https://doi.org/10.1016/j.ufug.2020.126720>

Reference: UFUG 126720

To appear in: *Urban Forestry & Urban Greening*

Received Date: 21 October 2019

Revised Date: 14 May 2020

Accepted Date: 15 May 2020

Please cite this article as: Lai KY, Sarkar C, Sun Z, Scott I, Are greenspace attributes associated with perceived restorativeness? A comparative study of urban cemeteries and parks in Edinburgh, Scotland, *Urban Forestry and amp; Urban Greening* (2020), doi: <https://doi.org/10.1016/j.ufug.2020.126720>

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2020 Published by Elsevier.

## Are greenspace attributes associated with perceived restorativeness? A comparative study of urban cemeteries and parks in Edinburgh, Scotland

Ka Yan Lai<sup>a\*</sup>, Chinmoy Sarkar<sup>a</sup>, Ziwen Sun<sup>b</sup>, Iain Scott<sup>b</sup>

<sup>a</sup>Healthy High Density Cities Lab, HKUrbanLab, The University of Hong Kong, Hong Kong, SAR China

<sup>b</sup>Edinburgh School of Architecture and Landscape Architecture, Edinburgh College of Art, University of Edinburgh, Scotland, United Kingdom

Email addresses: [laikyy@hku.hk](mailto:laikyy@hku.hk) (K.Y. Lai), [csarkar@hku.hk](mailto:csarkar@hku.hk) (C. Sarkar), [Ziwen.Sun@ed.ac.uk](mailto:Ziwen.Sun@ed.ac.uk) (Z. Sun), [iain.scott@ed.ac.uk](mailto:iain.scott@ed.ac.uk) (I. Scott)

\*Corresponding author at: 7F, Healthy High Density Cities Lab, Knowles Building, Pokfulam Road, Hong Kong, SAR China

*'The ceremonious burial of the dead in graves marked by a cairn, a tree, or a tall rock, formed perhaps the first permanent meeting place for the living....'*

Lewis Mumford, *The city in history: its origin, its transformations and its prospects*, Secker & Warburg, London, 1961, p. 84-89.

### ABSTRACT

The effects on the health and well-being of under-utilized and passive greenspace with specialist functions, for example the urban cemetery have been rarely studied. In this study, we aim to examine the differences in the associations between greenspace attributes and *perceived restorativeness* (defined as recovering from mental fatigue) across two urban greenspace typologies; namely, parks and cemeteries. Among sub-samples of the study participants, this research further explores if social (i.e., having knowledge of or a previous relationship to a deceased person interred in the cemetery) and geographical distance (i.e., residential street distance to the cemetery) had significant beneficial effect upon participants' perceived restorativeness. A face-to-face on-site survey was conducted in Edinburgh comprising  $N_1=113$  and  $N_2=120$  participants from parks and cemeteries respectively. Geographic Information System (GIS) was used to measure the distance from interviewees' home to the study sites, while multivariate linear regression models adjusting for sociodemographic covariates assessed the strength and

significance of the associations. Among the greenspace attributes, pleasantness and aesthetic quality remained significant predictors of perceived restorativeness in the case of parks and cemeteries. In addition, safety was significantly associated with perceived restorativeness in the park-exposure group, whereas presence of good paths was significant only in the cemetery-exposure group. Significant effects of greenspace attributes upon restorativeness were reported only among participants without a deceased person interred in the cemetery and those residing beyond a distance of 800 meters. The study findings advance our knowledge of specific greenspace features in relation to two typologies of greenspaces and may point to the need to integrate cemetery strategy with the local authority's urban greenspace planning and policy for optimizing the use of these thus far passive green areas.

**KEY WORDS:** Burial space, environment, GIS, neighbourhood, psychological restoration

## 1. INTRODUCTION

Rapid urbanization and city living have resulted in an incremental increase in stress-related exposures. The role of urban green environments, neighbourhood greenspace in particular, has received considerable research interest, given their stress-relieving restorative potential (Roe and Aspinall, 2012; Korpela et al., 2015). The creation of restorative urban environments is important to enhance the mental well-being of a city's inhabitants via the recovery of an individual's attention capacity, and to accumulate economic benefit through savings on healthcare expenditure worldwide (Weber and Trojan, 2018).

*Perceived restorativeness* has been defined as the ability to recover from mental fatigue or diminished psychological resources in order to better meet the demands of everyday life (Kaplan and Kaplan, 1989; Hartig et al., 1997; Han, 2018). A natural green environment is believed to enhance an individual's perceived restorativeness by effortlessly attenuating directed attention fatigue induced by prolonged mental efforts (Kaplan, 1995; Kaplan, 2001). Based on the theory, four dimensions of perceived restorativeness, namely, being away, fascination, coherence and compatibility are active when evaluating how an environment facilitates an individual's restorative experience. The dimension of being away refers to an environment as being physically or psychologically distinct from places people commonly experience, including the workplace they visit regularly (Korpela and Hartig, 1996). Fascination refers to the extent that a place can be considered as interesting and its inherent ability to distract an individual's attention effortlessly (Hartig et al., 1996; Kaplan, 2001). Coherence was initially included in another dimension called 'extent' (Hauru et al., 2012). In the present study, coherence is defined as the perception of an environment as being ordered and also having sufficient scope for sustainable physical and imaginative exploration (Korpela and Hartig, 1996; Hauru et al., 2012; Pals et al., 2014). Compatibility refers to the correlation between an individual's purpose in visiting a place and the environment's capacity to support this purpose (Kaplan, 2001). A combination of the four dimensions enhances the potential for a more complete restorative experience (Hartig et al., 1997).

Several attributes of an urban environment have been found to be associated with a higher level of perceived restorativeness, including environments with natural green elements (Hernández and Hidalgo, 2005; Lorenzo et al., 2016), less anthropogenic features (Carrus et al., 2013) and better air and water qualities of coastal parks (Hipp and Ogunseitan, 2011). Hartig et al. (1996) suggested that some environments might lead to a more complete restorative recovery than others. For instance, in contrast to urban environments, walking in farmland was associated with lower levels of stress and negative affect (Marselle et al., 2013). Compared with residing next to outdoor greenspace and having green elements in living rooms, individuals having private gardens were shown to have a higher level of perceived restorativeness (Cervinka et al., 2016). Peri-urban areas (Carrus et al., 2013) and a forest environment (Stigsdotter et al., 2017) have been shown to be associated with increased levels of perceived restorativeness when compared to an urban environment. These comparisons may provide insightful findings for decision makers and designers to help facilitate an active place for psychological restoration (Cervinka et al., 2016).

In the recent years with increased urbanization, higher densities in cities have been synonymous with reduced per-capita greenspace allocation (Fuller and Gaston, 2009). This has potential implications on mental health, given the reduction in availability of per-capita restorative environments they provide. As a result of this, compared with active greenspace facilitating a variety of uses, the role of alternative, passive green areas with specialist functions where recreational opportunities may not be provided has become crucial (Gearin and Kahle, 2006), especially the ways in which they may be retrofitted and utilized to provide additional health benefit to the resident population. In addition to common greenspaces such as parks and botanic gardens (Carrus et al., 2017; Liprini and Coetzee, 2017), other places with natural elements including cultural heritage sites (Cho et al., 2015) and cemeteries (Nordh et al., 2017) have also been shown to possess an attached restorative potential.

Since records began, of all the anthropogenic land uses, cemeteries have been the principal usage for the interment of the dead in a city (ASPO, 1950). Following Ebenezer Howard's Garden City Movement, Victorian cemeteries of the 19<sup>th</sup> century were built and designed by the same teams of architects who developed the country's public park system in the UK, even being considered as within the 'park family', and with an underlying objective of providing green and peaceful public landscapes beyond fulfilling their functional role as burial sites. One of the earliest records produced by J. Henry Llyod in the 1950 issue of *Town and Country Planning Review* estimated the annual demand for cemetery land in Great Britain at 500 acres (or around 202 hectares) with 98 acres (or around 40 hectares) for Greater London alone. With increasing urban expansion, the inherently close relationship between the parks and cemeteries diminished as they became neglected and dilapidated spaces. A perpetual urban planning problem associated with the cemetery has been related to its state of disuse, dereliction and passivity when further interment is no longer possible. Additionally, most current cemeteries were previously located on the outskirts of the cities; but now find themselves *landlocked* in strategically important urban, spatial locations as a result of several decades of continued city expansion and sprawl (Capels and Senville, 2006). With the diminishing availability of land for greenspace, cemeteries, in particular can constitute not just spaces for burying the dead, but also act as salutogenic places for contemplation, social interaction and physical activity (Evensen et al., 2017; Lai et al., 2019).

[INSERT TABLE 1 HERE]

Nonetheless, studies of the restorative potential of urban cemeteries have been very scarce and those published in recent years have generally concentrated on its biodiversity, as well as cultural, historical and everyday functions (Table 1), ignoring the potential health benefits of these spaces. Compared with the large body of studies exploring the associations between common urban greenspace and perceived restorativeness or other mental health-related outcomes (de Vries et al., 2003; Lachowycz and Jones, 2013; Sarkar et al., 2018; Houlden et al., 2018), the potential health effects of greenspace with specialist functions have been virtually non-existent. Recently, there has been a growing awareness of the sustainable use of historical urban cemeteries (Jones, 2011) where interment is no longer possible. UK's Planning Policy Guidance 17 (DCLG, 2006a) on open space, sport and recreation enlists cemeteries and churchyards within its definition of 'open space typology of public value' pointing to the potential to integrate them within local greenspace strategies and land-use policy.

In the present Scottish study, we hypothesize that in addition to traditional urban greenspace such as parks, specialist green areas such as historical cemeteries inherently possess a certain degree of restorative potential. We compare the associations between participants' perceived restorativeness and greenspace attributes in these two greenspace typologies; namely, parks, functionally employed for recreational purposes, and cemeteries, primarily for burial use. Given the important roles of connectivity with the deceased people interred in the cemetery (Swensen, 2018) as well as distance as a proxy in measuring the proximity to varying neighbourhood amenities (Gómez et al., 2015), this study additionally hypothesizes differential associations between greenspace attributes and perceived restorativeness based on distance (or connectivity). Two types of distances from the cemetery were examined; social distance was expressed in terms of participants having prior knowledge of or a previous relationship to a deceased person interred in the cemetery while geographical distance was expressed in terms of participants residing within a street distance of 800 meters from the cemeteries and beyond.

## **2. METHODOLOGY**

### **2.1 Study design**

[INSERT FIGURE 1 HERE]

A face-to-face on-site survey was conducted in Edinburgh, Scotland, United Kingdom. Victoria Park and the Meadows were selected to represent typical urban park sites. The former site was built in the early 20<sup>th</sup> century, whereas the latter one has been used as a public park since the 18<sup>th</sup> century. Warriston Cemetery and the Morningside Cemetery, both opened in the early 19<sup>th</sup> century were selected to represent cemeteries. The four historical study sites have been illustrated in Figure 1. A questionnaire survey comprising participants' perceived greenspace attributes within the study sites, perceived restorativeness, key sociodemographic characteristics and residential



postcodes to represent approximate dwelling location was filled in by the interviewer. Participants recruited were aged 18 years and over and were in an adequate physical and mental state to complete the questionnaire-survey. One specific location was chosen by the main researcher in each study site, the location being selected upon prior assessment of the level of pedestrian flow within each greenspace. In each site, data collection was conducted for three weekdays and two weekend days between March and April 2018. The duration lasted for 7 hours per day (9:00-12:00 and 13:00-17:00). Informed consent was obtained from the study participants before the data collection and the study protocol received prior ethical approval from the University of Edinburgh.

## 2.2 Measures

### *Greenspace attributes*

In the present study, we employed the Neighbourhood Open Space Scale (Sugiyama et al., 2009) to assess the greenspace attributes of both parks and cemeteries. A total of 13 environment characteristics were rated using a 5-point Likert scale (1=strongly agree; 5=strongly disagree). Principal component analysis with the use of Varimax with Kaiser Normalization was conducted for factor extractions. Items with a factor loading lower than 0.50 were deleted. Four dimensions comprising pleasantness (four items;  $\alpha=0.756$ ), safety (three items;  $\alpha=0.771$ ), good paths (two items;  $\alpha=0.615$ ) and aesthetics (single item) constituted by 10 items remained after the factor analysis (Supplementary Table 1). The Kaiser-Meyer-Olkin test statistic of the scale reaches 0.738 ( $p=0.000$ ), indicating a satisfactory level of sampling adequacy.

### *Perceived restorativeness*

The 16-item Restorativeness Scale was used to measure perceived restorativeness (Hartig et al., 1997) of the participants, which is the outcome variable of this study. The mean score of all the 16 items was used. Items with negative meanings were reversed before being calculated. Consistent with a previous study (perceived restorativeness:  $\alpha=0.90$ ) (Marselle et al., 2016), the Cronbach's alpha score of perceived restorativeness ( $\alpha=0.88$ ) is at a satisfactory level, showing adequate internal consistency. The Cronbach's alpha scores of the four dimensions of perceived restorativeness in our study (fascination:  $\alpha=0.84$ ; being away:  $\alpha=0.76$ ; compatibility:  $\alpha=0.85$ ; coherence:  $\alpha=0.57$ ) also correspond to that of another study in the UK (fascination:  $\alpha=0.94$ ; being away:  $\alpha=0.85$ ; compatibility:  $\alpha=0.92$ ; coherence:  $\alpha=0.62$ ) (Marselle et al., 2016).

### *Sociodemographic characteristics*

Interviewees' sociodemographic characteristics coded as dichotomous variables, included age (>40 vs.  $\leq 40$ ), gender (male vs. female), working status (employed/self-employed vs. unemployed/retired/partially retired), highest education obtained (below undergraduate degree vs. undergraduate degree or above), marital status (married vs. unmarried), having children (yes vs. no) and type of residential unit (living in a self-owned property vs. not living in a self-owned property), were obtained from the survey.

## 2.3 Analysis

The street centreline geographic dataset comprised of the Integrated Transport Network (ITN) layer from the United Kingdom Ordnance Survey. ArcGIS 10.1 was used to geocode the participants' residential locations to the level of postcode of residence. Street distances to the nearest park and cemetery centroids from users' residential postcode centroids were measured by using the ArcGIS Network Analyst with the algorithm of 'New Route' (i.e., finding the shortest pathway between two locations on a road network). Statistical analyses were performed using SPSS version 24. All missing data were replaced by the mean, despite the low missing rate. 117 out of 226 (56.2%) and 134 out of 185 (72.4%) approached users completed the questionnaire in the parks and cemeteries respectively. Only users who lived in Edinburgh with a postcode were selected for analysis, resulting in 113 ( $N_1$ ) and 120 ( $N_2$ ) samples in the park- and cemetery-exposure groups respectively. Data of the park- and cemetery-exposure groups were independently analysed.

[INSERT FIGURE 2 HERE]

Descriptive statistics and Chi-square test were primarily conducted to present the study participants' sociodemographic characteristics and the difference between the two exposure groups respectively. Bivariate analysis was conducted to show the univariate correlations between the greenspace attributes and perceived restorativeness. Multivariate linear regression was conducted to explore the associations between the greenspace attributes and perceived restorativeness across the two greenspace typologies. The first model (Model 1) was semi-adjusted for site selection, age and gender, while the second model (Model 2) was further adjusted for marital status, highest educational attainment, working status, having children or not and type of residential unit. As a supplementary in-depth analysis, multivariate linear regression analyses exploring the associations of greenspace attributes with the four dimensions of perceived restorativeness were conducted among the two exposure groups. We stratified our regression analyses within the cemetery-group based on their social connectivity (sub-groups comprising participants who had prior knowledge of or a previous relationship to a deceased person interred in the cemetery vs. those who have no social connection to a deceased interred in the cemetery) (Figure 2). We further stratified analyses within the cemetery group based on geographical proximity (participants who resided within 800 meters vs. those who lived beyond 800 meters from the cemetery). A distance of 800 meters was chosen because of previous studies showing the effect of the built environment on physical activity within 800 meters around the home and workplace (Hoehner et al., 2013; Forsyth and Oakes, 2014). We also re-ran the analysis at the thresholds of 1000 (Quatrini et al., 2019) and 1600 meters (Wright Wendel et al., 2012) as sensitivity analyses. A  $p$ -value $<0.05$  was significant.

### 3. RESULTS

[INSERT TABLE 2 HERE]

The mean (standard deviation; SD) age of participants were 40.38 (SD=18.68) and 50.38 (SD=17.21) years in the park- and cemetery-exposure groups respectively ( $p$ -value of difference



0.000). Those unemployed constituted 54.9% and 41.7% among the park- and cemetery-exposure groups respectively (p-value of difference 0.044) (Table 2). A majority of study participants in both the park- (69.9%) and cemetery-exposure (67.5%) groups obtained an undergraduate degree or above (p-value of difference 0.692). A higher proportion of interviewees who were married (43.3% vs. 29.2%), had children (52.5% vs. 32.7%) and lived in a self-owned property (75.8% vs. 45.1%) was found in the cemetery-exposure group, compared with that in the park (p-value of difference <0.05). The mean perceived restorativeness among participants of the parks and cemetery sub-groups were 3.93 (SD=0.72) and 4.01 (SD=1.01) respectively. The mean residential street distance to the parks and cemetery were 2102.92 meters (SD=2095.36) and 1906.35 meters (SD=1613.81) respectively.

[INSERT TABLE 3 HERE]

Table 3 shows the bivariate correlations between greenspace attributes and perceived restorativeness. Pleasantness and aesthetic quality were significantly associated with perceived restorativeness of both park- (pleasantness:  $r=0.440$ ,  $p<0.01$ ; aesthetics:  $r=0.312$ ,  $p<0.01$ ) and cemetery-exposure groups (pleasantness:  $r=0.447$ ,  $p<0.01$ ; aesthetics:  $r=0.347$ ,  $p<0.01$ ). Safety was only associated with perceived restorativeness in the park-exposure group ( $r=0.322$ ,  $p<0.01$ ), whereas the presence of good paths was only significant in the cemetery group ( $r=0.363$ ,  $p<0.01$ ).

[INSERT TABLE 4 HERE]

Multivariate linear regression (Table 4) was conducted to examine the associations between the greenspace attributes and perceived restorativeness after adjusting for site selection and sociodemographic covariates across the two sub-groups. Pleasantness (park-exposure group:  $\beta=0.394$ ,  $p<0.01$ ; cemetery-exposure group:  $\beta=0.283$ ,  $p<0.01$ ) and aesthetic quality (park-exposure group:  $\beta=0.195$ ,  $p<0.05$ ; cemetery-exposure group:  $\beta=0.246$ ,  $p<0.01$ ) remained significantly associated with perceived restorativeness in both groups as shown in our fully-adjusted Model 2. Safety was beneficially associated with perceived restorativeness, but only in the park-exposure subgroup ( $\beta=0.194$ ,  $p<0.05$ ). The presence of good paths was significant, but only in the cemetery-exposure group ( $\beta=0.211$ ,  $p<0.05$ ).

In-depth multivariate linear regression analyses exploring the associations of specific dimensions of perceived restorativeness with greenspace features are presented in Supplementary Tables 2 and 3. Pleasantness and aesthetics were associated with higher levels of fascination and compatibility in both park- (fascination: pleasantness:  $\beta=0.289$ ,  $p<0.01$ ; aesthetics:  $\beta=0.205$ ,  $p<0.05$ ; compatibility: pleasantness:  $\beta=0.317$ ,  $p<0.01$ ; aesthetics:  $\beta=0.221$ ,  $p<0.05$ ) and cemetery-exposure groups (fascination: pleasantness:  $\beta=0.226$ ,  $p<0.01$ ; aesthetics:  $\beta=0.171$ ,  $p<0.05$ ; compatibility: pleasantness:  $\beta=0.379$ ,  $p<0.01$ ; aesthetics:  $\beta=0.189$ ,  $p<0.05$ ). Pleasantness was additionally associated with a greater level of being away in the park-exposure group ( $\beta=0.295$ ,  $p<0.01$ ), while a positive association between aesthetics and being away was only found in the cemetery group ( $\beta=0.259$ ,  $p<0.01$ ). Safety was also positively associated with being away ( $\beta=0.246$ ,  $p<0.05$ ) and compatibility ( $\beta=0.218$ ,  $p<0.05$ ) in the park-exposure group, but negatively associated with being

away in the cemetery-group ( $\beta=-0.228$ ,  $p<0.05$ ). Presence of good paths was beneficially associated with being away only in the cemetery group ( $\beta=0.223$ ,  $p<0.05$ ).

[INSERT TABLE 5 HERE]

In the sample of participants from the cemetery subgroup ( $N_2=120$ ), we further stratified analyses into subgroups; participants having a known deceased person interred ( $n_{1a}=23$ ) and those without a known deceased person interred in the cemetery ( $n_{1b}=97$ ). In our model (Table 5) involving participants without a known deceased person interred in the cemetery, three greenspace attributes consistently remained beneficially associated with perceived restorativeness, namely, pleasantness ( $\beta=0.291$ ,  $SE=0.146$ ,  $p<0.01$ ), good paths ( $\beta=0.198$ ,  $p<0.05$ ), and aesthetics ( $\beta=0.272$ ,  $p<0.01$ ).

We also stratified analyses by geographic distance; participants who resided within 800 meters ( $n_{2a}=34$ ) and those who resided beyond 800 meters ( $n_{2b}=86$ ) from the cemetery (Table 5). The thresholds of 1000 meters (within 1000 meters:  $n_{3a}=48$ ; beyond 1000 meters:  $n_{3b}=72$ ) and 1600 meters (within 1600 meters:  $n_{4a}=58$ ; beyond 1600 meters:  $n_{4b}=62$ ) were also employed for sensitivity analyses (Supplementary Table 4). Pleasantness was significantly associated with perceived restorativeness in participants who resided beyond 800 meters ( $\beta=0.341$ ,  $p<0.01$ ) and also beyond 1000 meters ( $\beta=0.334$ ,  $p<0.01$ ), but within 1600 meters ( $\beta=0.334$ ,  $p<0.05$ ). The beneficial association between aesthetics and perceived restorativeness remained consistent in participants living beyond 800 ( $\beta=0.263$ ,  $p<0.01$ ), 1000 ( $\beta=0.320$ ,  $p<0.01$ ) and 1600 meters ( $\beta=0.367$ ,  $p<0.01$ ). Presence of good paths was associated with a higher level of perceived restorativeness in the subsample residing within 1600 meters ( $\beta=0.298$ ,  $p<0.05$ ).

#### 4. DISCUSSIONS

Whereas many of the previous studies focused on greenspace measurements with sophisticated approaches ignoring the importance of greenspace categorizations (Lachowycz and Jones, 2011), our study advances our knowledge of specific environmental features in relation to the two greenspace typologies. We present the first study exploring differential links between greenspace attributes and perceived restorativeness in parks and cemeteries employing a quantitative approach. Though cemeteries were principally used for interment of the dead, greenspace attributes commonly found in the parks, including pleasantness, good pathways and aesthetic quality were shown to have positive relationships with perceived restorativeness. Many historical cemeteries have been found to occupy important locations in the residential neighbourhood as reported in prior Scandinavian and Scottish studies (Swensen et al., 2016; Lai et al., 2019), our study also illustrated the potential long-term restorative benefits obtained from the cemeteries for relieving directed mental fatigue on a daily basis.

Our study showed that pleasantness, representing presence of facilities and active usage was beneficially associated with perceived restorativeness in both the park- and cemetery-exposure groups. Specifically, pleasantness was positively associated with fascination and compatibility in the two groups. Given the spacious area in the parks, users are likely fascinated as a result of using

recreational facilities such as tennis courts or other facilities for doing exercise or watching active users (Cervinka et al., 2016; Korpela and Hartig, 1996). Other facilities and services such as public lavatories (Moore et al., 2018) in the parks might be important, especially in satisfying users' physical needs, thereby prolonging the time they can spend in the park. These facilities might serve as environmental amenities supporting the users' needs, highlighting the importance of compatibility in enhancing the restorative experience in the park (Kaplan, 2001). In the case of urban cemeteries where recreational facilities and public lavatories were not available, benches (Sugiyama et al., 2009; Curl et al., 2015) and stone boundary walls (Nordh et al., 2017) may potentially play an important role in supporting users' restorative experience. Previous findings showed a variety of activities in cemeteries ranging from walking dogs to consuming alcohol or drugs (Evensen et al., 2017). Further studies are needed to survey the type of activities pursued in the cemeteries to shed light on the usefulness of corresponding environmental amenities, such as benches and dog bins. Subsequently, a correlation between users' physical needs and corresponding environmental amenities could be illustrated in the cemeteries, possibly adding to users' sense of perceived restorativeness (Kaplan, 2001). Additionally, high stone boundary walls may clearly separate individuals from their daily surroundings and potentially contribute to a peaceful and enclosed environment, unlike other common urban open space, thereby enhancing the restorative experience.

Consistent with expectations, aesthetic quality was positively associated with perceived restorativeness in both the park and cemetery groups. As with pleasantness, the aspect of aesthetics was positively associated with fascination and compatibility in the two groups, with being away additionally being significant in the cemetery group. The aesthetic aspect of a place is often associated with an individual's preference and pleasure (Ulrich, 1983). As previously evidenced, bushes (Gilchrist et al., 2015), trees or tree diversity (Hernández and Hidalgo, 2005; Akpınar, 2016), bird species richness (Wheeler et al., 2015) and other wild animals (Barrett and Barrett, 2001; Petersson et al., 2018) which inhabit urban greenspace, could help contribute to an aesthetically pleasing and natural environment in both parks and cemeteries. These elements of greenspace could help instil a sense of place, being away from individual's home or workplace, further facilitating their restorative experience (Lorenzo et al., 2016; Hipp et al., 2016). The results also showed how these potential green elements or biodiversity might help hold one's attention in a natural and effortless manner, enhancing the quality of fascination and leading to a higher degree of perceived restorativeness in the two greenspace typologies.

Our study reported a significant association between safety and increased perceived restorativeness among the park-exposure group, but not in the cemetery-exposure group. As evident from the in-depth analysis, safety was associated with higher levels of being away and compatibility in the park-exposure group, but negatively associated with being away in the cemetery-group. A few previous studies have shown the significance of an environment with minimized risk of danger in enhancing people's perceived restorativeness or health-related qualities, although these studies were not specifically in the context of cemeteries (Sugiyama et al., 2009; Nijs et al., 2014; Mesimäki et al., 2018). Since this study was conducted during daytime, safety might not be a tangible concern for the majority of users visiting cemeteries (Mason et al., 2013). Francis et al. (2012) also suggested that environmental qualities such as birdlife might have a stronger

relationship with mental health, in comparison to emotive qualities such as safety. Another potential explanation is that different types of greenspace might be prone to different types and degrees of anti-social behaviour (Kimpton et al., 2017), leading to inconsistent perceptions of safety in relation to the two greenspace typologies in this study. Furthermore, unique vegetation characteristics including vegetation density, structure, maintenance and design of various greenspace typologies likely influence safety perceptions as well as the level of psychological stress reductions (Jansson et al., 2013; Tomao et al., 2018), highlighting the need for further studies to encourage the provisions of restorative urban environment.

The presence of good paths was only significantly associated with increased perceived restorativeness in the cemetery-exposure group, but not in the park-exposure group. The presence of good paths was beneficially associated with being away specifically in the cemetery-exposure group. The visual scope of a place could be broadened by well-designed pathways (Herzog and Bryce, 2007). Curving pathways lined with shrubbery frequently occurring in old cemeteries appear to contribute to the perception of a calm environment for psychological restoration (Swensen et al., 2016). On the other hand, different perceptions and interpretations of pathways might lead to the inconsistent results relating to perceived restorativeness across the two greenspace typologies, similar to the perception of safety. For example, as the pathways in the cemeteries were usually muddy or in disrepair, some users might find them less walkable than other pedestrian pathways in the neighbourhood. Despite previous studies highlighting the importance of good paths for better accessibility in enhancing people's mental health (Seaman et al., 2010; Lachowycz and Jones, 2013), the potential difference in the impressions and interpretations of pathways in the two types of greenspace might explain why the aspect of good paths was only significantly correlated with perceived restorativeness in the cemetery-exposure group.

In the case of social connectivity, the greenspace attributes (pleasantness, aesthetics and presence of good paths) within the cemeteries were significantly associated with perceived restorativeness only in the sub-group with no social connectivity. However, among participants with a known deceased person interred in the cemetery, no significant association was reported. The subgroup without any attachment to the cemeteries in our study might be less likely to connect to it as a place for solace and contemplation and consider it a place for sorrow or showing respect to deceased relatives or friends (Arffmann, 2000). They are more likely to absorb the salutogenic and aesthetic aspects of the place. The multi-various use of cemeteries has been previously shown in other studies (McClymont, 2016; Skår et al., 2018). The recent positive transformation in social attitudes towards cemeteries has been eloquently captured: 'reflect our changing attitudes toward the cemetery landscape and our responses to the pressures of urban development...' (Harvey, 2006, p. 310). Equivalent to those who visited the cemeteries as part of their everyday lives as found in a Norwegian study (Evensen et al., 2017), cemeteries might tend to present as a natural and common greenspace, rather than a place for interment *per se* in the perceptions of those without any attachment to it. This may explain why greenspace attributes were associated with perceived restorativeness only in this subgroup of users. Nonetheless, previous studies have shown that memories are beneficial to psychological restoration (Ratcliffe and Korpela, 2016), so there might be some additional positive effect from closer social connectivity to the cemeteries upon perceived

restorativeness. The results may point to the overall beneficial effects of the cemetery for the general population in terms of providing exposure to salutogenic and restorative environments, besides their functional roles as spaces for interment of the dead. Further large-scale research should explore the potential influence of greenspace attributes on enhancing perceived restorativeness of those who had a closer social connectivity to the cemeteries.

The effect of pleasantness upon perceived restorativeness was significant in the participant subgroup who lived beyond a distance of 800 meters and within 1600 meters, while aesthetics was significantly associated with perceived restorativeness among participants residing beyond 800, 1000 and 1600 meters from the cemeteries, implying the potential mediating or moderating effect of geographical distance on perceived restorativeness. Our findings further shed light on the need of well-designed facilities and landscape quality of this place to enhance perceived restorativeness, specifically among residents having a physical proximity between 800 and 1600 meters, equivalent to a 10- to 20-minute walk from home. However, our findings do not imply that there is a complete absence of restorative experience for participants residing close to the cemeteries with increasing familiarity to the environment. Contrarily, a familiar environment may possess greater perceptions of being safe and reassuring, leading to better restorative experience (Korpela and Hartig, 1996; von Lindern et al., 2013). It is also possible that some participants in this study might not live near a cemetery, but their workplace might be in close proximity to a cemetery allowing them to temporarily escape from the pressured environment at work during break times, and more importantly recover from mental fatigue. A previous Norwegian study has established that cemeteries have the potential to be a destination for breaks during office hours (Evensen et al., 2017). Further large-scale studies are needed to corroborate this finding.

Our study is of value and has important implications from the perspective of sustainable urban planning and design as well as community health. Firstly, increasing urbanization has resulted in reductions in per-capita green exposures at an individual-level. Secondly, rapid urban expansion has meant that the cemeteries that were hitherto located on the periphery of the city, have over time undergone a shift relative to adjoining land uses, now finding themselves occupying key strategic locations. Thirdly we report for the first time that these, often dormant greenspaces with a specialist function, have an associated health value, with beneficial effects upon restorative potential and associated positive effects on mental health and wellbeing. Consequently, there is a need for an integrated approach, combining local cemetery use strategies with local authority urban greenspace planning and policy - with the objective of offsetting potential negative health effects which have accrued on account of per-capita greenspace reductions as a result of densification and increasingly compact neighbourhoods. This is specifically important, given that UK Planning Guidelines considers low densities as an inefficient use of land and encourages densification with residential densities in the range of 3000-5000 housing units/km<sup>2</sup> for all new housing developments (DCLG, 2006b). The mean residential density surrounding newly developed residential units over the period 2014–16 has remained at 3200 units/km<sup>2</sup> (DCLG, 2016). Many cemeteries, despite being in a neglected state due to poor maintenance, contain unique natural landscapes, biodiversity, artefacts and heritage of intangible value. Therefore, from a design perspective, attention should be given to retrofitting and re-designing these hitherto *passive* spaces into salutogenic activity spaces, simultaneously conserving their intrinsic aesthetic and tranquil



qualities. This may involve connecting these spaces to the green network within a city and improving accessibility and the quality of facilities and services, whilst provisioning for their timely maintenance and enhanced safety. Community health strategies should promote the active usage of these spaces by neighbouring populations in order to reap restorative benefit. A large body of prior studies have evidenced the restorative benefits of public open spaces, especially parks for older adults (particularly in retirement), the benefits attributed to an increase in physical activity and social interactions (Clarke and Nieuwenhuijsen, 2009; Liu et al., 2017). In our present study, nearly 70% of the cemetery-exposure subgroup users were over 40 years old with a mean age of 50, in contrast to only 36.3% in the case of the park-exposure subgroup suggesting that cemeteries do act as a potential restorative environment for older people during daytime hours (Evensen et al., 2017). The provision of well-designed and barrier free cemeteries with requisite facilities catering to older adults will be beneficial to their mental health and social networks.

The present study has several limitations. In order to supplement our evidence on the health effects of cemeteries, mediating and moderating analyses are promising in future studies so as to identify specific pathways via which parks and cemeteries may affect psychological restoration and subsequently devise design interventions. Since data collection was conducted during daytime only, future research should consider the health effects of cemeteries outside of working hours and in the evenings. However, as highlighted by previous studies (Skår et al., 2018), lighting after dark is generally limited in the cemeteries which may affect evening usage especially during winter months. In addition to some of the greenspace attributes examined in this study, other greenspace and environmental factors such as vegetation structure (e.g., shrubs, flowers), biodiversity, sound, lighting, maintenance and design features could be the subject of further analysis in future studies.

## 5. CONCLUSION

With the growing emphasis on the sustainable use of urban space and mental health, optimizing the allocation, siting and design of greenspace to enhance the mental capital of people living in cities is of considerable importance. The use of specialist green environments as salutogenic spaces aimed at enhancing population-level psychological restoration and wellbeing may constitute a key urban health strategy, thus far neglected by policy makers. Reaping the environmental and health-based benefits of these spaces will require the development of specific planning and design guidelines for their preservation and improvement to enhance their salutogenic and recreational potential. The present study provides the first empirical evidence reporting that different greenspace attributes within a cemetery have beneficial effects upon perceived restorativeness, comparable to those experienced in traditional urban greenspaces such as parks.

Our study suggests that cemeteries present a timely urban planning and public health opportunity to be embraced. According to the Confederation of Burial Authorities, there are approximately 3,500 pre-1914 historic cemeteries in the UK (CABE, 2007). The 1994 report on the management of old cemeteries highlighted the societal importance of cemeteries, in terms of their historical, ecological, education and leisure value (Dunk and Rugg, 1994). We additionally associate a *population health value* to these places. Following up from this research, future large-scale studies



are necessary to examine the restorative potential of these places across different cultural contexts such as in the Mediterranean countries (Yeshurun et al., 2013) with potentially dissimilar siting and usage and resulting long term protective effects upon health and wellbeing of population.

### **Author statement**

K.Y. Lai was responsible for study conceptualization, data collection, data curation, formal analysis and writing the original manuscript. C. Sarkar extensively revised the manuscript. K.Y. Lai, C. Sarkar, Z. Sun and I. Scott critically edited the manuscript.

### **Declaration of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### **REFERENCES**

- Akpinar, A., 2016. How is high school greenness related to students' restoration and health? *Urban Forestry & Urban Greening* 16, 1-8. 10.1016/j.ufug.2016.01.007
- Arffmann, L., 2000. Whose cemetery? *Mortality* 5, 125-126. 10.1080/713686005
- ASPO, 1950. *Cemeteries in the City Plan: Information Report No. 16*, Illinois. Available at: <https://www.planning.org/pas/reports/report16.htm>
- Barrett, G.W., Barrett, T.L., 2001. Cemeteries as repositories of natural and cultural diversity. *Conserv. Biol.* 15, 1820-1824. 10.1046/j.1523-1739.2001.00410.x
- CABE, 2007. *Briefing: Cemeteries, churchyards and burial grounds*. Commission for Architecture and Built Environment, London. Available at: <https://webarchive.nationalarchives.gov.uk/20110118111022/http://www.cabe.org.uk/files/cemeteries-churchyards-and-burial-grounds.pdf>
- Capels, V., Senville, W., 2006. Planning for Cemeteries. *Planning Commissioners Journal* 64, 1-8
- Carrus, G., Laforteza, R., Colangelo, G., Dentamaro, I., Scopelliti, M., Sanesi, G., 2013. Relations between naturalness and perceived restorativeness of different urban green spaces. *Psychology* 4, 227-244. 10.1174/217119713807749869
- Carrus, G., Scopelliti, M., Panno, A., Laforteza, R., Colangelo, G., Pirchio, S., Ferrini, F., Salbitano, F., Agrimi, M., Portoghesi, L., Semenzato, P., Sanesi, G., 2017. A Different Way to

Stay in Touch with `Urban Nature': The Perceived Restorative Qualities of Botanical Gardens. *Front. Psychol.* 8. 10.3389/fpsyg.2017.00914

Cervinka, R., Schwab, M., Schönbauer, R., Hämmerle, I., Pirgie, L., Sudkamp, J., 2016. My garden – my mate? Perceived restorativeness of private gardens and its predictors. *Urban Forestry & Urban Greening* 16, 182-187. 10.1016/j.ufug.2016.01.013

Cho, K.-S., Um, S.-H., Lee, T.J., 2015. Perceived Restorativeness of Visits to Cultural Heritage Sites. *Asia Pacific Journal of Tourism Research* 21, 1-24. 10.1080/10941665.2015.1107110

Clarke, P., Nieuwenhuijsen, E.R., 2009. Environments for healthy ageing: A critical review. *Maturitas* 64, 14-19. 10.1016/j.maturitas.2009.07.011

Curl, A., Ward Thompson, C., Aspinall, P., 2015. The effectiveness of 'shared space' residential street interventions on self-reported activity levels and quality of life for older people. Curl , A , Ward Thompson , C & Aspinall , P 2015 , ' The effectiveness of 'shared space' residential street interventions on self-reported activity levels and quality of life for older people ' vol. 139 , pp. 117-125 . DOI: 10.1016/j.landurbplan.2015.02.019. 10.1016/j.landurbplan.2015.02.019

DCLG, 2006a. Planning Policy Guidance 17: Planning for open space, sport and recreation, London. Available at: <https://webarchive.nationalarchives.gov.uk/20120920042539/http://www.communities.gov.uk/documents/planningandbuilding/pdf/ppg17.pdf>

DCLG, 2006b. Planning policy statement 3 (PPS 3): Housing, London. Available at [http://www.housinglin.org.uk/library/Resources/Housing/Policy\\_documents/PPS3.pdf](http://www.housinglin.org.uk/library/Resources/Housing/Policy_documents/PPS3.pdf)

DCLG, 2016. Land use change statistics in England: 2015–2016, London. Available at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/595749/Land\\_use\\_change\\_statistics\\_England\\_2015-16\\_-\\_2\\_March\\_2017\\_version.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/595749/Land_use_change_statistics_England_2015-16_-_2_March_2017_version.pdf)

de Vries, S., Verheij, R.A., Groenewegen, P.P., Spreeuwenberg, P., 2003. Natural environments - healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environment and Planning A* 35, 1717-1731. 10.1068/a35111

Dunk, J., Rugg, J., 1994. The management of old cemetery land : now and the future : a report of the University of York Cemetery Research Group. Crayford : Shaw & Sons, Crayford.

Evensen, K.H., Nordh, H., Skaar, M., 2017. Everyday use of urban cemeteries: A Norwegian case study. *Landscape and Urban Planning* 159, 76-84. 10.1016/j.landurbplan.2016.09.019

Forsyth, A., Oakes, J.M., 2014. Workplace Neighborhoods, Walking, Physical Activity, Weight Status, and Perceived Health: Assessing the Built Environment. *Transportation Research Record: Journal of the Transportation Research Board* 2452, 98-104. 10.3141/2452-12

Francis, J., Wood, L.J., Knuiman, M., Giles-Corti, B., 2012. Quality or quantity? Exploring the relationship between Public Open Space attributes and mental health in Perth, Western Australia. *Soc. Sci. Med.* 74, 1570-1577. 10.1016/j.socscimed.2012.01.032

- Fuller, R.A., Gaston, K.J., 2009. The scaling of green space coverage in European cities. *Biol. Lett.* 5, 352-355. 10.1098/rsbl.2009.0010
- Gearin, E., Kahle, C., 2006. Teen and Adult Perceptions of Urban Green Space Los Angeles. *Children Youth and Environments* 16, 25-48. <https://doi.org/10.7721/chilyoutenvi.16.1.0025>
- Gilchrist, K., Brown, C., Montarzino, A., 2015. Workplace settings and wellbeing: Greenspace use and views contribute to employee wellbeing at peri-urban business sites. *Landscape and Urban Planning* 138, 32-40. 10.1016/j.landurbplan.2015.02.004
- Gómez, E., Baur, J., Hill, E., Georgiev, S., 2015. Urban Parks and Psychological Sense of Community. *Journal of Leisure Research* 47, 388-398. 10.1080/00222216.2015.11950367
- Han, K.-T., 2018. A review of self-report scales on restoration and/or restorativeness in the natural environment. *Journal of Leisure Research*, 1-26. 10.1080/00222216.2018.1505159
- Hartig, T., Böök, A., Garvill, J., Olsson, T., Gärling, T., 1996. Environmental influences on psychological restoration. *Scand. J. Psychol.* 37, 378-393. 10.1111/j.1467-9450.1996.tb00670.x
- Hartig, T., Korpela, K., Evans, G.W., Gärling, T., 1997. A measure of restorative quality in environments. *Scandinavian Housing and Planning Research* 14, 175-194. 10.1080/02815739708730435
- Harvey, T., 2006. Sacred spaces, common places: The cemetery in the contemporary American city. *Geographical Review* 96, 295-312. 10.1111/j.1931-0846.2006.tb00054.x
- Hauru, K., Lehvävirta, S., Korpela, K., Kotze, D.J., 2012. Closure of view to the urban matrix has positive effects on perceived restorativeness in urban forests in Helsinki, Finland. *Landscape and Urban Planning* 107, 361-369. 10.1016/j.landurbplan.2012.07.002
- Hernández, B., Hidalgo, M.C., 2005. Effect of Urban Vegetation on Psychological Restorativeness. *Psychol. Rep.* 96, 1025-1028. 10.2466/pr0.96.3c.1025-1028
- Herzog, T.R., Bryce, A.G., 2007. Mystery and Preference in Within-Forest Settings. *Environ. Behav.* 39, 779-796. 10.1177/0013916506298796
- Hipp, J.A., Gulwadi, G.B., Alves, S., Sequeira, S., 2016. The Relationship Between Perceived Greenness and Perceived Restorativeness of University Campuses and Student-Reported Quality of Life. *Environ. Behav.* 48, 1292-1308. 10.1177/0013916515598200
- Hipp, J.A., Ogunseitan, O.A., 2011. Effect of environmental conditions on perceived psychological restorativeness of coastal parks. *J. Environ. Psychol.* 31, 421-429. 10.1016/j.jenvp.2011.08.008
- Hoehner, C.M., Allen, P., Barlow, C.E., Marx, C.M., Brownson, R.C., Schootman, M., 2013. Understanding the Independent and Joint Associations of the Home and Workplace Built Environments on Cardiorespiratory Fitness and Body Mass Index. *Am. J. Epidemiol.* 178, 1094-1105. 10.1093/aje/kwt111

- Houlden, V., Weich, S., Porto de Albuquerque, J., Jarvis, S., Rees, K., 2018. The relationship between greenspace and the mental wellbeing of adults: A systematic review. *PLoS One* 13, e0203000. 10.1371/journal.pone.0203000
- Jansson, M., Fors, H., Lindgren, T., Wiström, B., 2013. Perceived personal safety in relation to urban woodland vegetation – A review. *Urban Forestry & Urban Greening* 12, 127-133. <https://doi.org/10.1016/j.ufug.2013.01.005>
- Jones, D., 2011. The City of the Dead: The Place of Cultural Identity and Environmental Sustainability in the African-American Cemetery. *Landscape Journal: design, planning, and management of the land* 30, 226-240. 10.3368/lj.30.2.226
- Kaplan, R., Kaplan, S., 1989. *The experience of nature : a psychological perspective*. Cambridge University Press, Cambridge; New York.
- Kaplan, S., 1995. The restorative benefits of nature: Toward an integrative framework. *J. Environ. Psychol.* 15, 169-182. 10.1016/0272-4944(95)90001-2
- Kaplan, S., 2001. Meditation, Restoration, and the Management of Mental Fatigue. *Environ. Behav.* 33, 480-506. 10.1177/00139160121973106
- Kimpton, A., Corcoran, J., Wickes, R., 2017. Greenspace and Crime: An Analysis of Greenspace Types, Neighboring Composition, and the Temporal Dimensions of Crime. *Journal of Research in Crime and Delinquency* 54, 303-337. 10.1177/0022427816666309
- Korpela, K., De Bloom, J., Kinnunen, U., 2015. From restorative environments to restoration in work. *Intelligent Buildings International* 7, 215-223. 10.1080/17508975.2014.959461
- Korpela, K., Hartig, T., 1996. Restorative qualities of favorite places. *J. Environ. Psychol.* 16, 221-233. 10.1006/jevp.1996.0018
- Kowarik, I., Buchholz, S., Von Der Lippe, M., Seitz, B., 2016. Biodiversity functions of urban cemeteries: Evidence from one of the largest Jewish cemeteries in Europe. *Urban Forestry & Urban Greening* 19, 68-78. 10.1016/j.ufug.2016.06.023
- Lachowycz, K., Jones, A.P., 2011. Greenspace and obesity: a systematic review of the evidence. *Obes. Rev.* 12, e183. <https://doi.org/10.1111/j.1467-789X.2010.00827.x>
- Lachowycz, K., Jones, A.P., 2013. Towards a better understanding of the relationship between greenspace and health: Development of a theoretical framework. *Landscape and Urban Planning* 118, 62-69. 10.1016/j.landurbplan.2012.10.012
- Lai, K.Y., Scott, I., Sun, Z., 2019. Everyday Use of the City Cemetery: A Study of Environmental Qualities and Perceived Restorativeness in a Scottish Context. *Urban Science* 3, 72. 10.3390/urbansci3030072
- Liprini, M.R., Coetzee, N., 2017. The relationship between students' perceptions of the University of Pretoria's on-campus green spaces and attention restoration. *Human Geographies: Journal of Studies and Research in Human Geography* 11, 155-167. 10.5719/hgeo.2017.112.2

- Liu, Y., Dijst, M., Faber, J., Geertman, S., Cui, C., 2017. Healthy urban living: Residential environment and health of older adults in Shanghai. *Health & Place* 47, 80. 10.1016/j.healthplace.2017.07.007
- Lorenzo, E., Corraliza, J.A., Collado, S., Sevillano, V., 2016. Preference, restorativeness and perceived environmental quality of small urban spaces / Preferencia, restauración y calidad ambiental percibida en plazas urbanas. *Psycology* 7, 1-26. 10.1080/21711976.2016.1149985
- Marselle, M.R., Irvine, K.N., Lorenzo-Arribas, A., Warber, S.L., 2016. Does perceived restorativeness mediate the effects of perceived biodiversity and perceived naturalness on emotional well-being following group walks in nature? *J. Environ. Psychol.* 46, 217-232. 10.1016/j.jenvp.2016.04.008
- Marselle, M.R., Irvine, K.N., Warber, S.L., 2013. Walking for well-being: are group walks in certain types of natural environments better for well-being than group walks in urban environments? *Int. J. Environ. Res. Public Health* 10, 5603. 10.3390/ijerph10115603
- Mason, P., Kearns, A., Livingston, M., 2013. "Safe Going": The influence of crime rates and perceived crime and safety on walking in deprived neighbourhoods. *Soc. Sci. Med.* 91, 15-24. 10.1016/j.socscimed.2013.04.011
- McClymont, K., 2016. 'That eccentric use of land at the top of the hill': cemeteries and stories of the city. *Mortality* 21, 378-396. 10.1080/13576275.2016.1151865
- Mesimäki, M., Hauru, K., LehväVirta, S., 2018. Do small green roofs have the possibility to offer recreational and experiential benefits in a dense urban area? A case study in Helsinki, Finland. *Urban Forestry & Urban Greening*. 10.1016/j.ufug.2018.10.005
- Moore, T.H.M., Kesten, J.M., López-López, J.A., Ijaz, S., McAleenan, A., Richards, A., Gray, S., Savović, J., Audrey, S., 2018. The effects of changes to the built environment on the mental health and well-being of adults: Systematic review. *Health and Place* 53, 237-257. 10.1016/j.healthplace.2018.07.012
- Morelli, F., Mikula, P., Benedetti, Y., Bussière, R., Jerzak, L., Tryjanowski, P., 2018. Escape behaviour of birds in urban parks and cemeteries across Europe: Evidence of behavioural adaptation to human activity. *The Science of the total environment* 631-632, 803. 10.1016/j.scitotenv.2018.03.118
- Mumford, L., 1961. *The city in history : its origins, its transformations and its prospects*. Secker & Warburg, London.
- Nijs, M., Bun, C., Tempelaar, W., Wit, N., Burger, H., Plevier, C., Boks, M., 2014. Perceived School Safety is Strongly Associated with Adolescent Mental Health Problems. *Community Ment. Health J.* 50, 127-134. 10.1007/s10597-013-9599-1
- Nordh, H., Evensen, K.H., Skår, M., 2017. A peaceful place in the city—A qualitative study of restorative components of the cemetery. *Landscape and Urban Planning* 167, 108-117. 10.1016/j.landurbplan.2017.06.004

- Pals, R., Steg, L., Dontje, J., Siero, F.W., van Der Zee, K.I., 2014. Physical features, coherence and positive outcomes of person–environment interactions: A virtual reality study. *J. Environ. Psychol.* 40, 108-116. 10.1016/j.jenvp.2014.05.004
- Petersson, A., Cerwén, G., Liljas, M., Wingren, C., 2018. Urban cemetery animals: an exploration of animals' place in the human cemetery \*. *Mortality* 23, 1-18. 10.1080/13576275.2017.1282942
- Quatrini, V., Tomao, A., Corona, P., Ferrari, B., Masini, E., Agrimi, M., 2019. Is new always better than old? Accessibility and usability of the urban green areas of the municipality of Rome. *Urban Forestry & Urban Greening* 37, 126-134. <https://doi.org/10.1016/j.ufug.2018.07.015>
- Ratcliffe, E., Korpela, K.M., 2016. Memory and place attachment as predictors of imagined restorative perceptions of favourite places. *J. Environ. Psychol.* 48, 120-130. 10.1016/j.jenvp.2016.09.005
- Roe, J.J., Aspinall, P.A., 2012. Adolescents' Daily Activities and the Restorative Niches that Support Them. *Int. J. Environ. Res. Public Health* 9, 3227-3244. 10.3390/ijerph9093227
- Sarkar, C., Webster, C., Gallacher, J., 2018. Residential greenness and prevalence of major depressive disorders: a cross-sectional, observational, associational study of 94 879 adult UK Biobank participants. *Lancet Planetary Health* 2, e162-e173. 10.1016/S2542-5196(18)30051-2
- Seaman, P.J., Jones, R., Ellaway, A., 2010. It's not just about the park, it's about integration too: why people choose to use or not use urban greenspaces.(Research). *Int. J. Behav. Nutr. Phys. Act.* 7, 78. 10.1186/1479-5868-7-78
- Skår, M., Nordh, H., Swensen, G., 2018. Green urban cemeteries: more than just parks. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability* 11, 362-382. 10.1080/17549175.2018.1470104
- Stigsdotter, U., Corazon, S., Sidenius, U., Kristiansen, J., Grahn, P., 2017. It is not all bad for the grey city - A crossover study on physiological and psychological restoration in a forest and an urban environment. *Health & Place* 46, 145. 10.1016/j.healthplace.2017.05.007
- Sugiyama, T., Thompson, C.W., Alves, S., 2009. Associations Between Neighborhood Open Space Attributes and Quality of Life for Older People in Britain. *Environ. Behav.* 41, 3-21. 10.1177/0013916507311688
- Swensen, G., 2018. Between romantic historic landscapes, rational management models and obliterations – urban cemeteries as green memory sites. *Urban Forestry & Urban Greening* 33, 58-65. 10.1016/j.ufug.2018.04.013
- Swensen, G., Nordh, H., Brendalmo, J., 2016. A green space between life and death – a case study of activities in Gamlebyen Cemetery in Oslo, Norway. *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography* 70, 41-53. 10.1080/00291951.2015.1102169
- Swensen, G., Skår, M., 2018. Urban cemeteries' potential as sites for cultural encounters. *Mortality*, 1-24. 10.1080/13576275.2018.1461818



- Tomao, A., Secondi, L., Carrus, G., Corona, P., Portoghesi, L., Agrimi, M., 2018. Restorative urban forests: Exploring the relationships between forest stand structure, perceived restorativeness and benefits gained by visitors to coastal *Pinus pinea* forests. *Ecological Indicators* 90, 594-605. <https://doi.org/10.1016/j.ecolind.2018.03.051>
- Ulrich, R.S., 1983. Aesthetic and affective response to natural environment, in: Altman, I., Wohlwill, J.F. (Eds.), *Behavior and the natural environment*. New York : Plenum Press, pp. 85-125.
- Weber, A.M., Trojan, J., 2018. The Restorative Value of the Urban Environment: A Systematic Review of the Existing Literature. *Environ. Health Insights* 12. 10.1177/1178630218812805
- Wheeler, B.W., Lovell, R., Higgins, S.L., White, M.P., Alcock, I., Osborne, N.J., Husk, K., Sabel, C.E., Depledge, M.H., 2015. Beyond greenspace: an ecological study of population general health and indicators of natural environment type and quality. *International journal of health geographics* 14, 17. 10.1186/s12942-015-0009-5
- Wright Wendel, H.E., Zarger, R.K., Mihelcic, J.R., 2012. Accessibility and usability: Green space preferences, perceptions, and barriers in a rapidly urbanizing city in Latin America. *Landscape Urban Plann.* 107, 272-282. <https://doi.org/10.1016/j.landurbplan.2012.06.003>
- Yeshurun, R., Bar-Oz, G., Nadel, D., 2013. The social role of food in the Natufian cemetery of Raqefet Cave, Mount Carmel, Israel. *Journal of Anthropological Archaeology* 32, 511-526. <https://doi.org/10.1016/j.jaa.2013.09.002>

Table 1.

A review of studies in relation to urban cemetery published in recent years.

| <b>Component</b>   | <b>Author<br/>(year)</b> | <b>Setting</b>   | <b>Study type</b> | <b>Issue(s)</b>  |
|--------------------|--------------------------|--|-------------------|--|
| Biodiversity       | Kowarik et al. (2016)    | Berlin, Germany  | Quantitative      | Biodiversity functions of urban cemeteries                                   |
|                    | Morelli et al. (2018)    | Czech Republic, France, Italy and Poland                     | Quantitative      | Escape distance of birds in urban parks and cemeteries                       |
| Culture or history | Swensen and Skår (2018)  | Norway   | Qualitative       | Exploring cemetery as a public shared urban space in a multicultural context |
|                    | Harvey (2006)            | United States  | Qualitative       | History of the development of cemeteries                                     |
| Everyday lives     | McClymont (2016)         | England and Wales, United Kingdom                            | Qualitative       | Functions of cemeteries on a daily basis                                     |
|                    | Swensen et al. (2016)    | Oslo, Norway   | Qualitative       | The role of urban cemeteries play as green public space in urban life        |
|                    | Skår et al. (2018)       | Norway   | Qualitative       | Cemeteries' functions as public spaces in urban life                         |
|                    | Evensen et al. (2017)    | Oslo, Norway   | Quantitative      | Everyday use of urban cemeteries   |
|                    | Swensen (2018)           | Oslo, Norway; Sheffield, United Kingdom; Kaliningrad, Russia | Qualitative       | The role of historical cemeteries play as greenspace                         |
| Health benefit     | Nordh et al. (2017)      | Oslo, Norway   | Qualitative       | Restorative components of the cemetery                                       |

Table 2.  
Descriptive analysis for the sample.

|   | <b>Parks</b><br><b>(N<sub>1</sub>=113)</b> | <b>Cemeteries</b><br><b>(N<sub>2</sub>=120)</b> | p-value <sup>+</sup> |
|---|--|---|----------------------|
|   | %  | %   |                      |
| <b>Sociodemographic characteristics</b>       |  |   |                      |
| <i>Age</i>                                    |  |   |                      |
| 18-40   | 63.7%                                      | 30.8%   | 0.000                |
| > 40  | 36.3%                                      | 69.2%   |                      |
| <i>Gender</i>                                 |  |   |                      |
| Male  | 46.9%                                      | 43.3%   | 0.584                |
| Female  | 53.1%                                      | 56.7%   |                      |
| <i>Marital Status</i>                         |  |   |                      |
| Married                                       | 29.2%                                      | 43.3%   | 0.025                |
| Nonmarried                                    | 70.8%                                      | 56.7%   |                      |
| <i>Highest education obtained</i>             |  |   |                      |
| Without undergraduate degree                  | 30.1%                                      | 32.5%   | 0.692                |
| Undergraduate degree or above                 | 69.9%                                      | 67.5%   |                      |
| <i>Working Status</i>                         |  |   |                      |
| Employed/self-employed                        | 45.1%                                      | 58.3%   | 0.044                |
| Unemployed/Retired/partially retired          | 54.9%                                      | 41.7%   |                      |
| <i>Having children</i>                        |  |   |                      |
| Yes   | 32.7%                                      | 52.5%   | 0.002                |
| No  | 67.3%                                      | 47.5%   |                      |
| <i>Living in a self-owned property or not</i> |  |   |                      |
| Living in a self-owned property               | 45.1%                                      | 75.8%   | 0.000                |

+ p-value of the difference between users being interviewed in the cemeteries and parks by using Chi-square test.

Table 3.

*Bivariate analysis between greenspace attributes and perceived restorativeness.*

|                           |            | M(SD)       | Pleasantness | Safety  | Good paths | Aesthetics |
|---------------------------|------------|-------------|--------------|---------|------------|------------|
| Perceived Restorativeness | Parks      | 3.93 (0.72) | 0.440**      | 0.322** | 0.165      | 0.312**    |
|                           | Cemeteries | 4.01 (1.01) | 0.447**      | -0.027  | 0.363**    | 0.347**    |

*Abbreviations:* M(SD), Mean(Standard deviation).*Note.* \*p<0.05; \*\*p<0.01.

Journal Pre-proof

Table 4.

Summary of multivariate linear regression analyses for variables predicting perceived restorativeness by greenspace typologies.

| Variable     | Parks<br>( $N_1=113$ ) |             |         |                      |             |         | Cemeteries<br>( $N_2=120$ ) |             |          |                      |             |         |
|--------------|------------------------|-------------|---------|----------------------|-------------|---------|-----------------------------|-------------|----------|----------------------|-------------|---------|
|              | Model 1 <sup>a</sup>   |             |         | Model 2 <sup>b</sup> |             |         | Model 1 <sup>a</sup>        |             |          | Model 2 <sup>b</sup> |             |         |
|              | <i>B</i>               | <i>SE B</i> | $\beta$ | <i>B</i>             | <i>SE B</i> | $\beta$ | <i>B</i>                    | <i>SE B</i> | $\beta$  | <i>B</i>             | <i>SE B</i> | $\beta$ |
| Pleasantness | 0.605                  | 0.153       | 0.385** | 0.618                | 0.154       | 0.394** | 0.486                       | 0.122       | 0.294**  | 0.468                | 0.126       | 0.283** |
| Safety       | 0.188                  | 0.076       | 0.216*  | 0.169                | 0.077       | 0.194*  | -0.125                      | 0.099       | -0.099   | -0.137               | 0.105       | -0.109  |
| Good paths   | -0.117                 | 0.121       | -0.090  | -0.118               | 0.124       | -0.091  | 0.269                       | 0.105       | 0.204*   | 0.279                | 0.108       | 0.211*  |
| Aesthetics   | 0.202                  | 0.091       | 0.191*  | 0.207                | 0.096       | 0.195*  | 0.296                       | 0.092       | 0.225**  | 0.324                | 0.098       | 0.246** |
| $R^2$        |                        |             | 0.265   |                      |             | 0.263   |                             |             | 0.470    |                      |             | 0.453   |
| $F$          |                        |             | 6.768** |                      |             | 4.322** |                             |             | 16.053** |                      |             | 9.217** |

Note. \* $p<0.05$ ; \*\* $p<0.01$ ;

<sup>a</sup>adjusted for study site, age and gender;

<sup>b</sup>adjusted for study site, age, gender, marital status, highest education obtained, working status, having children or not and type of residential unit.

Table 5.

Summary of linear regression analyses for variables predicting perceived restorativeness by social and geographical distances in the cemeteries.

| Variable              | Cemeteries<br>(N <sub>2</sub> =120)     |             |         |                                      |             |         |                                 |             |         |                                 |             |         |
|-----------------------|---|-------------|---------|--------------------------------------|-------------|---------|---------------------------------|-------------|---------|---------------------------------|-------------|---------|
|                       | Social connectivity                     |             |         |                                      |             |         | Geographical connectivity       |             |         |                                 |             |         |
|                       | Close social connectivity <sup>a#</sup> |             |         | No social connectivity <sup>b#</sup> |             |         | Within 800 meters <sup>c#</sup> |             |         | Beyond 800 meters <sup>d#</sup> |             |         |
|                       | (n <sub>1a</sub> =23)                   |             |         | (n <sub>1b</sub> =97)                |             |         | (n <sub>2a</sub> =34)           |             |         | (n <sub>2b</sub> =86)           |             |         |
|                       | <i>B</i>                                | <i>SE B</i> | $\beta$ | <i>B</i>                             | <i>SE B</i> | $\beta$ | <i>B</i>                        | <i>SE B</i> | $\beta$ | <i>B</i>                        | <i>SE B</i> | $\beta$ |
| Pleasantness          | 0.298                                   | 0.480       | 0.171   | 0.481                                | 0.146       | 0.291** | 0.106                           | 0.380       | 0.080   | 0.626                           | 0.157       | 0.341** |
| Safety                | -0.374                                  | 0.432       | -0.321  | -0.102                               | 0.119       | -0.080  | -0.017                          | 0.258       | -0.013  | -0.136                          | 0.128       | -0.109  |
| Good paths            | 0.871                                   | 0.708       | 0.504   | 0.247                                | 0.116       | 0.198*  | 0.467                           | 0.243       | 0.469   | 0.201                           | 0.142       | 0.132   |
| Aesthetics            | 0.271                                   | 0.330       | 0.223   | 0.367                                | 0.112       | 0.272** | 0.312                           | 0.339       | 0.176   | 0.322                           | 0.113       | 0.263** |
| <i>R</i> <sup>2</sup> |   |             | -0.047  |                                      |             | 0.469   |                                 |             | 0.265   |                                 |             | 0.498   |
| <i>F</i>              |   |             | 0.917   |                                      |             | 8.06**  |                                 |             | 1.99    |                                 |             | 8.01**  |

Note. \*p<0.05; \*\*p<0.01;

<sup>a</sup>users who had knowledge of or a previous relationship to a deceased person interred in the cemetery;

<sup>b</sup>users who had no knowledge of a deceased person interred in the cemetery;

<sup>c</sup>users who resided within 800 meters from the cemetery;

<sup>d</sup>users who resided beyond 800 meters from the cemetery;

<sup>#</sup>adjusted for study site, age, gender, marital status, highest education obtained, working status, having children or not and type of residential unit.





Figure 1. The map of Edinburgh and images of the four study sites (the map was retrieved from [www.google.no/maps/](http://www.google.no/maps/)).

*Note.* Warriston Cemetery (top left); Victoria Park (top right); Morningside Cemetery (bottom left); Meadows (bottom right) (the photos were taken by the main researcher during data collection).

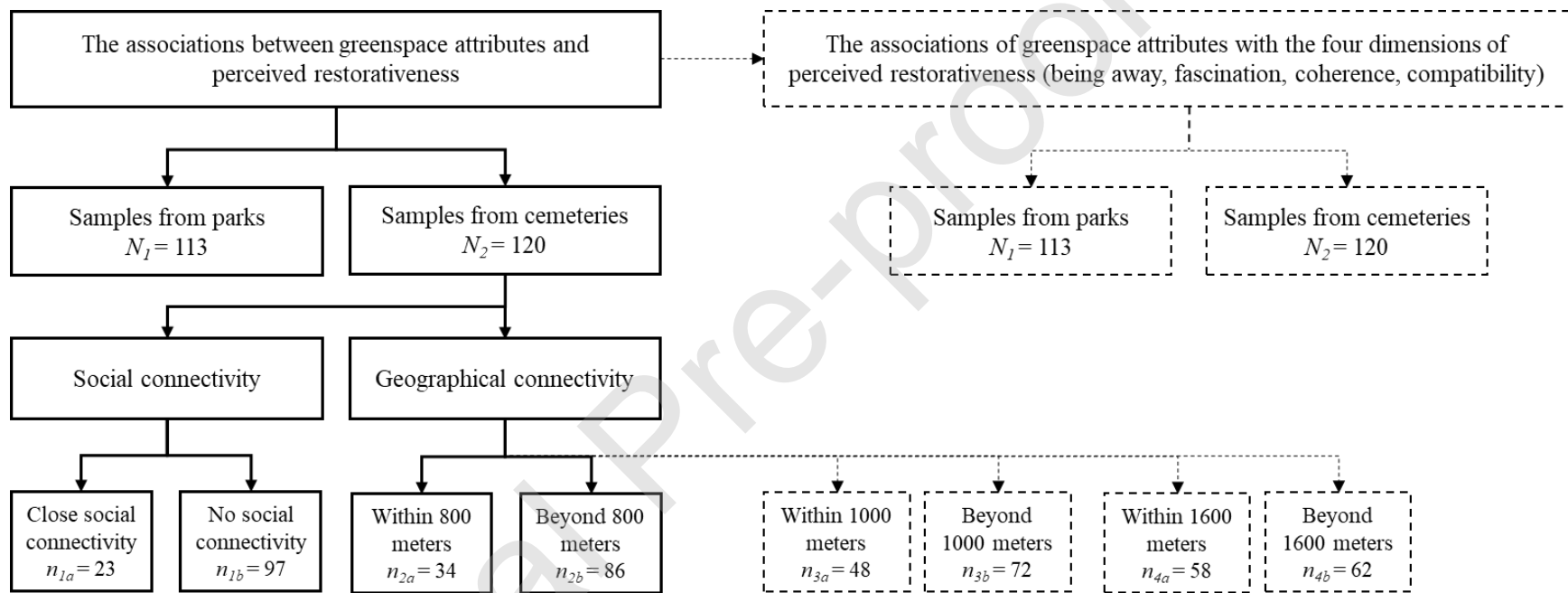


Figure 2. Analytical approach of the study.

*Note.* Solid lines represent the main analysis, while dotted lines represent the sensitivity analysis.